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Does Universalization of Health Work? Evidence from Health Systems Restructuring and Maternal and Child Health in Brazil

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Non-Technical Summary

The Sustainable Development Goals issued in September 2015 endorse achievement of Universal Health Coverage (UHC) by 2030 in Target 3.8, and Target 3.7 focuses specifically upon ensuring universal access to sexual and reproductive health-care services. Yet implementing UHC is challenging of resources and organizational capacity in richer and poorer countries alike. We study the case of Brazil, which is a middle income country carrying the double burden of infectious and non-communicable diseases. Moreover, Brazil is a potential model to other countries in regard to its commitment to universalization of public health provision. Following its return to democracy in 1988, Brazil established universal and egalitarian access to health care as a constitutional right, enforceable in court. A new unified public health system was created in 1990. In 1994, a major restructuring of the system was set in motion through implementation of the Family Health Program, designed to extend access to primary health care. We investigate the success of the restructuring engineered by rollout of the Family Health Program (PSF) across municipalities.

Alongside a massive expansion of basic health facilities staffed with General Practitioners, nurses and outreach workers at the community level, the PSF was associated with a decline in the density of hospital facilities and specialists per capita. Therefore in addition to investigating impacts on primary health outcomes, it is important that we study impacts on access to hospital care. Using administrative data from multiple sources and an event study approach, we identify large reductions in maternal, foetal, neonatal and post-neonatal mortality. We document increases in prenatal care visits, the probability of a hospital birth and increases in other causes of maternal and child hospitalization, which suggest that the survival gains are supply-driven. Classifying medical conditions into those that are amenable to primary care and those that are not, we find that, in line with the intended rationalization of health services, hospitalization for children increased mostly for causes not amenable to primary care. However, reductions in mortality stemmed from both sorts of causes. Programmatic changes also led to overall reductions in all-age and teenage fertility, and these were larger among more educated women. This, together with the identified reduction in foetal mortality, will have led to an endogenous shift in the composition of births towards higher-risk births. As a result, our estimates of mortality reduction are conservative, and compositional change may be the reason that we see no improvement in the quality of births indicated by birth weight and APGAR scores.

This is the first draft of the paper. *Revisions will be posted here:* https://sites.google.com/site/srbhalotra/.

Does Universalization of Health Work? Evidence from Health Systems Restructuring and Maternal and Child Health in Brazil

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Abstract

We investigate restructuring of the health system in Brazil motivated to operationalize universal health coverage. Using administrative data from multiple sources and an event study approach that exploits the staggered rollout of programmatic changes across municipalities, we find large reductions in maternal, foetal, neonatal and post-neonatal mortality, and fertility. We document increased prenatal care visits, hospital births and other maternal and child hospitalization, which suggest that the survival gains were supply-driven. We find no improvement in the quality of births, which may be explained by endogenous shifts in the composition of births towards higher-risk births.

Key Words: family health program, health, primary care, inequality, access, Brazil.
JEL Codes: I12, I18, J10, J13, J24, O54.

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Contents

1 Introduction

Universal health coverage is today at the forefront in the worldwide public health debate. World Health Organization's Director General Margaret Chan recently stated that "universal health coverage is the single most powerful concept that public health has to offer", while World Bank's president Jim Yong Kim called for the global community to "bend the arc of history to ensure that everyone in the world has access to affordable, quality health services in a generation". The Lancet, arguably the most influential medical journal in the world, dedicated a recent issue to maternal and child health, under the opening headline that "every woman, every newborn, everywhere has the right to good quality care". In the US, Obamacare became one of the key domestic policy issues of the last decade.

This movement towards universal health coverage comes partly from the increasing intellectual acceptance in the public health arena of two particular relationships. First, access to primary and preventive care can potentially deliver major improvements in health at relatively low costs (e.g. Caldwell, 1986; Harris, 2014). Second, improvements in children's health, especially during the gestational period and in the first years of life, can have permanent, life-altering impacts on long-term health, education, and a host of other socioeconomic outcomes (Almond and Mazumder, 2013). The combination of these factors, coupled with an understanding that individual – or parental – investments in health may not be optimal due to credit constraints or to behavioral biases, leads to the idea that access to health care of a minimum quality should be, at the very least, subsidized, and possibly provided freely under specific circumstances.

The question remains as to whether countries in general, and developing countries in particular, can effectively deliver the goal of universal health coverage. The financial and institutional challenges imposed by this objective cannot be minimized and its very desirability rests on how feasible it may be for the vast majority of countries, which still face serious competing demands on public resources, to achieve it.

The experience of Brazil in the late 20th century constitutes a particularly appealing setting to analyze these questions. After two decades of dictatorship, Brazil transitioned into democracy in 1985. The ensuing 1988 Constitution established "universal and egalitarian" access to health care as a constitutional right, enforceable in court. Legislation enacted in 1990 to regulate the changes brought by the constitution established the new Brazilian public health system, called the Unified Health System (SUS, for *Sistema Unificado de Saúde*). The Unified Health System is supposed to guarantee free, comprehensive and universal health coverage, including access to medical and pharmaceutical services

(Hunt et al., 2013). In this regard, Brazil is considered a forerunner by the public health community and a potential model for other developing and developed societies (Harris, 2014).

The new Unified Health System was built on the principle of reorganization of the Brazilian public health sector through expansion of a network of primary care community centers and rationalization of the use of resources (Gragnolati et al., 2013). The supply of basic health care at the community level was implemented through the Brazilian Family Health Program (PSF, for *Programa Saúde da Família*), which placed primary care medical doctors and community health agents within poor communities. This change shifted 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 population and the public health system was placed in local communities. This new approach aimed at including a large number of poor families in the public health system and lessening the pressure on public hospitals, which would then be able to concentrate resources on more serious and complicated conditions.

Notwithstanding anecdotal evidence of increased access to basic health care for a major part of the poorer population and improving health outcomes over the last two decades, concerns about service quality and rationing remain as first order public policy issues in Brazil (Victora et al., 2011; Paim et al., 2011; CNI, 2012). In reality, despite constitutional guarantees, access is still a serious problem and rationing of services takes place through long waiting times, which vary across procedures, regions, and socioeconomic strata. Still, even with these limitations, previous research has documented that the introduction of the PSF was indeed associated with reductions in mortality (Rocha and Soares, 2010; Harris, 2014; Guanais, 2013). In reality, the model of community health programs has historically been seen as an important determinant of health improvements under precarious socioeconomic conditions, and more recently has also been shown to be effective in reducing mortality in other settings outside of Brazil (Caldwell, 1986; Cesur et al., 2015; Bailey and Goodman-Bacon, 2015)

This evidence, though, only identifies the net effect of community health programs on mortality outcomes. It does not speak to some of the key issue surrounding the role that community centers can play within the design of a universal health coverage system: (i) To what extent are they able to expand access and what is their effectiveness in doing so (ii) What are the mechanisms through which they end up affecting mortality outcomes? (iii) Can they be effectively integrated into the broader network of public health facilities?

In the case of Brazil, the expansion of the community health network was conceived as part of a decentralization process aimed at rationalizing the provision of health care and reorganizing the allocation of treatment across the different layers of the public health system (community health centers, emergency ambulatories, general hospitals, and specialized hospitals). There is no previous analysis of how expansion of primary health care at the local level may have generated positive spillovers for hospital care in a context where hospitals suffered from over-crowding and long waiting times. There is also no evidence on the specific changes through which to primary care that may have reduced mortality.

This paper focuses on the impact of the introduction of the Unified Health System, particularly through the expansion of its Family Health Program strategy, on the rationalization of public health provision, access to public health care, and health outcomes. To achieve this objective, we use administrative records to construct an unprecedented dataset covering various interconnected aspects of the Brazilian health system. We use mortality and hospitalization records from the Brazilian Ministry of Health's System of Information (DataSUS) with individual-level data since the mid-1990s on admissions, main diagnosis, length of stay, procedures, expenditures, mortality outcomes, and some demographic characteristics (including age, gender, state, and, in some cases, educational level). These data cover the universe of mortality outcomes and hospitalizations through the public health system in Brazil, constituting a rare opportunity for analyzing issues that are potentially useful outside the Brazilian context as well.

One major challenge in this direction is how to disentangle access from the incidence of the underlying health conditions. Hospitalizations associated with cancer, for example, may increase because access is increasing, or because the incidence of cancer in the population is increasing (if prevention and early treatment are ineffective). Since the underlying prevalence of most health conditions in the population is not observed, hospitalization data by itself are not able to disentangle the supply and demand sides when measuring access to health care.

In order to overcome this problem, we concentrate our analysis on a specific event for which we can observed the demand for health care and the preventive and curative efforts allocated to it: a birth. By focusing on births, we are immediately able to condition observed treatment delivery on the underlying demand, therefore disentangling the demand and supply sides. In addition, pre-natal care and maternal and infant health are among the main priorities of the PSF and also constitute the main focus of the international movement for universal health coverage. By restricting attention to it, we can assess whether the PSF was indeed able to improve access to preventive care while at the same time allowing hospitals to shift resources to curative procedures associated with more complicated conditions, while still maintaining focus on what is potentially the most important aspect of universal access.

We track the period of major expansion of the program, between 1996 and 2004, to ask: How did the PSF impact the provision of different types of services across the public health system? Did it increase access to prenatal care and assisted births? To what extent did this translate into improved health for the newborn and for the mother? Did the PSF, by addressing problems early enough, lower hospital admission rates for simpler conditions and improve hospital access for conditions that indeed should require hospitalization? How did the PSF influence who gets access to pre-natal care and who gets admitted to hospitals?

Our main findings are as follows. Using municipality-specific dates of introduction of the PSF we find that, consistent with federal plans, there were immediate and large increases in the population covered by primary care and attended by teams of general physicians, nurses and outreach workers. Although the total number of home visits is unresponsive to PSF expansion, we find an increase in home visits attended by professionals with a college degree, suggesting close monitoring where needed. We also document sharp programme-related increases in municipality-level health expenditure. Despite this but, in line with the intention to stream into hospitals only those cases that needed hospital care, we show that PSF-introduction is associated with a decline in hospital bed per capita and also with fewer gynaecological and paediatric specialists per head. We find that PSF is associated with an increase in the average number of prenatal care visits, and increases in the share of hospital births and C-sections. We also document an increase in maternal hospitalization for reasons other than delivery and, among infants, a tendency (imprecisely determined) towards an increase in hospitalization for causes that are not amenable to primary care. Overall, it seems that despite a decline in the density of hospital facilities, hospitalization, at least for maternal and child health, was not compromised. So as to check if maternal and child health displaced hospitalization for other conditions, we investigated admissions for chronic disease. Although the estimates are imprecise, we can reject a decline in hospitalization from chronic disease and, other than for diabetes, the pattern of coefficients suggests, if anything, an increase.

Turning to outcomes, we identify large programme impacts on mortality. 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 often not (see Conti and Ginja (2016) for example), and foetal mortality is typically not studied. Importantly, most outcomes are increasing in duration of exposure to the programme, consistent with the evidence of it expanding continuously through time. We also find significant reductions in fertility. Although this is not conclusive in any way, the evidence suggests that fertility decline may have been a direct result of PSF exposure, rather than a response to mortality decline. Studying heterogeneity in impact by a binary classification of the education of the mother, we find that mortality decline was concentrated among less educated women while fertility decline was greater among more educated women. As the latter will have shifted the composition of births towards higher-risk births, our estimates of mortality decline are conservative. Despite the very large improvements in mortality after birth, we find no evidence that PSF was associated with healthier children at birth. There is no significant improvement in birth weight, gestation length or APGAR scores. We suggest that this may be on account of selective foetal survival and endogenous selection into the sample of births.

This paper addresses a major policy issue in Brazil, where the commitment implicit in a constitutional right to health led to the implementation of a health system with universal coverage and no access fee. Still, this experience can be seen as a laboratory as to the possibilities and pitfalls of the implementation of universal health care in other developing countries with scarce resources and limited institutional capabilities. The evidence from Brazil may therefore be useful in the discussion of universalization in other contexts as well.

The remainder of the paper is structured as follows. Section 2 outlines a brief history of the Brazilian Unified Health System and of the Family Health Program and discusses their organizational structure. Section 3 describes the various datasets used in our statistical analysis. Section 4 discusses our empirical strategy. Section 5 presents the results. Finally, Section 6 concludes the paper.

2 The Unified Health System and the Role of the Family Health Program

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 access to public health and relied partly on a limited network of philanthropic institutions and on the private sector and out-of-pocket expenses (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 as the primary care arm of the Brazilian Unified Health System. Following some pilot programs in a very small number of municipalities, and the ensuing conception of a standardized national primary care strategy in the 1990s, the PSF was rapidly expanded. By the end of the first decade of the 2000s, roughly ten years after its creation, it had already reached virtually every municipalities in the country.

The PSF 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 (the following institutional description of the Family Health Program draws from the discussion in 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 conditions, 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. Expanded teams can also include one dentist, one assistant dentist, and one dental hygiene technician. A health team follows between 3,000 and 4,500 individuals – roughly 1,000 families – from a given neighborhood or community (in the case of rural areas). The health teams perform their work both in the basic health units and in the households. Basic health units are community health centers that function as the operational basis of a PSF team in a given neighborhood or community.

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).[1]

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 (through handling and preparation of food, cleanliness, strategies and guidance on how to deal with simpler health conditions and to prevent complications, etc.). This strategy should reduce the occurrence of – and improve the response to – simpler health conditions and minimize the effect of endemic problems or diseases. 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 reorganization of the Brazilian health system. Within the newly designed system, simpler conditions should in principle be dealt with in the context of the PSF itself, 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 of resources.

The significance of this change must be understood in light of the previous context of public health provision in Brazil. The PSF targets poor communities. In fact, its implementation extended basic health care in Brazil to a group that in most cases had very little access to any primary care at all. As a result, many times public hospitals would be the first point of contact between individuals and the public health system, even when the underlying health condition did not demand anything more than some sort of primary care attention. The ensuing overcrowding of public hospitals and inefficiency in allocation of medical resources were therefore considered first order problems. So the PSF appeared as well as a way to deal with this systemic allocation problem.

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[1] An additional advantage of having such a focused program implemented at the national level is related to experience exchange. Experiences across different teams and areas can quickly lead to improved practices and better health outcomes in other communities, with successful strategies being diffused throughout the entire system.

In administrative and budgetary terms, the PSF is a federally sponsored program that is implemented in a decentralized way by municipalities. Implementation therefore involves different government levels and, in principle, should imply coordination across municipality, state, and federal governments. But there seems to be instances of implementation without direct involvement of state governments. In short, the program is a package originally conceived by the Ministry of Health and implementation requires voluntary adhesion of local administrations, preferably with state support (see Brazilian Ministry of Health, 2006a, for a description of the official attributions of the different spheres of government). The municipality is responsible for the provision and maintenance of the physical structure associated with the community health centers, while the federal government is responsible for the base salaries of medical doctors, nurses, and community health workers, plus the provisions of medicines and other medical material covered by the program. Municipalities can also increase the salaries of PSF workers by paying an additional on top of the base salary transfer from the federal government.

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).[2] Considering 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).

It is important to investigate impacts of re-structuring because, although positively motivated, it may not have improved access or outcomes for the following reasons. First, hospital density declined alongside growth and spread of primary facilities, suggesting potential losses that might offset any gains. Second, despite the unusual commitment of the Brazilian state to universal public health coverage, there do remain concerns about service quality and rationing of access (Victora et al., 2011; Paim et al., 2011; CNI, 2012). Third, a key feature of community health programmes such as the PSF is to provide information to encourage preventative behaviours but, in fact, the evidence that behaviour can be manipulated with information is mixed (Fitzsimons et al., 2016; Dupas, 2011). Similarly, another important component of the PSF was that it increased the density of primary care facilities, but it is not clear that demand always responds to the supply of facilities (Mohanan et al., 2014). In other words, incomplete take up may have limited PSF impacts. Fourth, maternal and neonatal mortality have, in general, been harder to address than post-neonatal mortality. Finally, any actual improvements may be veiled by endogenous heterogeneity in fertility or mortality responses. We attempt to address the last concern by modelling

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[2] The exchange rate (R$/US$) varied between 1.84 and 2.72 in the period under consideration.

fertility responses by the education of the mother, and by conducting back of the envelope calculations to estimate the bias in our estimates for mortality decline.

The expansion of the PSF is portrayed in Figure 1a. It started as a pilot project covering few municipalities in 1994 and grew into a nationwide large scale program in less than 15 years. By 2006, it was already present in more than 90% of municipalities and was estimated to cover more than 85 million people (Brazilian Ministry of Health, 2006b). The federal budget allocated to the program expanded concomitantly with its coverage, 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).

The rapid expansion of the PSF starting in 1998 was the outcome of an explicit effort from the federal government, following the intensification of federal support and the development of a standardized "PSF package". The federal nature of the program and the objective to expand it to the entire country are, from an empirical perspective, appealing characteristics of the Brazilian experience.

Mounting evidence has already identified some of the health benefits associated with the implementation of the PSF. Macinko et al. (2006) evaluate the impact of the program on infant mortality, using state level data (27 states), and find a significant impact of program implementation on reductions in morality. Macinko et al. (2007), through a survey of subjective perceptions, show that the presence of the program in a municipality is associated with better perceived health on the part of the population. Aquino et al. (2009) analyze the effect of PSF coverage on infant mortality in 771 municipalities from 1996 to 2004, finding a robust association between program coverage and mortality reduction. Rocha and Soares (2010) look at municipality data for the entire country and find a robust correlation between the timing of program implementation and reductions in mortality. Most of the effect they estimate is concentrated on mortality before age 5 and in poorer areas of the country. More recent research, following the initial literature on the PSF in Brazil, has documented consistent mortality reducing effects of community-based health interventions in other countries as well, such as Turkey (Cesur et al., 2015) and the US (Bailey and Goodman-Bacon, 2015).

Despite this evidence, still little is known about the mechanisms through which the PSF impacted mortality outcomes. Did the PSF play the expected role in helping rationalize the use of resources in the public health system? Did it indeed improve access to primary care? If so, was the increase in access concentrated among the poorest population? Was it indeed able to provide monitoring of certain health conditions? Though broad answers to these questions may be very difficult to provide with the data currently available, we try to tackle them and to provide evidence on the actual role played by the PSF in the restructuring of the public health system and in extending primary care access and monitoring to the Brazilian population.

3 Data

Data related to implementation of the PSF are obtained from the Brazilian Ministry of Health (Department of Basic Attention, MS/DAB), and provide the year of implementation in each municipality, starting from 1996. Municipalities are the smallest administrative units in the Brazilian political system. The borders of some municipalities, however, have changed over time with the creation of new units across years. We thus combine municipalities into Minimum Comparable Areas (MCAs), which are the smallest geographic units that can be consistently compared over time.[3] Our sample contains yearly data for 4,265 MCAs over the 1996-2004 period.

Data on health outcomes and access to health care are also available from the Brazilian Ministry of Health (MS/Datasus). We first construct data on infant and maternal mortality from 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 (we construct alternative definitions of maternal related mortality based on the full sample of women of reproductive age). 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.

The microdata make a total of 574,793 infant deaths, 565,452 deaths of women aged 10-49 years, and 163,720 fetal deaths. We collapse the microdata to build an yearly panel of data at the MCA of residence level for the 1996-2004 period containing the number of infant, maternal and fetal deaths (total, and by timing and cause of death). Though mortality records in some of the poorest states were still considered deficient by the 1990s (see Paes and Albuquerque, 1999), our empirical strategy – to be explained later on – controls for systematic differences in levels of measured mortality across states in a given year, so this concern should not affect the results.

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[3] We obtained the coding of MCAs from Ipeadata, and combined the municipalities' codes into MCAs' codes by using the 1991 layer of minimum comparable areas as reference.

The second health database that we use in our analysis is the National System of Information on Birth Records (Datasus/SINASC), which covers every registered birth in Brazil. The data provide information on, among other things, 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 (such as age and schooling). This information allows us to construct a MCA-by-year of birth panel over the 1996-2004 period containing information on number of births and relevant birth outcomes (making a total of 27,501,026 births).

The third health dataset is the National System of Information on Hospitalizations (Datasus/SIH), which contains administrative information at the hospitalization level. The data are managed by the Health Care Agency (SAS/Ministry of Health) with support of local and regional public health agencies, which receive information about hospitalizations from public and private hospitals through standardized inpatient forms, AIHs (*Autorização de Internação Hospitalar*). The dataset includes all hospital admissions funded by the Brazilian Unified Health System. It provides information on cause of hospitalization, duration of stay, final outcome (discharge or death), socioeconomic characteristics of the patient (municipality and zipcode of residence, gender, and date of birth), costs, level of complexity and type of bed (regular or ITU).

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 available at the code level, for these data we restrict the 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 (we construct alternative definitions of maternal hospitalization based on the full sample of women of reproductive age). These records make a total of 5,114,890 infant hospital admissions, and 19,951,777 maternal hospitalizations. We use the microdata to build a MCA-by-year panel over the 1998-2004 period containing information on number of hospital admissions (total, by cause of hospitalization and by other characteristics).

The last health dataset that we use in our analysis is 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, for instance, 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 (the large number of 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 delivered a given health service in a given municipality and year. We are also able to identify the type of health professional that delivered the service (physicians by specialization, nurses, or community health agents). The data thus allow us to build a MCA-by-year panel over the 1996-2004 period containing relevant pieces of information on the supply of outpatient health care.

Finally, we make use of other municipality data that are auxiliary to our analysis. Information on hospital infrastructure (number of hospital beds and presence of hospital in the municipality) is obtained from the Ministry of Health. We collect data from the Ministry of Social Development (MDS/SAGI) on the coverage of *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 Brazilian Cenus Bureau (IBGE, after *Instituto Brasileiro de Geografia e Estatística*). These data allow us to convert number of deaths and hospital admissions into mortality and hospitalization rates, respectively. All variables are collapsed at the MCA-by-year level, and merged with the other data containing PSF variables as well as health outcomes.

Table 1 presents some descriptive statistics for MCAs at our baseline year. 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. There were improvements along many dimensions in the following decades, though at different paces. Figure 1b presents aggregated trends for health expenditures, health access indicators as well as different outcome variables.

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 in coverage across 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, creating omitted trends. To the extent that surveillance of births and deaths is determined by state-level functionaries, this will be addressed by our controls for state*year fixed effects. Any residual bias will lead to under-estimation of fertility decline, but the direction of bias in estimates of mortality decline is unclear a priori because both the numerator (death counts) and the denominator (birth counts) tend to benefit from extension of surveillance. A different but related issue is measurement error in assignment of cause of death, which often arises because there are co-morbidities with, for instance, an infection from one cause making an individual vulnerable to other causes of death. Assignment typically requires a professional to ascertain the cause of death and, again, we may expect that by raising the density of generalized health professionals per capita, PSF expansion reduced measurement error. The upshot for our main results is this will tend to improve the precision of our estimates of cause-specific mortality trends.

4 Empirical Strategy

4.1 Identification

We explore the sequential process of implementation of the PSF starting in the mid-1990s and adopt a difference-in-differences strategy. Our goal is to analyze how implementation of the program was associated with changes in in the allocation and use of resources across the different hierarchical layers of the public health system, in access to health care, and in various health outcomes. Our unit of observation is an MCA (Minimum Comparable Area) at a point in time.[4]

Previous research has documented a heterogeneous effect of the PSF on mortality according to the time of exposure to the program (Rocha and Soares, 2010). This seems to be a function of logistical considerations in the initial phases of implementation and of the fact that some health conditions only respond to the intervention after some lag following initial treatment. It is also possible that this pattern is partly due to the heterogeneity in the effect of treatment across first and late movers, and we also discuss this possibility in detail when presenting the results. In any case, for these reasons, our main difference-in-differences specification allows for heterogeneity of the effect of the PSF as a function of the time of exposure to the program. Similar approaches were adopted by Rocha and Soares (2010) when analyzing the PSF and Bailey and Goodman-Bacon (2015) when looking at an

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[4] Minimum Comparable Areas (MCAs) are collections of municipalities corresponding to the same geographical areas that can be consistently compared over time. Since the number of Brazilian municipalities changed during the period of our analysis, we must use MCAs if we want to compare consistent geographic units over time. There is a trade off in this choice, though, since the PSF was implemented at the municipality level and an MCA is a slightly more aggregate unit. So, by choosing MCAs as units of analysis, we are probably losing some precision in the definition of treatment (we consider that an MCA received the treatment if any municipality within it implemented the PSF). 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.

US community primary care intervention.

The sources of variation in the data used to identify the effects of the program are, therefore, the different timing of adoption and the different time of exposure. Our benchmark specification is the following:

$$Health_{mt} = \alpha^h + \sum_{j=0}^{J} \beta_j^h \times PSF_{mt-j} + \gamma^h \times X_{mt} + \theta_m^h + \mu_{st}^h + \epsilon_{mt} \tag{1}$$

where $Health_{mt}$ denotes some health-related variable (measuring supply, access, or outcome) for municipality m in year t, PSF_{mt-j} is a dummy variable assuming value 1 if municipality m had already received the program in year $t - j$, X_{mt} denotes a set of AMC controls, θ_m^h is an AMC fixed-effect, μ_{st}^h is a state-specific time dummy, ϵ_{mt} is a random error term, and α^h, $\beta_j^h s$, and γ^h 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.[5] Our set of controls included in X_{mt} varies across specification, but includes a dummy for the presence of a hospital in the MCA, the local coverage of *Bolsa Família* (the conditional cash transfer program that constitutes the main social protection program in Brazil), and dummy indicating if the MCA left PSF at some point in time. To deal with the fact that the variance of some health outcomes (such as 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 MCA level to account for the possibility of serially correlated and heteroskedastic errors (as suggested by Bertrand et al. (2004). Our sample covers the interval between 1996 and 2004, since this is the period of largest expansion in coverage and that contains most of the diff-in-diff variation between treatments and controls (before 1996 or after 2004, there is very little cross-sectional variation in coverage).

The main econometric concern in this specification is that adoption of the PSF may be a function of local health conditions and, therefore, endogenous to the evolution of some of the dependent variables of interest. The fact that the PSF experienced an accelerated ex-

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[5] In the case of mortality, this strategy also deals with the potential problem of underreporting. Systematic variation in, for example, 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. In the case of mortality, in particular, this would bias the estimated coefficient in the direction of finding an increase, rather than a reduction, in mortality.

pansion starting in the late 1990s as part of an explicit effort of the federal government, reaching more than 90% of municipalities in roughly ten years, lessens this concern. In addition, Rocha and Soares (2010) explicitly analyze the determinants of PSF implementation during this period and find that endogeneity of adoption does not seem to be a concern. They perform a hazard estimation of the probability that a municipality receives the program and find that political orientation and fixed initial characteristics are strongly correlated with the timing of adoption, but that past health shocks bear only a very weak quantitative relationship with it. They conclude that there is a substantial degree of variation in the timing of adoption driven by cross-sectional differences across locations that do not change with time (and that are captured by fixed-effects in a difference-in-differences strategy).

Still, in order to address this concern, we present most of our results including pre-treatment trends in the main specification. We check for the presence of pre-existing trends by including pre-treatment lags as in the equation below:

$$\begin{aligned} Health_{mt} &= \alpha^h + \sum_{i=1}^{I} \beta^h_{pre,i} \times PSF_{mt+i} + \sum_{j=0}^{J} \beta^h_j \times PSF_{mt-j} + \gamma^h \times X_{mt} \\ &\quad + \theta^h_m + \mu^h_{st} + \epsilon_{mt}, \end{aligned} \tag{2}$$

where the variable PSF_{mt+i} capture whether municipality m will receive the program i years into the future, and the other variables were defined in equation 1. If there are pre-existing trends that challenge our identification strategy, one would expect the coefficients $\beta^h_{pre,i}$ in the specification above to be statistically significant. For ease of exposition, we present most of our results in graphical form, plotting together in the same figure the estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors, based on the estimation of equation 2.

Our second empirical concern in relation to equation 1 is omitted variables. This potential problem is not ruled out by the strategy discussed in the previous paragraph. It is conceivable that good governments – or governments with certain political orientation – are inclined to adopt the PSF and are also inclined to implement other social policies. In the limit, if the timing of implementation and expected effect of these different social policies were identical to those of the PSF, the impact of each individual program would not be identifiable. In order to account for the possibility of other competing social policies affecting health outcomes, we control for some local policies that may be correlated with PSF adoption and with improvements in health, such as access to hospitals (in some specifications) and presence of the conditional cash transfer program. In addition, we also look in detail at specific dimensions that should respond particularly to the type of intervention that characterizes the PSF.

4.2 Outcomes

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 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, 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.[6] 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 characterize restructuring, access, and health outcomes for events surrounding births in a reasonably accurate way. In addition, we should expect births to respond to the implementation of PSF within a relatively limited time window, while the timing of the effects on other conditions – such as chronic diseases – could play out over decades. We use a vast array of variables constructed from the administrative health datasets to try to capture these dimensions.

We start by considering the restructuring of the health system. First, we look at how the PSF affected the distribution of facilities offering general practitioners services in comparison to those offering more specialized services. The idea is that the PSF should have increased the number of facilities offering general practitioners services and maybe, due to restructuring, reduce the number of facilities with specialists services. In sequence, we analyze access. We look at the impact of the PSF on the share of births covered by adequate pre-natal care and on the share of deliveries taking place in hospitals.

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[6] 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 our results section.

We then move to the analysis of health outcomes at birth and immediately following birth. We start by looking at infant mortality and reproducing the main results obtained by Rocha and Soares (2010). As these authors, we consider mortality by cause of death, but, differently from them, we also classify causes of death into health conditions that should be more responsive to the type of primary care provided by the PSF and those that should be relatively less responsive to it. This categorization follows that originally proposed by Alfradique et al. (2009), who classified health conditions into those responsive to primary care attention (ICSAP, after the acronym in Portuguese) and those not responsive to primary care attention (non-ICSAP). Notice that, coupled with the restructuring of the system, the introduction of the PSF could end up affecting both ICSAP and non-ICSAP conditions, since in principle it could have freed up specialized resources to be more effectively used in the treatment of non-ICSAP conditions. We also use this classification throughout the paper to help us assess whether the PSF indeed impacted reallocation of resources across the different hierarchical layers of the health system as expected.

Following, we look at a broad set of birth outcomes that have not yet been analyzed by the literature on the PSF or on community health programs in other contexts: fetal mortality, mortality in the first 24 hours and in the first 27 days, APGAR scores, birth weight, and gestational length. We also extend the mortality analysis from previous studies by looking at maternal mortality and mortality for women of reproductive age (we look at this second variable due to large underreporting of maternal mortality as a cause of death in the Brazilian administrative records, as documented, for example, by Szwarcwald et al. (2014)). Maternal health is one of the main focuses of the PSF, so this is an essential health outcome.

We also analyze the Brazilian data on hospitalizations, which up to now have never been explored in the literature. We look at maternal and infant hospitalization rates and decompose this analysis by conditions that should and should not be responsive to primary health care (ICSAP and non-ICSAP). Hospitalization helps us assess whether the PSF was indeed able to deal with simpler conditions while at the same time increasing access to hospitals for clinical complications that require more specialized and intensive care.

We also conduct estimate impacts of PSF implementation on inequality of access and outcomes. In the birth data, we can use the educational level of the mother to investigate whether effects are heterogeneous according to family background. We explain in detail the definition of each variable used as results are presented in the next section.

5 Results

We present our main results in graphical form, plotting together in the same figure the estimated coefficients $\beta^{h}_{pre,i}$, $i's$ and $\beta^{h}_{j}s$ and their respective standard errors, based on the estimation of equation 2. Regression tables that mirror the event study pictures are in the appendix. The graphs are presented in three stages, describing the restructuring of the system, indicators of access to health services, and maternal and child health outcomes. Regression tables that mirror the event study pictures are in the online appendix. In general, across a rich set of diverse outcomes, we can reject pre-trends. In a few cases, there is a pre-trend in a direction opposing that which is precipitated by initiation of PSF. In the odd case where there is a pre-trend that cannot be distinguished from programme impacts, this is flagged in the discussion below.

5.1 Restructuring

Figure 2a shows that the share of the population covered by PSF increased 14% in the first year and by 46% by the eighth year. We observe a similar pattern for the share of children up to 1 year old covered by PSF. Also, PSF penetration was associated with an immediate and statistically significant increase in the number of outpatient facilities with a PSF physician as well as in the number of PSF teams per capita.

Alongside with coverage expansion, we observe in Figure 2b that municipality health expenditure per capita increased by close to 20% in the first year of the programme, and this increase was sustained through to the following years. We observe no similar pattern on PSF effects on total expenditure net of health expenditure. Even though PSF is associated with an increase in health spending, the program has not led to an expansion of the total number of outpatient facilities per capita. Productivity, however, increased continuously. Figure 2b portrays an increase in the total number of outpatient procedures per capita, and a jump in home visits made by health personnel with a college degree (doctors and nurses). We also observe an increase educational in-group activities per capita carried out by health professionals.

Figure 2c shows that there was also a concomitant decline in outpatient facilities and procedures with specialists per capita, as well as in the density of hospital facilities and in the number of hospital beds per capita. Outpatient facilities with a gynaecologist/obstetrician declined by 5% in year-1 and 35% by year-8 while the corresponding decline in facilities with pedeatricians was 9% and 50% respectively. In line with this there was a sharp drop in the number of gynaecological and paediatric appointments per capita. The probability that the municipality has a hospital dropped immediately upon introduction of PSF, cumulating to a 1.7 percentage point drop by the fourth year, and 3.1 by the eighth year. Hospital beds per capita (mean of 2.6 per 1000 individuals) fell by 1.5% in the first year, and by 11.1% by the eighth year.

5.2 Access

Figure 3a presents PSF effects on indicators of access to health services. There was an increase in access to community-based prenatal care among pregnant women. This was most marked at the margin of 7 or more visits, which only 44% of the population achieved pre-PSF. The percentage of women accessing 7+ visits increased by 1.5 percentage points (3.4%) in the year of introduction of PSF, rising to 7 percentage points (15.8%) by the eighth year.

Despite the reduction in the density of hospital facilities, the share of hospital births increased gradually from 0.4 percentage points (3.4%) in year-1 to 1.9 percentage points (2%) in year-8. 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 under the PSF. 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 that there are no doubt large variations in the quality of hospital facilities across developing countries.

The share of caesarean sections increased through the period, from 1.6% in the first year to 8.6% points by year-8 on a pre-intervention mean of 38%. Using the hospitalization data, we also document a PSF-led increase in maternal hospitalization rates (MHR) for reasons other than delivery (pregnancy complications), which is entirely on account of non-ICSAP causes, alongside no change in hospitalization for ICSAP-causes (though the latter are a small share of the total). Hospitalization of women for non-ICSAP causes increases by 8.1% in the first year, climbing to 40.6% in the eighth year. Both jump precisely at the introduction of PSF. Infant hospitalization show an immediate decrease in hospitalization for ICSAP causes (close to 40% of all causes) that hovers between 2% and 6% rather than accumulating over time. We also observe an increase in infant hospitalization for non-ICSAP causes from year-4 and though this is not statistically significant, it again allows us to reject the concern that the post-PSF decline in hospital density compromised hospital care. Reductions in ICSAP (rather than non-ICSAP) cases is consistent with outpatient care being able to address many problems like infections that children may develop.

Although the distinction between ICSAP and non-ICSAP causes of hospitalization and death in the maternal and child domain is neat, and we have shown that PSF-expansion did not compromise access or outcomes for non-ICSAP causes, a potential lingering concern is that other non-ICSAP conditions suffered. Although it is amenable to primary care in the early stages, once advanced, chronic disease often requires hospitalization. We therefore examined whether PSF expansion was associated with a decline in hospitalization for chronic disease. Figure 3b presents the results. The estimates are imprecise but there is in general no evidence of reduced hospitalization. Overall, the pattern is for hospitalization to increase from year-3 of PSF expansion, for ICSAP and non-ICSAP cases. This pattern is also evident for neoplasms and cardio-vascualar disease, although for diabetes there is a decrease. In principle, hospitalization rates may rise either because the incidence of advanced chronic disease rises or because access to care improves. Since PSF improved other primary care outcomes, it seems fair to assume it also reduced the incidence of advanced chronic disease by encouraging early detection and management, for instance through lifestyle changes. In this case, any increase in hospitalization is likely to signal improved access.

In summary, these patterns suggest that the huge increase in outpatient care under the PSF reduced the caseload of hospitals, allowing hospitals to accommodate more of the procedures that require inpatient care. Specifically, the PSF will have 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.

5.3 Outcomes

Prior to PSF implementation, in 1996, it is notable that with maternal mortality at 0.5 per 1000 births (against a world mean in 1996 of 3.66), Brazil had already achieved the Sustainable Development Goals (SDG) target of 0.70 per 1000 births by 2030. Similarly, its pre-intervention neonatal mortality rate of 10.37 in 1000 births (compared with a global mean of 33.7) was ahead of the SDG target of 12 in 1000 births.[7] In general, there are diminishing returns to life-saving interventions as places with high mortality rates include many readily preventable deaths. Thus we may have expected modest impacts in Brazil but in fact we identify exceptional improvements.

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[7] Brazil's infant mortality rate in 1996 was 19.33, compared with a global mean of 59 per 1000 births.

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, since MMR is rare (0.03 per 1000 women and 0.40 per 1000 births), these data are noisy. For this reason alongside estimates for MMR we also report estimates for the total female mortality rate in the reproductive ages (age 10 to 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 4 we observe a clear tendency for a sharp reduction in maternal mortality (MMR) and, more precisely determined, in mortality among women of reproductive age (FMR), upon the introduction of PSF. 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 3.9 (3.8) in year-1, growing to 39.1 (25.8) in year-8. The percentage reductions in MMR (FMR) per birth are 7.3 (5.6) in year-1 and 53.1 (41.2) 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), less than the 53.1% decline generated by eight years of PSF expansion, despite Brazil having started out with relatively low rates. It is also useful to compare PSF expansion with a different policy approach. Using quasi-experimental variation in policy implementation across countries, Bhalotra et al. (2016) estimate that the introduction of quotas for women in parliament led to a 10% decline in maternal mortality on average, 5.8% after exposure for 1-4 years (roughly one electoral term), 8.9% after 5-8 years, and 16.2% for exposure of twelve or more years. While this is impressive on its own, the 8.9% figure for eight years exposure to quotas is much smaller than the 53.1% figure for the same exposure to the PSF.

5.3.2 Infant Mortality

In Figure 5 we observe that the infant mortality rate shows a significant drop of 9% in the second year of PSF penetration, rising steadily to 34% in year-8. In absolute changes these are drops of 1.73 and 6.55 percentage points, and the pre-PSF mean is 19.33 deaths per 1000 births. Importantly, the introduction of PSF is associated with marked declines in infant mortality from both ICSAP and non-ICSAP causes.[8] Mortality from ICSAP causes (pre-programme mean of 2.2%) falls immediately by 6.2%, rising steadily to 38.1% while mortality from non-ICSAP causes (pre-programme mean of 17.2%) initially falls by 3.4%, rising to 33.4%.

We also investigated the timing of declines in infant mortality, following the bio-medical literature in distinguishing neonatal (first 27 days) from post-neonatal (28 days and onwards to age 1) mortality. Figure 6 presents the results. Postneonatal mortality shows a significant decline of 5.4% in the first year, rising to 24.6% eight years after introduction of PSF (mean of 8.96 per 1000 births). Neonatal mortality decline is only statistically significant from year-3, rising steadily to 39.4% in year-8 (mean 10.37). Since we have an unusual granularity in the administrative death records, we also report estimates that split neonatal mortality into death in the first day of life vs the rest of the first month. Both show significant declines, the former slightly larger in percentage terms. Somewhat unusually, we also have estimates for foetal mortality (mean of 4.44 per 1000). This also shows a steady decline, starting upon introduction of PSF, becoming precisely determined from year-5 and rising continuously to a reduction of 41.1% in year-8.

To put these achievements in perspective, we note that the 34% and 39.4% declines in infant and neonatal mortality associated with eight years of exposure to the PSF 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 7% reduction in child mortality (equivalent to 0.34 deaths per 1000 livebirths) which is only evident at three or more years of exposure, restricted to a sub-sample of poorer municipalities, and arising primarily from reductions in diarrhea/intestinal and respiratory infections. In contrast we found a significant drop of 9% in the second year of PSF penetration, rising steadily to 34% in year-8.[9] 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 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 of PSF (which rose to 6.55 by year-8).

The very substantial reductions in foetal and neonatal mortality suggest improvements in maternal health which may cover a wider range of conditions than those which determine

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[8] ICSAP mortality is 11.3% of all infant mortality while ICSAP hospitalization is 40% of all infant hospitalization.

[9] 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 programmes even larger.

maternal mortality, as does the reduction in infant mortality from congenital causes.

5.3.3 Fertility

A shown in Figure 7, fertility exhibits a clear pattern of decline immediate upon the introduction of PSF, although the individual coefficients are only statistically significant from year-3 onwards. 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 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 and local clinics providing contraception. Figure 2b suggests that educational activities may have played the important role. In addition, fertility may have declined in response to reductions in mortality. For this reason, it is useful to compare our estimates with estimates of historical fertility responses to mortality decline. Consider estimates derived from the introduction of the first antibiotics in America, which led to large declines in infant and maternal mortality. The decline in infant pneumonia mortality of 28% 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 and Venkataramani, 2014). 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 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 response of fertility to the PSF-expansion may have been large. As discussed below, we find that fertility decline stems mostly from more-educated women in the sample while mortality decline stems more from less-educated women, and this further diminishes the likely importance of the mortality-channel in determining fertility decline.

5.3.4 Quality of Births

Figure 7 also shows no significant change in the quality of births. Potential explanations of this result are selective foetal survival, with the marginal birth being more fragile; endogenous heterogeneity in fertility decline that, as we note below, raised the share of births from higher-risk (less educated) mothers; and, possibly, endogenous increases in the use of C-sections (which may be associated with breathing difficulties among newborns).

Birth weight and APGAR-1 scores show no consistent pattern, while indicators for low birth weight and gestation of at least 37 weeks suggest a deterioration, although all coefficients are indistinguishable from zero. The APGAR-5 score (taken 5 minutes rather than 1 minute after birth) also deteriorates and the change is significant by year-4, at 0.5%, growing to 0.9% by year-8. Since boys are more vulnerable to foetal death (Gluckman and Hanson, 2004; Low, 2015), the share of boys at birth is also an indicator of foetal health and this shows a tendency to increase although it is also imprecise through the sample period.

5.3.5 Socio-Economic Gradients in Programme Impact

We analysed socio-economic gradients using two approaches. First, we divided the sample of mothers in the vital statistics data into more and less educated women, polarized so that high refers to having at least some secondary school and low to having no schooling. Second, we divided all individual hospitalizations into poor and non-poor zip-codes, identified by using GIS to associate zip-codes with income in the 1990 census track, and cutting the sample at the median income. Analysis of fertility by education of the mother is done using the logarithm of births in a municipality and year because the natural denominator, the population of women of reproductive age (or teen age) in a municipality and year is not (readily) available by education. The baseline population of women at risk of birth is absorbed by municipality fixed effects. We may be concerned that maternal mortality decline generates endogenous variation in this population over time. However as this will lead us to under-estimate fertility decline, we can read our estimates as providing a lower bound on the true decline. We also use the logarithm of the total number of cases in the analysis of mortality by education of the mother, and hospitalization by zip-code income.

In Figure 8a we observe that the PSF-led increase in prenatal care visits (to 7 or more) and the increase in the share of C-section births comes from less educated women, but the increase in the share of hospital births comes from both groups. Figure 8b shows that maternal and infant mortality decline is only precisely identified among women with low levels of education. This is consistent with higher baseline levels of mortality in this. Although the dynamic response of birth weight to PSF-expansion remains statistically insignificant in each group, as it was on average, separating women by education reveals that the tendency for birth weight to deteriorate may stem from less educated women. This may be because of the education gradient in foetal mortality, which implies that the marginal birth (i.e. the birth that would have died but survived on account of PSF) is more likely to be in the sample of births to less educated women.[10]

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(Albanesi and Olivetti, 2014; Bhalotra et al., 2016). 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).

Maternal and infant hospitalization cases by zip code are presented in Figure 9. These estimates are imprecise, making it difficult to draw any firm conclusions. However, it seems that we cannot reject the null that hospitalization rates did not respond differently to PSF expansion in non-poor as compared with poor neighbourhoods.

6 Final Remarks

Brazil is a forerunner in provision of universal health coverage through a unified health system. Aggregate trends show impressive declines in indicators of population health since democratization in 1988. So as to identify causal effects of the Family Health Programme (PSF), the conduit by which primary care was expanded, we exploit municipality-level variation in PSF expansion. 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 also find significant programme-led declines in fertility.

We provide some of the scarce structured evidence that UHC can work if 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 significant decline in hospital beds and specialists per capita, we find no evidence that hospitalization for morbidities that required hospital care was compromised.

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[10] Education gradients in fertility (discussed below) only imply that the share of births to less educated women was increasing in PSF penetration.

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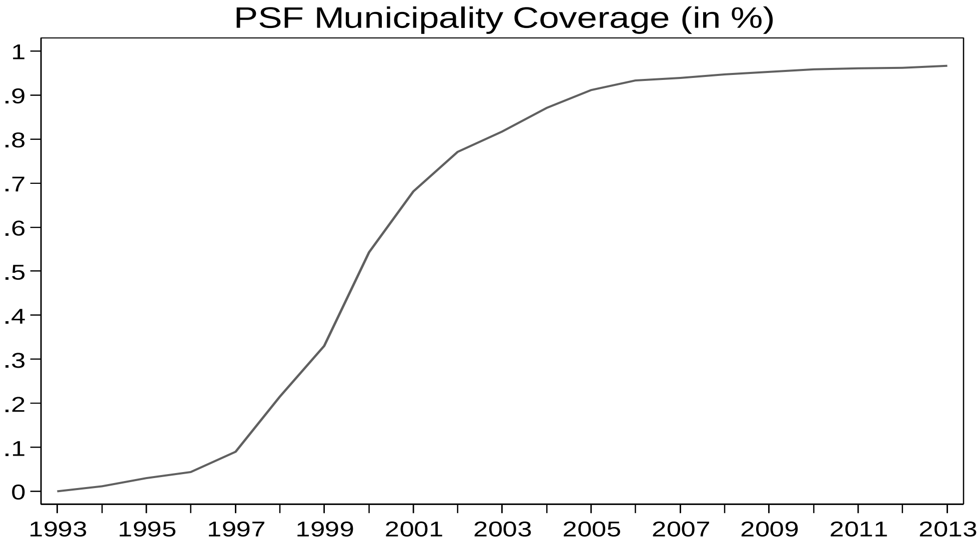
Appendix

A Descriptive Statistics

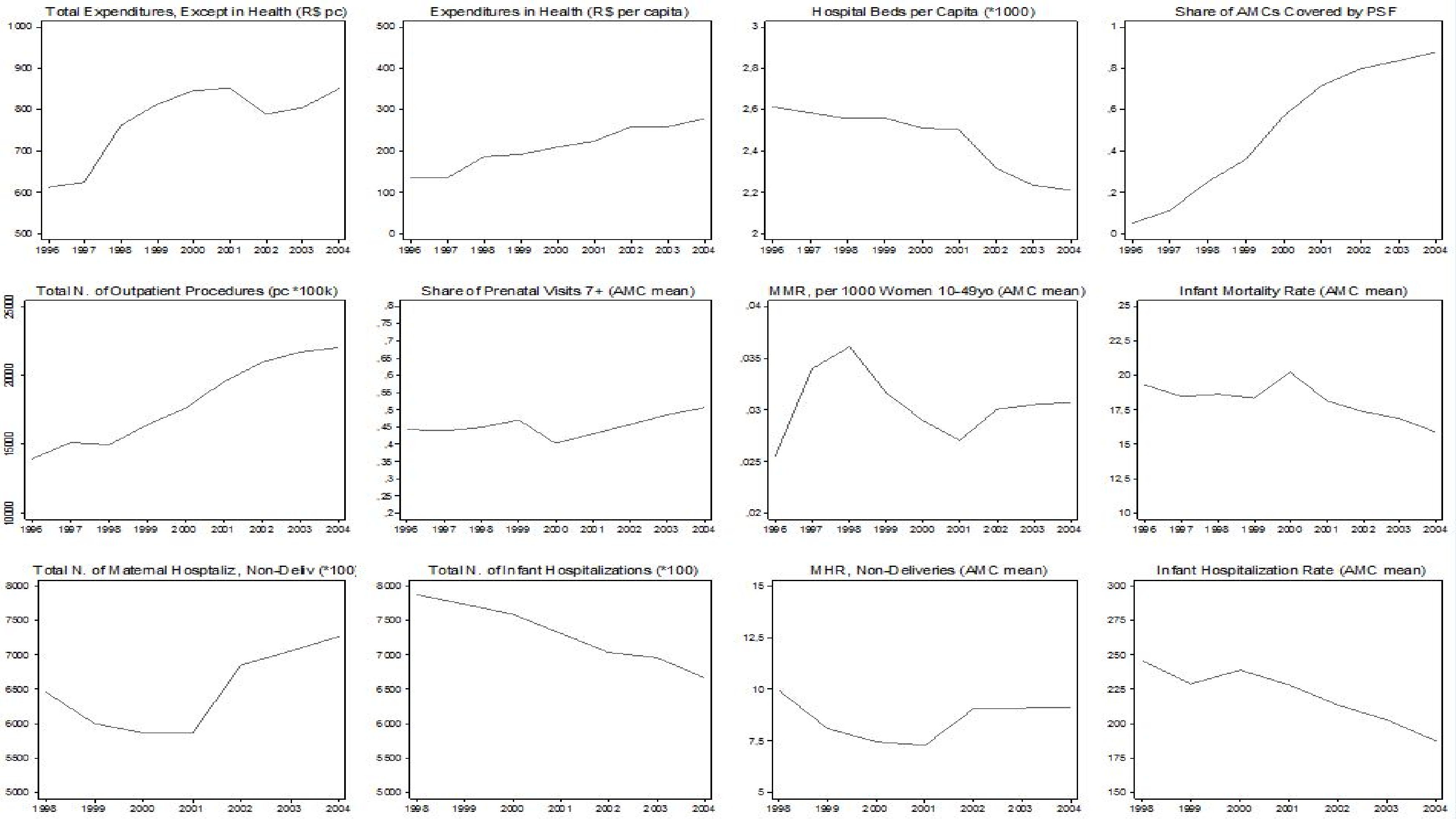
Figure 1: PSF Expansion and Aggregate Trends

(a) PSF Expansion



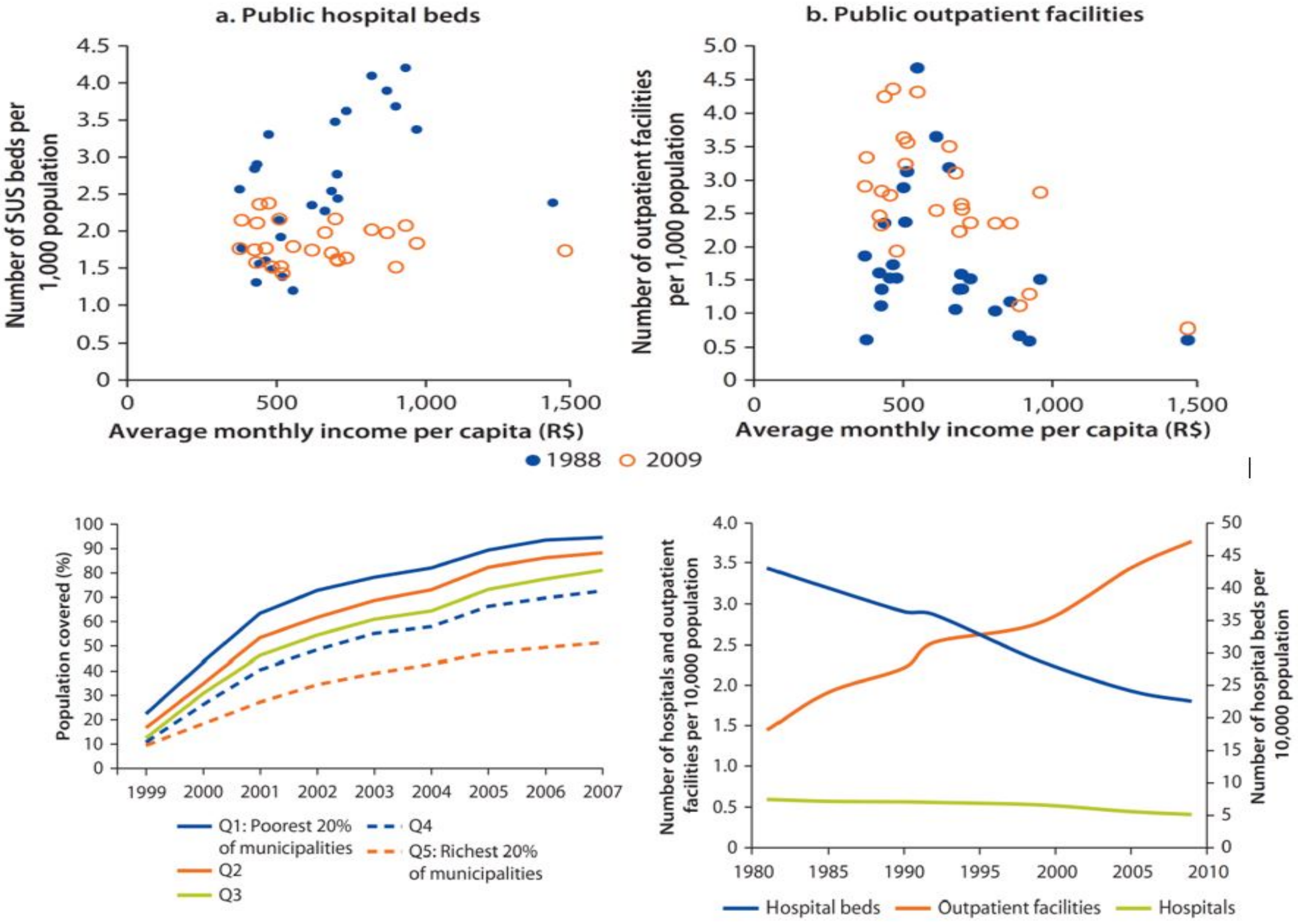
Source: Brazilian Ministry of Health, SAS/Dept de Atenção Básica – DAB.

(b) Aggregate Trends



Note: The original source of data used to compute each variable is listed on Table 1.

(c) Aggregate Trends



Note: Graphics originally from Figures 2.13, 2.2 and 2.4 from Gragnolati et al. (2013). The left figure at the panel bottom draws upon Macinko (2011, apud. Gragnolati et al., 2013), and refers to PSF population coverage by municipality income quintile.

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
N. of Appointments for Provision of Diaphragm (per women*1000 10-49yo)	4,267	0.32	7.06	0	323	Datasus/SIA	1996
N. of Appointments for Provision/Insertion of IUD (per women*1000 10-49yo)	4,267	0.63	11.49	0	476	Datasus/SIA	1996
Number of Pediatric Appointments (per children*1000 0-1yo)	4,265	11.07	14.65	0	197	Datasus/SIA	1998
Number of Gyneco-Obstetrical Appointments (per women*1000 10-49yo)	4,267	144.6	300.2	0	4329	Datasus/SIA	1998
Number of Gynecological Appointments (per women*1000 10-49yo)	4,267	196.6	329.6	0	4450	Datasus/SIA	1998
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 1000 Babies 0-1yo)	4,265	16.57	13.60	0	166.7	Datasus/SIM	1996
Maternal Mortality Rate (MMR, only if ICD10="O", per 1000 Babies 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
MHR, if Complications: ICSAP	4,267	0.16	0.45	0	7.173	Datasus/SIH	1998
MHR, if Complications: Non-ICSAP	4,267	9.77	8.22	0	73.30	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 1000 babies 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 1000 babies 0-1yo)	4,265	245.7	146.10	0	2190.2	Datasus/SIH	1998
IHR: ICSAP	4,265	85.14	68.80	0	857.1	Datasus/SIH	1998
IHR: Non-ICSAP	4,265	160.5	112.55	0	1684.2	Datasus/SIH	1998
Fertility Rates and Other Birth Outcomes (Mean, Conditional on Birth)							
Total Fertility Rate (women age 10-49)	4,267	0.05	0.02	0	0.14	Datasus/SINASC	1996
Teenage Fertility Rate (women 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

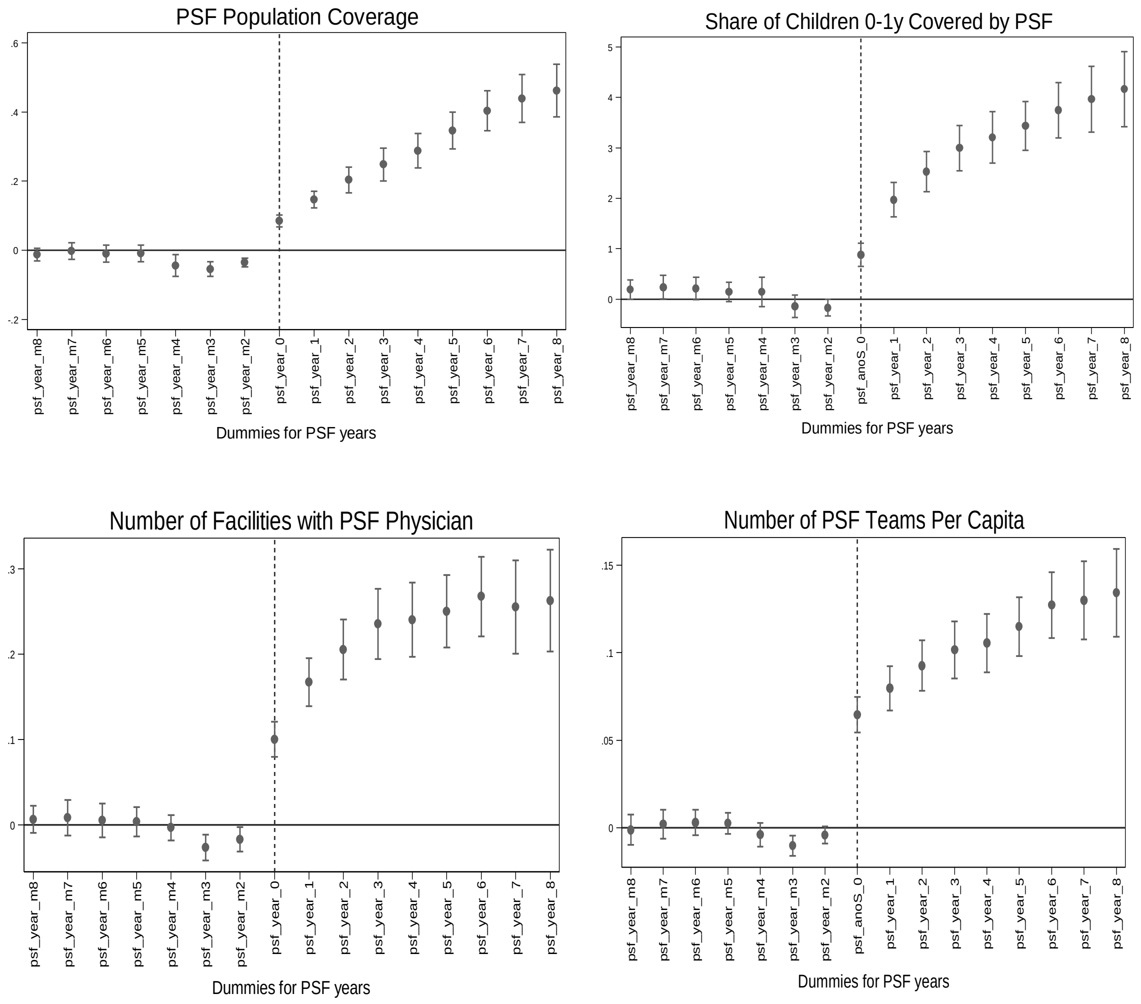
Table 1: Main Descriptive Statistics (at the baseline year) – *Cont.*

	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	0	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	0	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
Hospitalization Rates by Chronic Conditions (all individuals age 50+, *1000)							
All	4,267	188.29	89.13	0.00	1493.56	Datasus/SIH	1998
ICSAP	4,267	72.12	43.26	0.00	597.42	Datasus/SIH	1998
Non-ICSAP	4,267	116.17	54.64	0.00	896.14	Datasus/SIH	1998
Neoplasms	4,267	6.29	4.97	0.00	37.18	Datasus/SIH	1998
Diabetes Mellitus	4,267	3.84	4.26	0.00	92.70	Datasus/SIH	1998
CVD	4,267	49.09	31.03	0.00	421.46	Datasus/SIH	1998

B Main Results

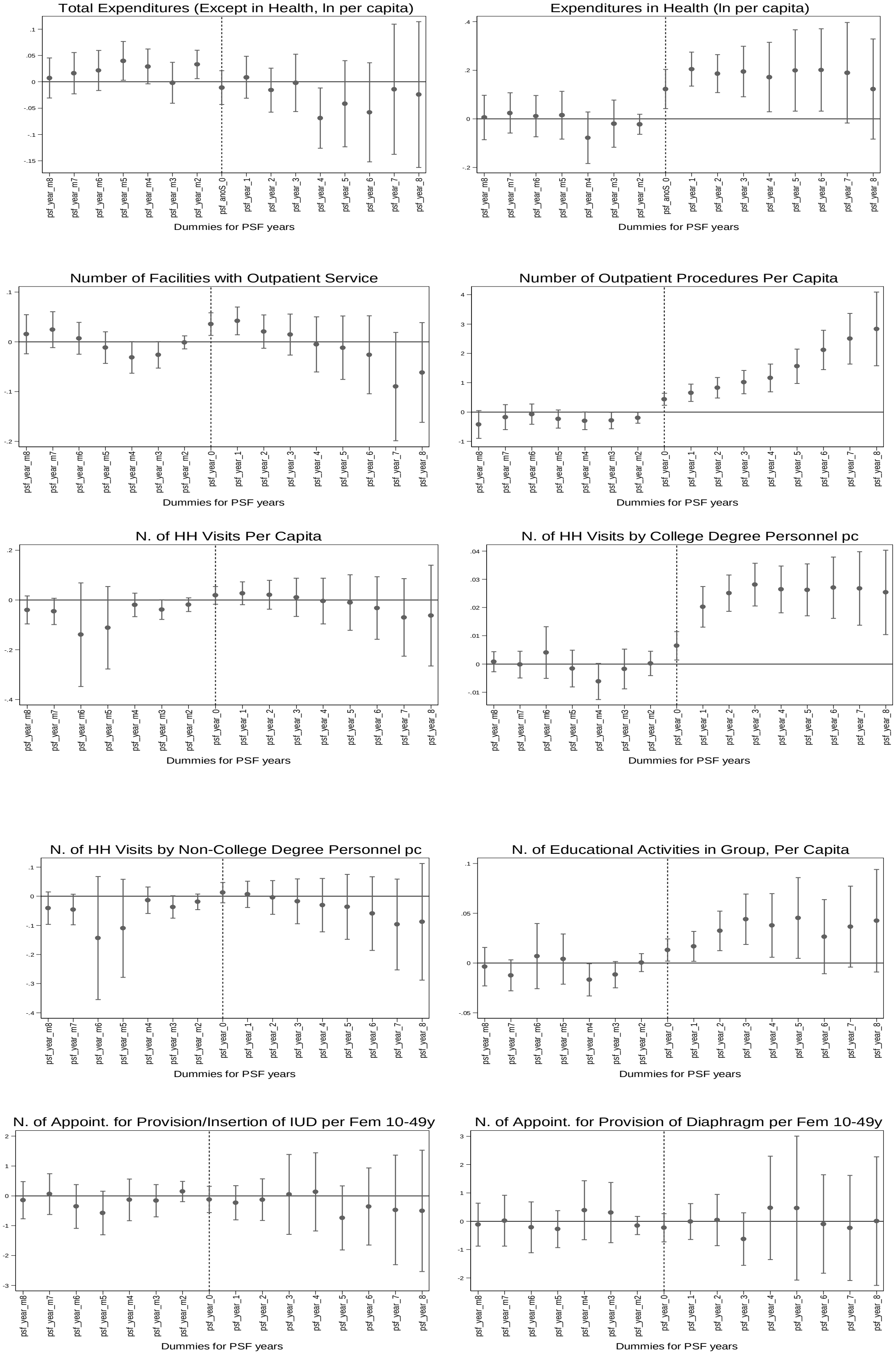
Figure 2: PSF Coverage and Its Effects on Health System Restructuring

(a) PSF Coverage



Note: Each figure plots together the estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors, based on the estimation of equation 2. The tables with the estimates are presented for the interested reader in the Appendix C.

(b) PSF Effects on Health Expenditures, Number of Health Facilities and Ambulatory Procedures



(c) PSF Effects on Health Expenditures, Number of Health Facilities and Ambulatory Procedures (*cont.*)

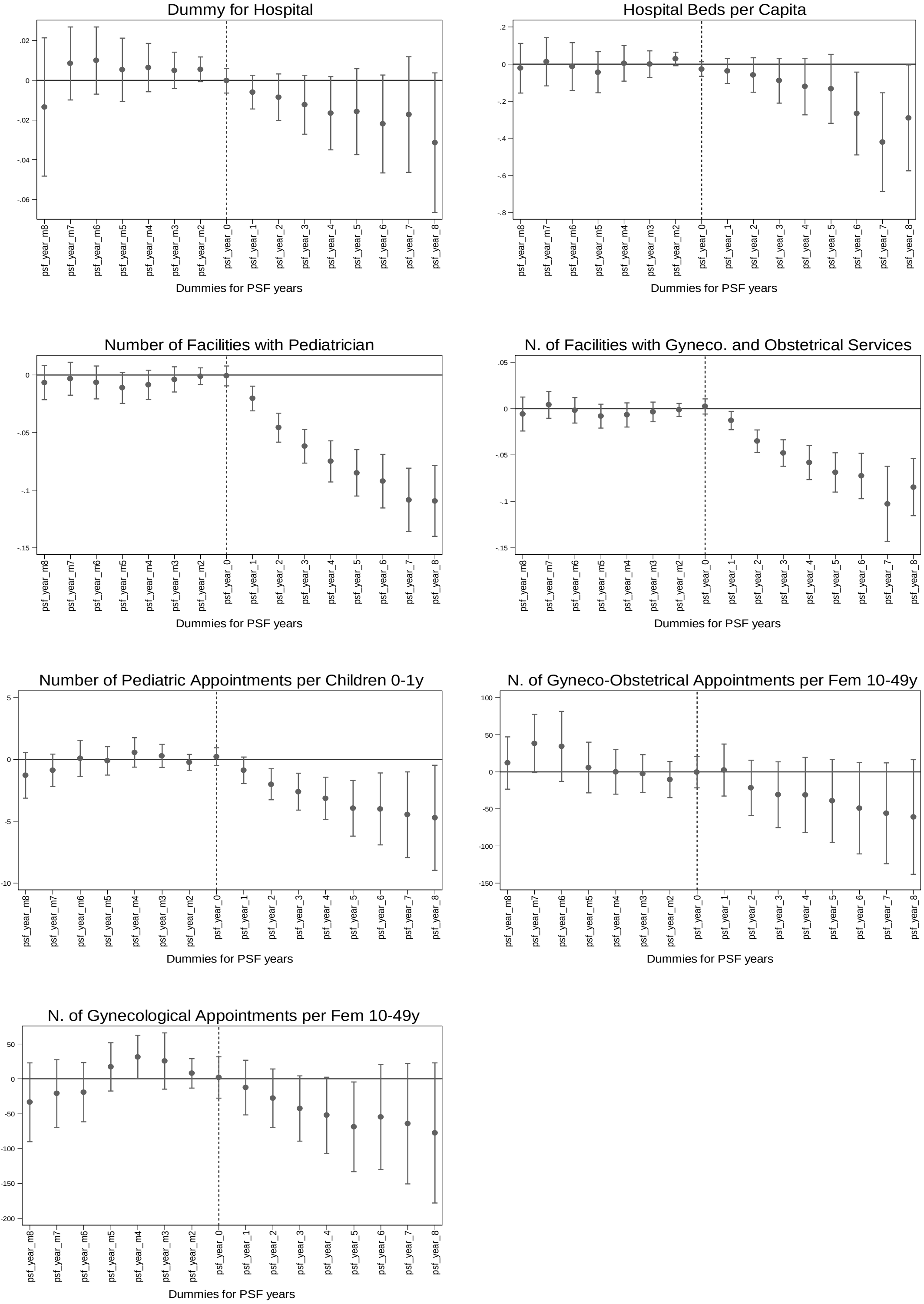
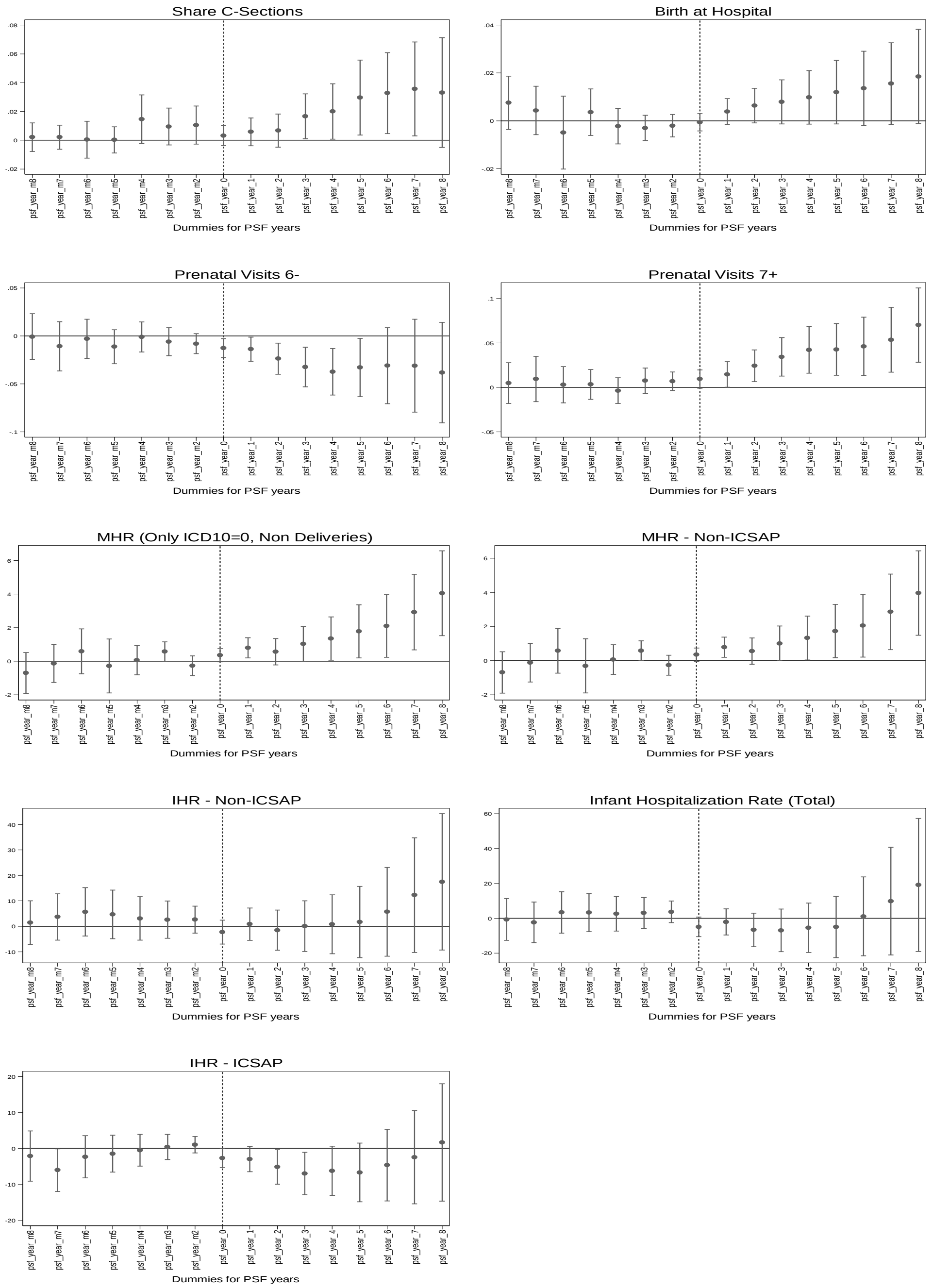


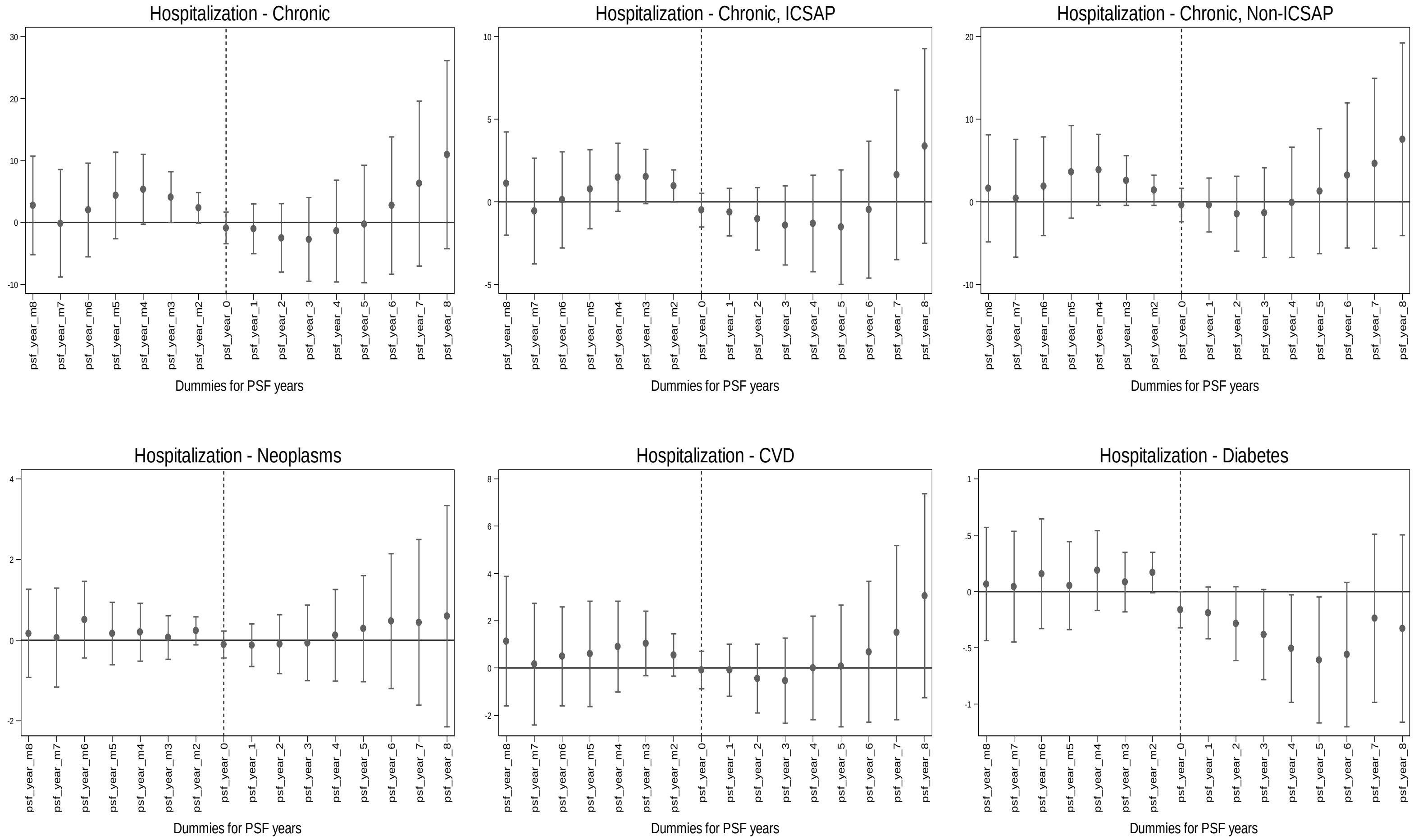
Figure 3: Access to Health Services, Prenatal and Delivery Conditions

(a) PSF Effects on Maternal and Infant Hospitalization Rates, Prenatal and Delivery Conditions



Note: Each figure plots together the estimated coefficients $\beta^{h}_{pre,i}s$ and $\beta^{h}_{j}s$ and their respective standard errors, based on the estimation of equation 2. The tables with the estimates are presented for the interested reader in the Appendix C.

(b) PSF Effects on Hospitalization Rates, Chronic Conditions (individuals aged 50+ per 1000)



Hospitalization - Chronic

Hospitalization - Chronic, ICSAP

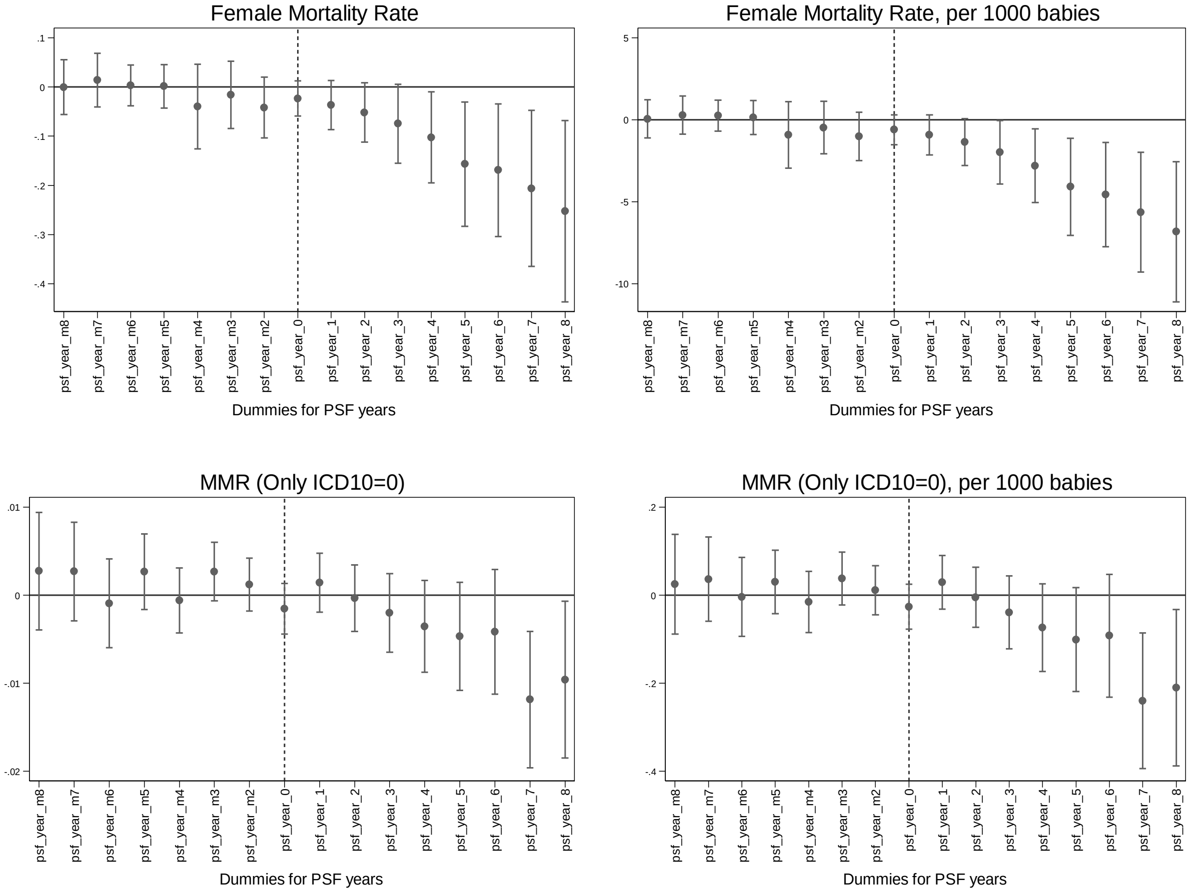
Hospitalization - Chronic, Non-ICSAP

Hospitalization - Neoplasms

Hospitalization - CVD

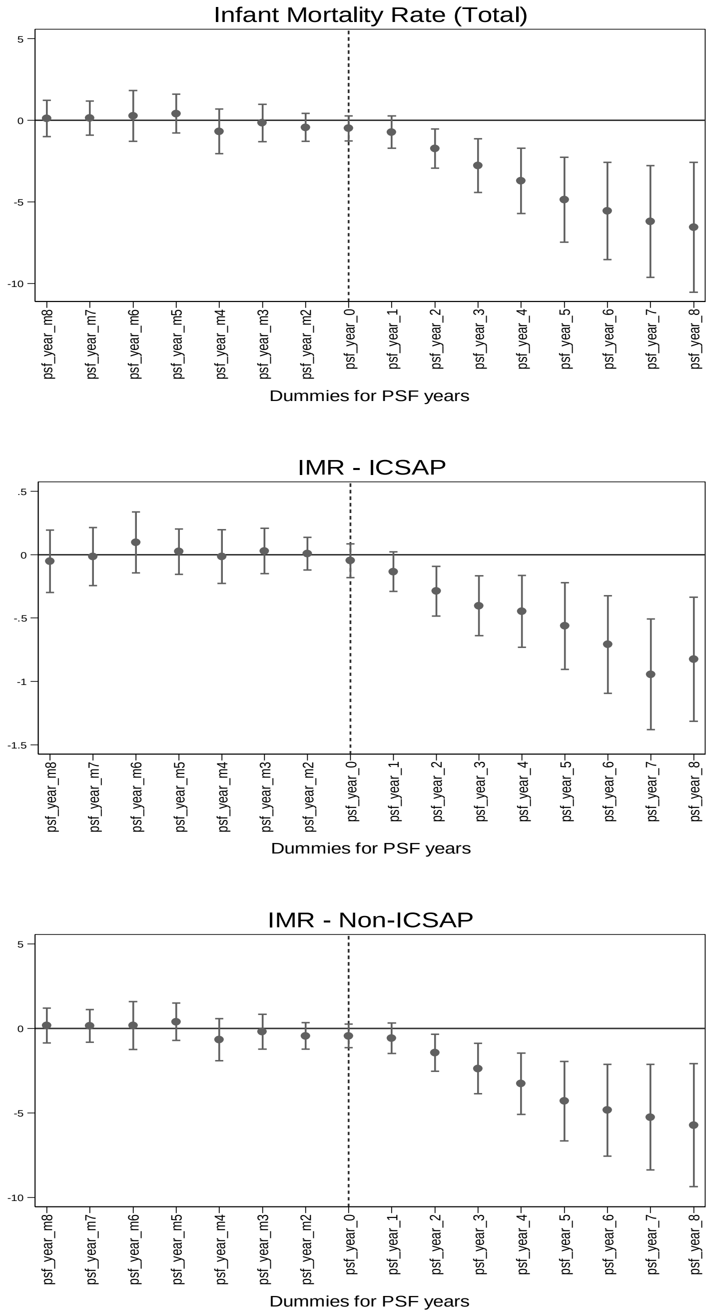
Hospitalization - Diabetes

Figure 4: PSF Effects on Female Mortality (FM) and Maternal Mortality (MMR) Rates



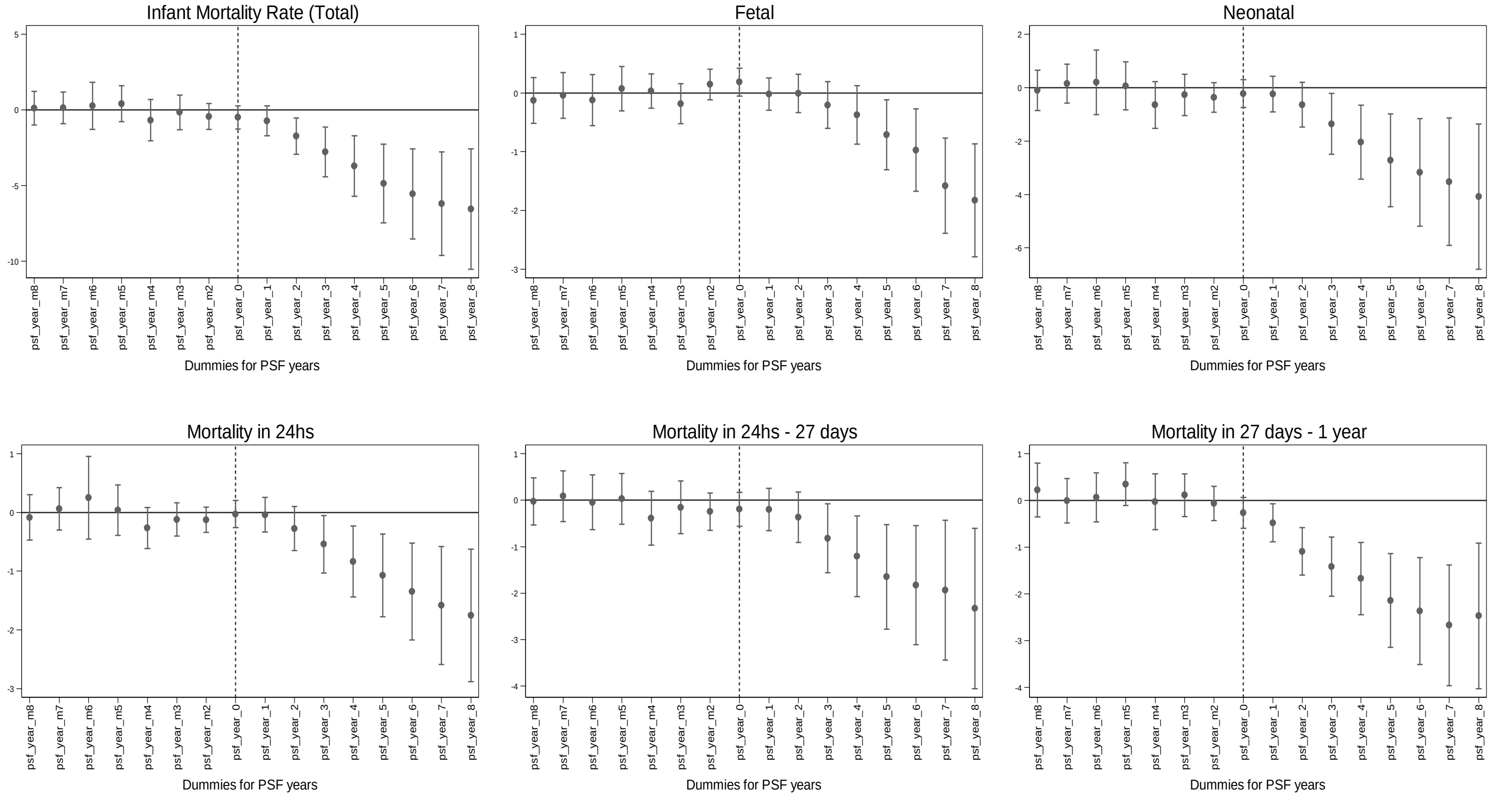
Note: Each figure plots together the estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors, based on the estimation of equation 2. The tables with the estimates are presented for the interested reader in the Appendix C.

Figure 5: PSF Effects on Infant Mortality Rate (Total and By Cause of Death)



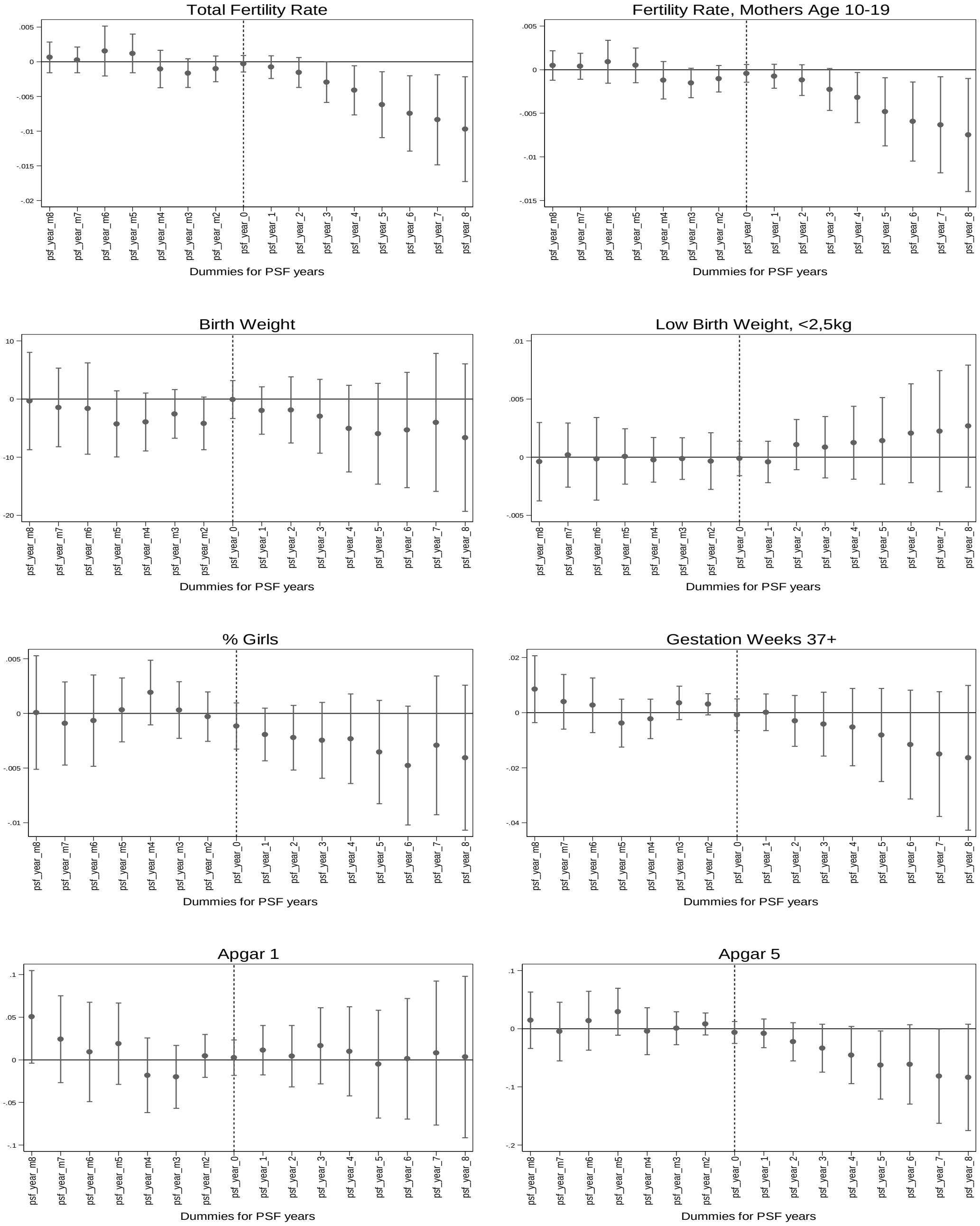
Note: Each figure plots together the estimated coefficients $\beta^{h}_{pre,i}s$ and $\beta^{h}_{j}s$ and their respective standard errors, based on the estimation of equation 2. The tables with the estimates are presented for the interested reader in the Appendix C.

Figure 6: PSF Effects on Infant Mortality Rate, By Timing of Death



Note: Each figure plots together the estimated coefficients $\beta^{h}_{pre,i}s$ and $\beta^{h}_{j}s$ and their respective standard errors, based on the estimation of equation 2. The tables with the estimates are presented for the interested reader in the Appendix C.

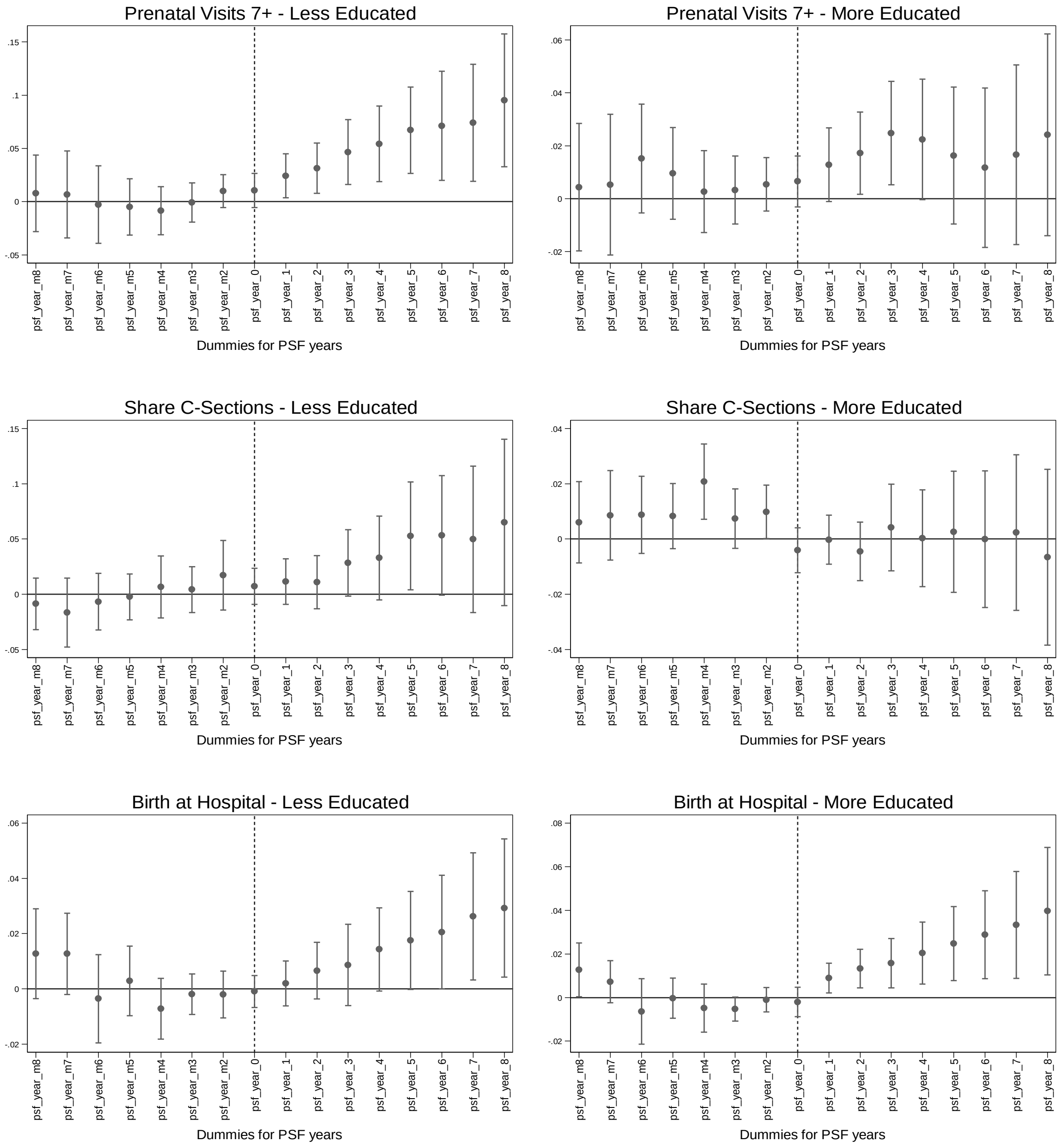
Figure 7: PSF Effects on Other Birth Outcomes



Note: Each figure plots together the estimated coefficients $\beta^{h}_{pre,i}s$ and $\beta^{h}_{j}s$ and their respective standard errors, based on the estimation of equation 2. The tables with the estimates are presented for the interested reader in the Appendix C.

Figure 8: Inequality in Access to Health Services and Health Outcomes

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



Prenatal Visits 7+ - Less Educated

Prenatal Visits 7+ - More Educated

Share C-Sections - Less Educated

Share C-Sections - More Educated

Birth at Hospital - Less Educated

Birth at Hospital - More Educated

Note: Each figure plots together the estimated coefficients $\beta^{h}_{pre,i}s$ and $\beta^{h}_{j}s$ and their respective standard errors, based on the estimation of equation 2. The tables with the estimates are presented for the interested reader in the Appendix C.

(b) PSF Effects on Health Outcomes by Education of the Mother

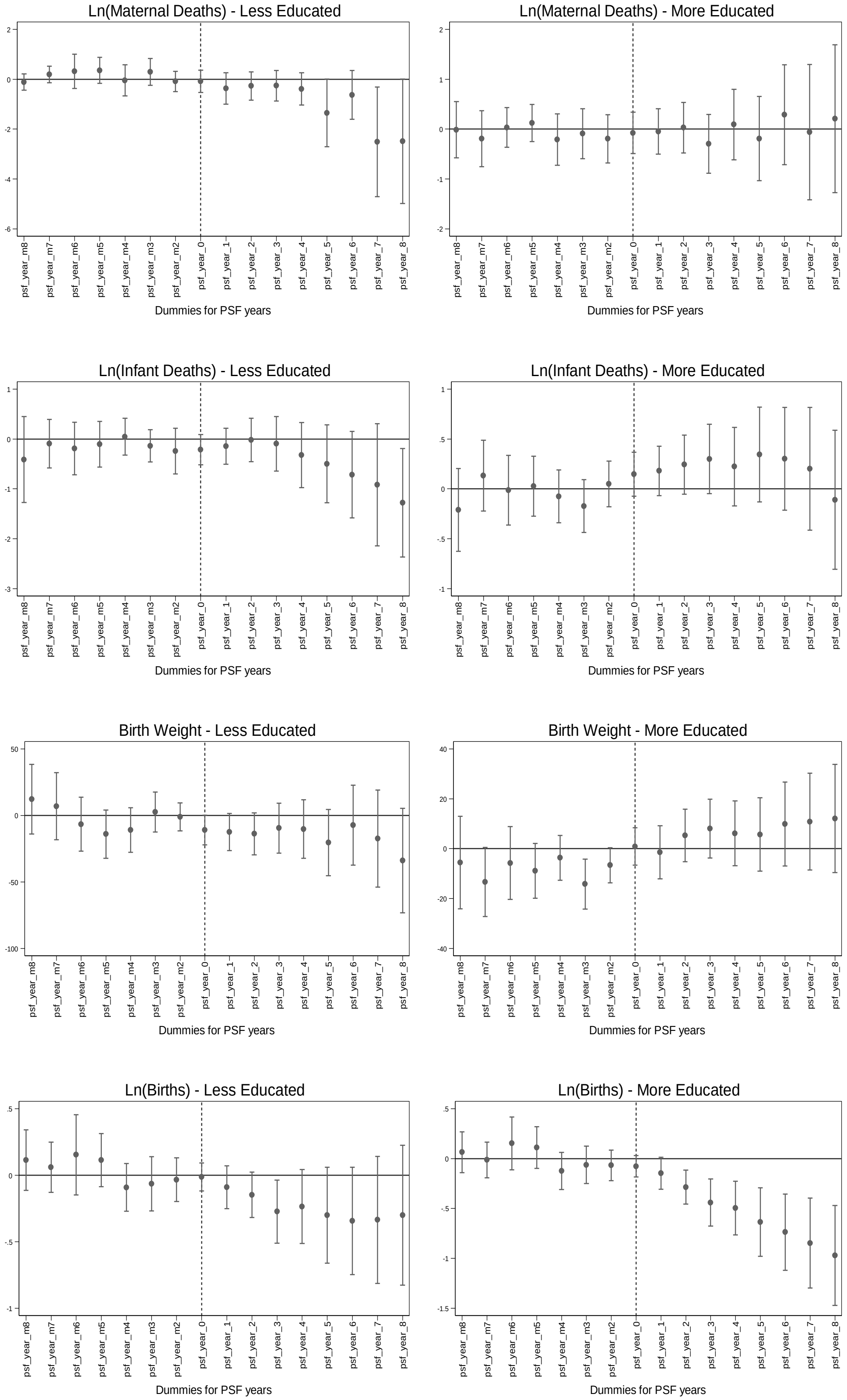
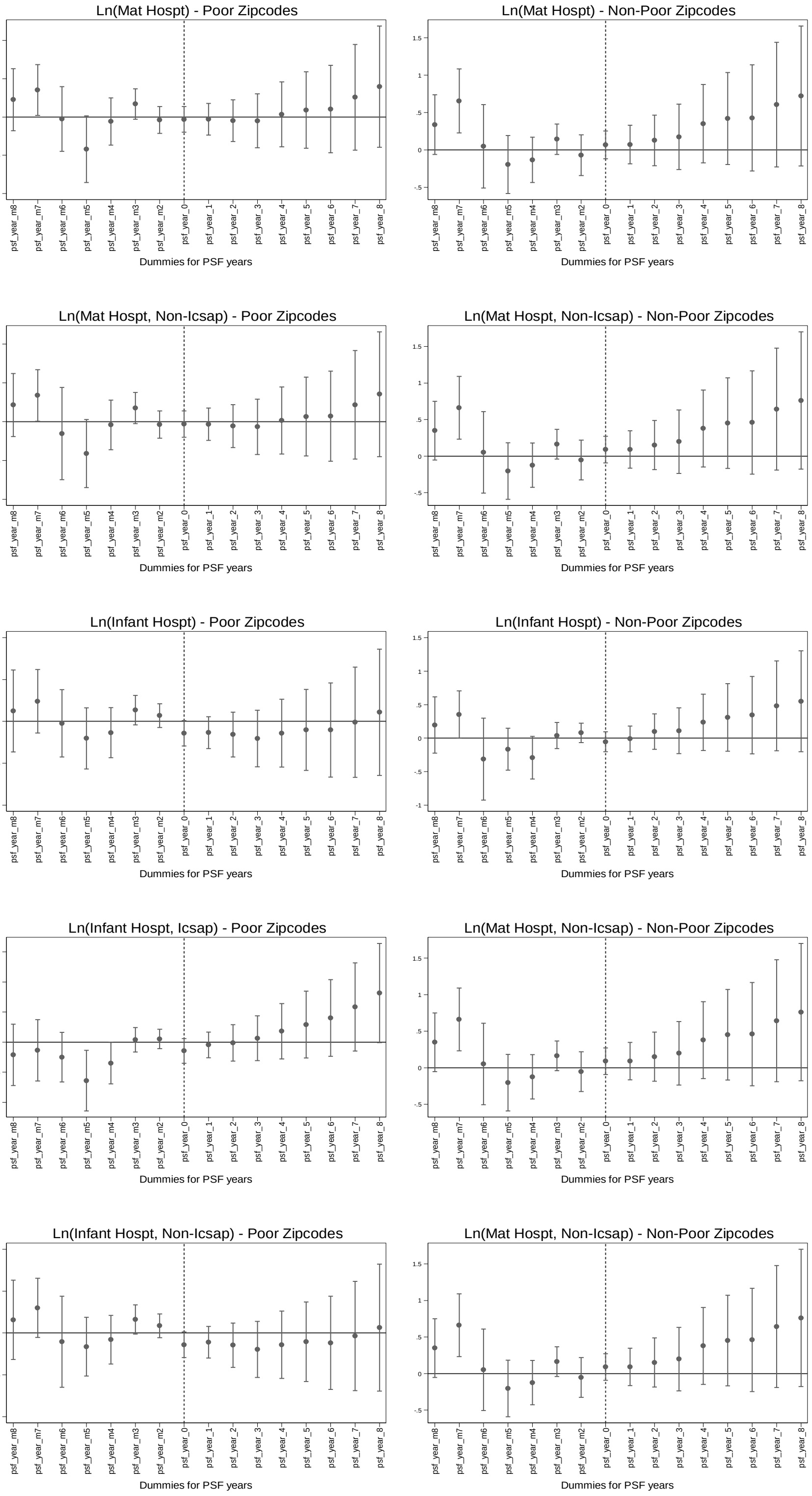


Figure 9: PSF Effects on Maternal (MHR) and Infant (IHR) Hospitalization Rates by Zipcode SES (in Logarithm)


Ln(Mat Hospt) - Poor Zipcodes

Ln(Mat Hospt) - Non-Poor Zipcodes

Ln(Mat Hospt, Non-Icsap) - Poor Zipcodes

Ln(Mat Hospt, Non-Icsap) - Non-Poor Zipcodes

Ln(Infant Hospt) - Poor Zipcodes

Ln(Infant Hospt) - Non-Poor Zipcodes

Ln(Infant Hospt, Icsap) - Poor Zipcodes

Ln(Mat Hospt, Non-Icsap) - Non-Poor Zipcodes

Ln(Infant Hospt, Non-Icsap) - Poor Zipcodes

Ln(Mat Hospt, Non-Icsap) - Non-Poor Zipcodes

C Additional Material: Regression Tables

Table B.1: Number of Ambulatory Facilities (all rates calculated per 1000 women age 10-49 years old)

	PSF Population Coverage (1)	Share of Children 0-1y Covered by PSF (2)	Number of Health Facilities With PSF GP (3)	Number of PSF Teams Per Capita (4)
PSF-Year -8	-0.012	0.187	0.008	-0.001
	(0.009)	(0.098)*	(0.007)	(0.004)
PSF-Year -7	-0.002	0.237	0.004	0.002
	(0.012)	(0.118)**	(0.006)	(0.004)
PSF-Year -6	-0.010	0.211	-0.001	0.003
	(0.013)	(0.113)*	(0.006)	(0.004)
PSF -Year -5	-0.009	0.141	-0.018	0.002
	(0.012)	(0.099)	(0.008)**	(0.003)
PSF-Year -4	-0.044	0.146	-0.023	-0.004
	(0.016)***	(0.149)	(0.006)***	(0.003)
PSF-Year -3	-0.054	-0.140	-0.014	-0.010
	(0.011)***	(0.114)	(0.007)**	(0.003)***
PSF-Year -2	-0.036	-0.170	-0.004	-0.004
	(0.006)***	(0.084)**	(0.003)	(0.002)*
PSF-Year 0	0.085	0.877	0.076	0.065
	(0.009)***	(0.117)***	(0.007)***	(0.005)***
PSF-Year +1	0.146	1.972	0.133	0.080
	(0.012)***	(0.176)***	(0.009)***	(0.006)***
PSF-Year +2	0.204	2.528	0.172	0.093
	(0.019)***	(0.202)***	(0.011)***	(0.007)***
PSF-Year +3	0.248	2.995	0.196	0.101
	(0.024)***	(0.229)***	(0.014)***	(0.008)***
PSF-Year +4	0.288	3.207	0.193	0.106
	(0.025)***	(0.261)***	(0.015)***	(0.009)***
PSF-Year +5	0.346	3.433	0.195	0.115
	(0.027)***	(0.247)***	(0.017)***	(0.009)***
PSF-Year +6	0.404	3.747	0.208	0.127
	(0.029)***	(0.281)***	(0.020)***	(0.010)***
PSF-Year +7	0.439	3.967	0.196	0.130
	(0.035)***	(0.333)***	(0.025)***	(0.011)***
PSF-Year +8	0.462	4.166	0.198	0.134
	(0.039)***	(0.380)***	(0.026)***	(0.013)***
Observations	29,869	29,865	38,403	29,869
y_mean	0.247	3.395	0.258	0.126

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.2: Number of Ambulatory Facilities (all rates calculated per 1000 women age 10-49 years old)

	Total Expenditures, Except in Health (ln per capita) (1)	Expenditures in Health (ln per capita) (2)	N. of Facilities with Outpatient Service (3)	N. of Outpatient Procedures Per Capita (4)	N. of Educational Activities in Group Per Capita (5)	N. of Appoint. for Provision of Diaphragm per Fem 10-49y (6)	N. of Appoint. for Provision/Insertion of IUD per Fem 10-49y (7)
PSF - Year -8	0.007	0.006	0.015	-0.428	-0.004	-0.117	-0.147
	(0.019)	(0.047)	(0.020)	(0.242)*	(0.010)	(0.387)	(0.319)
PSF - Year -7	0.016	0.024	0.025	-0.176	-0.012	0.023	0.058
	(0.020)	(0.042)	(0.018)	(0.217)	(0.008)	(0.457)	(0.349)
PSF - Year -6	0.022	0.011	0.007	-0.075	0.007	-0.213	-0.356
	(0.019)	(0.043)	(0.016)	(0.176)	(0.017)	(0.457)	(0.375)
PSF - Year -5	0.040	0.015	-0.012	-0.238	0.004	-0.276	-0.577
	(0.019)**	(0.050)	(0.016)	(0.158)	(0.013)	(0.332)	(0.372)
PSF - Year -4	0.029	-0.078	-0.031	-0.301	-0.017	0.389	-0.134
	(0.017)*	(0.054)	(0.016)*	(0.154)*	(0.008)**	(0.531)	(0.355)
PSF - Year -3	-0.002	-0.020	-0.026	-0.290	-0.012	0.308	-0.164
	(0.020)	(0.049)	(0.014)*	(0.144)**	(0.007)*	(0.543)	(0.274)
PSF - Year -2	0.033	-0.022	-0.001	-0.198	0.000	-0.150	0.145
	(0.014)**	(0.021)	(0.007)	(0.096)**	(0.005)	(0.165)	(0.174)
PSF - Year 0	-0.011	0.123	0.036	0.436	0.013	-0.228	-0.121
	(0.016)	(0.041)***	(0.012)***	(0.104)***	(0.006)**	(0.254)	(0.226)
PSF - Year +1	0.009	0.205	0.042	0.656	0.017	-0.008	-0.235
	(0.020)	(0.036)***	(0.014)***	(0.149)***	(0.008)**	(0.323)	(0.292)
PSF - Year +2	-0.016	0.186	0.021	0.827	0.032	0.044	-0.129
	(0.021)	(0.040)***	(0.017)	(0.180)***	(0.010)***	(0.461)	(0.357)
PSF - Year +3	-0.002	0.194	0.015	1.018	0.044	-0.626	0.048
	(0.028)	(0.053)***	(0.021)	(0.203)***	(0.013)***	(0.474)	(0.684)
PSF - Year +4	-0.069	0.172	-0.005	1.165	0.038	0.471	0.131
	(0.029)**	(0.073)**	(0.028)	(0.241)***	(0.016)**	(0.931)	(0.668)
PSF - Year +5	-0.042	0.199	-0.012	1.561	0.045	0.466	-0.741
	(0.042)	(0.086)**	(0.032)	(0.300)***	(0.021)**	(1.296)	(0.547)
PSF - Year +6	-0.058	0.201	-0.026	2.114	0.026	-0.098	-0.358
	(0.048)	(0.087)**	(0.040)	(0.342)***	(0.019)	(0.887)	(0.660)
PSF - Year +7	-0.014	0.190	-0.090	2.499	0.037	-0.235	-0.472
	(0.063)	(0.105)*	(0.056)	(0.439)***	(0.021)*	(0.945)	(0.936)
PSF - Year +8	-0.024	0.123	-0.062	2.832	0.042	0.007	-0.506
	(0.071)	(0.105)	(0.051)	(0.642)***	(0.026)	(1.158)	(1.037)
Observations	35,676	35,364	38,403	38,403	38,403	38,403	38,403
y_mean	6.511	5.137	1.561	10.21	0.0914	1.190	1.127

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.3: Number of Ambulatory Facilities (all rates calculated per 1000 women age 10-49 years old)

	Dummy for Hospital	Hospital Beds per Capita	N. of Health Facilities With Obstetric / Gineco Services	N. of Health Facilities With Pediatrician	N. of Pediatric Appointments per Children 0-1y	N. of Gyneco-Obstetrical Appointments per Fem 10-49y	N. of Gynecological Appointments per Fem 10-49y
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
PSF - Year -8	-0.013	-0.022	-0.006	-0.006	-1.288	11.957	-33.493
	(0.018)	(0.068)	(0.009)	(0.008)	(0.940)	(17.987)	(28.875)
PSF - Year -7	0.008	0.012	0.004	-0.003	-0.882	38.141	-20.928
	(0.009)	(0.066)	(0.007)	(0.007)	(0.672)	(20.055)*	(24.756)
PSF - Year -6	0.010	-0.013	-0.002	-0.006	0.088	34.211	-19.071
	(0.009)	(0.065)	(0.007)	(0.007)	(0.742)	(24.098)	(21.742)
PSF - Year -5	0.005	-0.044	-0.008	-0.011	-0.109	5.654	17.353
	(0.008)	(0.056)	(0.007)	(0.007)	(0.586)	(17.448)	(17.616)
PSF - Year -4	0.006	0.003	-0.007	-0.008	0.562	-0.114	31.403
	(0.006)	(0.049)	(0.007)	(0.006)	(0.607)	(15.291)	(15.899)**
PSF - Year -3	0.005	0.000	-0.004	-0.004	0.279	-2.626	25.614
	(0.005)	(0.036)	(0.005)	(0.006)	(0.477)	(13.050)	(20.605)
PSF - Year -2	0.005	0.028	-0.001	-0.001	-0.242	-10.585	7.987
	(0.003)*	(0.019)	(0.004)	(0.004)	(0.328)	(12.401)	(10.739)
PSF - Year 0	-0.000	-0.027	0.002	-0.001	0.221	-0.483	2.039
	(0.003)	(0.020)	(0.004)	(0.004)	(0.364)	(10.817)	(15.101)
PSF - Year +1	-0.006	-0.038	-0.013	-0.020	-0.880	2.470	-12.337
	(0.004)	(0.034)	(0.005)**	(0.005)***	(0.550)	(17.879)	(19.968)
PSF - Year +2	-0.009	-0.059	-0.035	-0.046	-2.016	-21.711	-27.717
	(0.006)	(0.047)	(0.006)***	(0.006)***	(0.640)***	(18.937)	(21.349)
PSF - Year +3	-0.012	-0.090	-0.048	-0.062	-2.610	-30.984	-42.425
	(0.008)	(0.062)	(0.007)***	(0.007)***	(0.766)***	(22.620)	(23.915)*
PSF - Year +4	-0.017	-0.121	-0.058	-0.075	-3.148	-31.119	-52.053
	(0.009)*	(0.078)	(0.009)***	(0.009)***	(0.873)***	(25.785)	(27.864)*
PSF - Year +5	-0.016	-0.134	-0.069	-0.085	-3.950	-39.287	-68.746
	(0.011)	(0.095)	(0.011)***	(0.010)***	(1.155)***	(28.540)	(32.751)**
PSF - Year +6	-0.022	-0.267	-0.073	-0.092	-4.005	-49.201	-54.687
	(0.013)*	(0.114)**	(0.012)***	(0.012)***	(1.485)***	(31.399)	(38.508)
PSF - Year +7	-0.017	-0.421	-0.103	-0.108	-4.475	-56.056	-64.314
	(0.015)	(0.136)***	(0.021)***	(0.014)***	(1.770)**	(34.668)	(44.065)
PSF - Year +8	-0.031	-0.290	-0.085	-0.109	-4.724	-60.871	-77.621
	(0.018)*	(0.146)**	(0.016)***	(0.016)***	(2.172)**	(39.461)	(51.254)
Observations	38,403	38,403	38,403	38,403	29,865	29,869	29,869
y_mean	0.757	2.456	0.344	0.280	11.89	131.2	228.2

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}$s and β^h_js and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.4: Prenatal, Delivery Conditions and Hospitalization Rates

	Prenatal Visits 6-	Prenatal Visits 7+	Birth at Hospital	Share C-Sections	MHR: ICD10="O" (Non Deliveries)	MHR Non-ICSAP	IHR (Total)	IHR ICSAP	IHR Non-ICSAP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PSF - Year -8	-0.001	0.005	0.008	0.002	-0.704	-0.692	-0.660	-2.079	1.419
	(0.012)	(0.012)	(0.006)	(0.005)	(0.624)	(0.620)	(6.099)	(3.568)	(4.402)
PSF - Year -7	-0.011	0.009	0.004	0.002	-0.136	-0.124	-2.297	-6.009	3.711
	(0.013)	(0.013)	(0.005)	(0.004)	(0.578)	(0.574)	(5.912)	(3.019)**	(4.648)
PSF - Year -6	-0.003	0.003	-0.005	0.000	0.591	0.577	3.387	-2.295	5.682
	(0.010)	(0.010)	(0.008)	(0.007)	(0.681)	(0.670)	(6.043)	(2.984)	(4.849)
PSF - Year -5	-0.011	0.003	0.004	0.000	-0.281	-0.306	3.266	-1.440	4.706
	(0.009)	(0.009)	(0.005)	(0.005)	(0.822)	(0.812)	(5.586)	(2.605)	(4.863)
PSF - Year -4	-0.001	-0.004	-0.002	0.015	0.062	0.062	2.611	-0.492	3.103
	(0.008)	(0.007)	(0.004)	(0.009)*	(0.445)	(0.443)	(5.066)	(2.241)	(4.354)
PSF - Year -3	-0.006	0.008	-0.003	0.010	0.570	0.581	3.054	0.421	2.634
	(0.007)	(0.007)	(0.003)	(0.007)	(0.297)*	(0.296)**	(4.512)	(1.783)	(3.753)
PSF - Year -2	-0.008	0.007	-0.002	0.011	-0.270	-0.266	3.705	1.046	2.659
	(0.005)	(0.005)	(0.002)	(0.007)	(0.301)	(0.298)	(3.168)	(1.169)	(2.710)
PSF - Year 0	-0.013	0.009	-0.001	0.003	0.357	0.349	-4.918	-2.681	-2.237
	(0.005)**	(0.005)*	(0.002)	(0.004)	(0.201)*	(0.199)*	(2.851)*	(1.343)**	(2.397)
PSF - Year +1	-0.014	0.015	0.004	0.006	0.796	0.789	-2.071	-2.932	0.861
	(0.006)**	(0.007)**	(0.003)	(0.005)	(0.305)***	(0.302)***	(3.814)	(1.796)	(3.254)
PSF - Year +2	-0.024	0.024	0.006	0.007	0.564	0.558	-6.632	-5.133	-1.499
	(0.008)***	(0.009)***	(0.004)*	(0.006)	(0.401)	(0.396)	(4.915)	(2.446)**	(4.012)
PSF - Year +3	-0.032	0.034	0.008	0.017	1.026	1.007	-6.914	-6.963	0.049
	(0.010)***	(0.011)***	(0.005)*	(0.008)**	(0.525)*	(0.519)*	(6.247)	(3.009)**	(5.080)
PSF - Year +4	-0.037	0.042	0.010	0.020	1.349	1.324	-5.385	-6.228	0.843
	(0.012)***	(0.013)***	(0.006)*	(0.010)**	(0.659)**	(0.654)**	(7.221)	(3.498)*	(5.902)
PSF - Year +5	-0.033	0.043	0.012	0.030	1.777	1.730	-4.925	-6.651	1.726
	(0.016)**	(0.015)***	(0.007)*	(0.013)**	(0.807)**	(0.798)**	(8.978)	(4.163)	(7.149)
PSF - Year +6	-0.031	0.046	0.014	0.033	2.099	2.049	1.136	-4.591	5.727
	(0.020)	(0.017)***	(0.008)*	(0.014)**	(0.952)**	(0.938)**	(11.520)	(5.084)	(8.905)
PSF - Year +7	-0.031	0.054	0.016	0.036	2.925	2.858	9.852	-2.416	12.268
	(0.025)	(0.019)***	(0.009)*	(0.017)**	(1.148)**	(1.130)**	(15.746)	(6.614)	(11.496)
PSF - Year +8	-0.038	0.070	0.019	0.033	4.050	3.963	19.169	1.687	17.482
	(0.027)	(0.021)***	(0.010)*	(0.019)*	(1.290)***	(1.261)***	(19.463)	(8.314)	(13.662)
Observations	38,266	38,189	38,258	38,259	29,869	29,869	29,865	29,865	29,865
y_mean	0.492	0.454	0.949	0.362	8.582	8.431	220.9	81.39	139.5

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.5: Hospitalization Rates - all individuals aged 50+ per 1000

	All	ICSAP	Non-ICSAP	Neoplasms	Diabetes Mellitus	CVD
	(1)	(2)	(3)	(4)	(5)	(6)
PSF - Year -8	2.737	1.111	1.626	0.168	0.066	1.138
	(4.060)	(1.593)	(3.307)	(0.559)	(0.256)	(1.396)
PSF - Year -7	-0.141	-0.564	0.423	0.061	0.044	0.164
	(4.423)	(1.631)	(3.627)	(0.625)	(0.251)	(1.311)
PSF - Year -6	2.021	0.122	1.899	0.508	0.158	0.494
	(3.859)	(1.483)	(3.045)	(0.484)	(0.248)	(1.070)
PSF - Year -5	4.375	0.765	3.610	0.165	0.052	0.604
	(3.563)	(1.222)	(2.859)	(0.396)	(0.200)	(1.137)
PSF - Year -4	5.357	1.479	3.878	0.197	0.187	0.905
	(2.883)*	(1.050)	(2.189)*	(0.365)	(0.181)	(0.979)
PSF - Year -3	4.089	1.526	2.563	0.065	0.084	1.042
	(2.095)*	(0.837)*	(1.530)*	(0.276)	(0.136)	(0.699)
PSF - Year -2	2.360	0.965	1.395	0.232	0.168	0.553
	(1.251)*	(0.493)*	(0.929)	(0.176)	(0.091)*	(0.456)
PSF - Year 0	-0.897	-0.505	-0.393	-0.111	-0.162	-0.084
	(1.305)	(0.522)	(1.024)	(0.170)	(0.081)**	(0.403)
PSF - Year +1	-1.028	-0.633	-0.395	-0.128	-0.191	-0.091
	(2.055)	(0.735)	(1.674)	(0.270)	(0.117)	(0.560)
PSF - Year +2	-2.482	-1.033	-1.449	-0.099	-0.285	-0.443
	(2.831)	(0.965)	(2.309)	(0.372)	(0.167)*	(0.744)
PSF - Year +3	-2.738	-1.425	-1.313	-0.069	-0.382	-0.534
	(3.445)	(1.223)	(2.781)	(0.476)	(0.204)*	(0.919)
PSF - Year +4	-1.387	-1.320	-0.067	0.121	-0.507	-0.000
	(4.200)	(1.489)	(3.398)	(0.578)	(0.243)**	(1.118)
PSF - Year +5	-0.251	-1.534	1.283	0.284	-0.608	0.088
	(4.836)	(1.770)	(3.863)	(0.672)	(0.285)**	(1.311)
PSF - Year +6	2.728	-0.478	3.206	0.471	-0.560	0.684
	(5.647)	(2.113)	(4.482)	(0.854)	(0.327)*	(1.520)
PSF - Year +7	6.279	1.625	4.654	0.440	-0.237	1.500
	(6.792)	(2.619)	(5.244)	(1.050)	(0.381)	(1.881)
PSF - Year +8	10.939	3.373	7.566	0.595	-0.328	3.055
	(7.744)	(3.007)	(5.954)	(1.400)	(0.424)	(2.202)
Observations	29,869	29,869	29,869	29,869	29,869	29,869
y_mean	179.9	67.96	111.9	7.862	4.279	49.23

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.6: Female Mortality (FM), Maternal Mortality (MMR) and Maternal Hospitalization (MHR) Rates

	Female Mortality Rate per 1000 women 10-49 years old	MMR (only ICD10="O") per 1000 women 10-49 years old	Female Mortality Rate per 1000 babies 0-1 year old	MMR (only ICD10="O") per 1000 babies 0-1 year old
	(1)	(2)	(3)	(4)
PSF - Year -8	-0.000	0.003	0.052	0.025
	(0.028)	(0.003)	(0.594)	(0.058)
PSF - Year -7	0.014	0.003	0.284	0.036
	(0.028)	(0.003)	(0.595)	(0.049)
PSF - Year -6	0.003	-0.001	0.257	-0.004
	(0.021)	(0.003)	(0.485)	(0.046)
PSF - Year -5	0.001	0.003	0.134	0.030
	(0.022)	(0.002)	(0.526)	(0.037)
PSF - Year -4	-0.040	-0.001	-0.923	-0.016
	(0.044)	(0.002)	(1.032)	(0.036)
PSF - Year -3	-0.016	0.003	-0.479	0.038
	(0.035)	(0.002)	(0.816)	(0.031)
PSF - Year -2	-0.042	0.001	-1.017	0.011
	(0.032)	(0.002)	(0.748)	(0.029)
PSF - Year 0	-0.024	-0.002	-0.608	-0.026
	(0.018)	(0.001)	(0.462)	(0.026)
PSF - Year +1	-0.037	0.001	-0.932	0.029
	(0.025)	(0.002)	(0.623)	(0.031)
PSF - Year +2	-0.052	-0.000	-1.357	-0.005
	(0.031)*	(0.002)	(0.733)*	(0.035)
PSF - Year +3	-0.075	-0.002	-1.987	-0.039
	(0.041)*	(0.002)	(0.989)**	(0.042)
PSF - Year +4	-0.103	-0.004	-2.805	-0.074
	(0.047)**	(0.003)	(1.145)**	(0.051)
PSF - Year +5	-0.157	-0.005	-4.088	-0.101
	(0.065)**	(0.003)	(1.511)***	(0.060)*
PSF - Year +6	-0.169	-0.004	-4.564	-0.092
	(0.069)**	(0.004)	(1.618)***	(0.071)
PSF - Year +7	-0.206	-0.012	-5.636	-0.240
	(0.081)**	(0.004)***	(1.863)***	(0.079)***
PSF - Year +8	-0.252	-0.010	-6.828	-0.210
	(0.094)***	(0.005)**	(2.183)***	(0.091)**
Observations	38,403	38,403	38,395	38,395
y_mean	0.962	0.0305	17.03	0.502

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.7: Infant Mortality Rate (all rates calculated per 1000 babies 0-1 year old)

	Infant Mortality Rate (Total)	ICSAP	Non-ICSAP
	(1)	(2)	(3)
PSF - Year -8	0.117	-0.051	0.168
	(0.570)	(0.126)	(0.523)
PSF - Year -7	0.139	-0.015	0.153
	(0.532)	(0.116)	(0.493)
PSF - Year -6	0.271	0.096	0.174
	(0.795)	(0.122)	(0.723)
PSF - Year -5	0.414	0.024	0.389
	(0.605)	(0.091)	(0.564)
PSF - Year -4	-0.677	-0.016	-0.661
	(0.697)	(0.108)	(0.633)
PSF - Year -3	-0.160	0.029	-0.190
	(0.584)	(0.092)	(0.526)
PSF - Year -2	-0.434	0.009	-0.444
	(0.438)	(0.066)	(0.403)
PSF - Year 0	-0.488	-0.047	-0.443
	(0.390)	(0.068)	(0.359)
PSF - Year +1	-0.721	-0.134	-0.587
	(0.500)	(0.079)*	(0.460)
PSF - Year +2	-1.731	-0.288	-1.443
	(0.614)***	(0.100)***	(0.557)***
PSF - Year +3	-2.776	-0.403	-2.374
	(0.836)***	(0.121)***	(0.759)***
PSF - Year +4	-3.715	-0.447	-3.269
	(1.019)***	(0.145)***	(0.924)***
PSF - Year +5	-4.862	-0.562	-4.301
	(1.322)***	(0.175)***	(1.200)***
PSF - Year +6	-5.543	-0.709	-4.835
	(1.521)***	(0.196)***	(1.384)***
PSF - Year +7	-6.192	-0.944	-5.249
	(1.743)***	(0.223)***	(1.589)***
PSF - Year +8	-6.551	-0.825	-5.728
	(2.026)***	(0.250)***	(1.856)***
Observations	38,395	38,395	38,395
y_mean	18.14	1.777	16.37

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.8: Infant Mortality Rate, By Timing of Death

	Infant Mortality Rate (Total)	Fetal	Neonatal	Mortality in 24hs	24hs-27 days	27 days - 1 year
	(1)	(2)	(3)	(4)	(5)	(6)
PSF - Year -8	0.117	-0.129	-0.108	-0.085	-0.023	0.225
	(0.570)	(0.199)	(0.386)	(0.197)	(0.258)	(0.294)
PSF - Year -7	0.139	-0.042	0.145	0.059	0.086	-0.006
	(0.532)	(0.199)	(0.373)	(0.184)	(0.278)	(0.241)
PSF - Year -6	0.271	-0.120	0.203	0.249	-0.046	0.068
	(0.795)	(0.222)	(0.618)	(0.359)	(0.302)	(0.268)
PSF - Year -5	0.414	0.074	0.067	0.039	0.028	0.347
	(0.605)	(0.192)	(0.460)	(0.220)	(0.280)	(0.233)
PSF - Year -4	-0.677	0.033	-0.649	-0.262	-0.386	-0.028
	(0.697)	(0.149)	(0.445)	(0.178)	(0.296)	(0.304)
PSF - Year -3	-0.160	-0.184	-0.272	-0.119	-0.153	0.112
	(0.584)	(0.174)	(0.397)	(0.146)	(0.288)	(0.233)
PSF - Year -2	-0.434	0.146	-0.369	-0.125	-0.244	-0.065
	(0.438)	(0.133)	(0.282)	(0.110)	(0.205)	(0.188)
PSF - Year 0	-0.488	0.185	-0.223	-0.028	-0.196	-0.265
	(0.390)	(0.121)	(0.268)	(0.117)	(0.187)	(0.168)
PSF - Year +1	-0.721	-0.019	-0.240	-0.040	-0.201	-0.481
	(0.500)	(0.139)	(0.343)	(0.150)	(0.231)	(0.208)**
PSF - Year +2	-1.731	-0.008	-0.639	-0.275	-0.364	-1.092
	(0.614)***	(0.167)	(0.427)	(0.191)	(0.276)	(0.258)***
PSF - Year +3	-2.776	-0.206	-1.360	-0.541	-0.820	-1.416
	(0.836)***	(0.203)	(0.582)**	(0.250)**	(0.377)**	(0.323)***
PSF - Year +4	-3.715	-0.376	-2.043	-0.836	-1.207	-1.672
	(1.019)***	(0.254)	(0.709)***	(0.308)***	(0.442)***	(0.394)***
PSF - Year +5	-4.862	-0.712	-2.722	-1.072	-1.650	-2.140
	(1.322)***	(0.303)**	(0.887)***	(0.361)***	(0.572)***	(0.512)***
PSF - Year +6	-5.543	-0.972	-3.175	-1.345	-1.830	-2.367
	(1.521)***	(0.357)***	(1.025)***	(0.420)***	(0.653)***	(0.582)***
PSF - Year +7	-6.192	-1.578	-3.521	-1.583	-1.938	-2.670
	(1.743)***	(0.414)***	(1.217)***	(0.513)***	(0.767)**	(0.659)***
PSF - Year +8	-6.551	-1.826	-4.082	-1.753	-2.329	-2.470
	(2.026)***	(0.490)***	(1.386)***	(0.575)***	(0.880)***	(0.795)***
Observations	38,395	38,395	38,395	38,395	38,395	38,395
y_mean	18.14	4.770	10.92	4.206	6.715	7.225

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.9: Other Birth Outcomes

	Total Fertility Rate	Fertility Rate (Age 10-19)	Birth Weight	Low Birth Weight (<2,5k)	% Girls	Gestation Weeks 37+	Apgar 1	Apgar 5
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PSF - Year -8	0.001	0.000	-0.350	-0.000	0.000	0.009	0.050	0.015
	(0.001)	(0.001)	(4.263)	(0.002)	(0.003)	(0.006)	(0.028)*	(0.025)
PSF - Year -7	0.000	0.000	-1.444	0.000	-0.001	0.004	0.024	-0.005
	(0.001)	(0.001)	(3.444)	(0.001)	(0.002)	(0.005)	(0.026)	(0.026)
PSF - Year -6	0.002	0.001	-1.642	-0.000	-0.001	0.003	0.009	0.014
	(0.002)	(0.001)	(4.006)	(0.002)	(0.002)	(0.005)	(0.030)	(0.026)
PSF - Year -5	0.001	0.000	-4.276	0.000	0.000	-0.004	0.019	0.029
	(0.001)	(0.001)	(2.897)	(0.001)	(0.001)	(0.004)	(0.024)	(0.021)
PSF - Year -4	-0.001	-0.001	-3.935	-0.000	0.002	-0.002	-0.018	-0.004
	(0.001)	(0.001)	(2.541)	(0.001)	(0.002)	(0.004)	(0.022)	(0.021)
PSF - Year -3	-0.002	-0.002	-2.557	-0.000	0.000	0.004	-0.020	0.001
	(0.001)	(0.001)*	(2.136)	(0.001)	(0.001)	(0.003)	(0.019)	(0.014)
PSF - Year -2	-0.001	-0.001	-4.194	-0.000	-0.000	0.003	0.005	0.008
	(0.001)	(0.001)	(2.311)*	(0.001)	(0.001)	(0.002)	(0.013)	(0.010)
PSF - Year 0	-0.000	-0.000	-0.095	-0.000	-0.001	-0.001	0.003	-0.006
	(0.001)	(0.001)	(1.660)	(0.001)	(0.001)	(0.003)	(0.011)	(0.010)
PSF - Year +1	-0.001	-0.001	-1.979	-0.000	-0.002	0.000	0.011	-0.008
	(0.001)	(0.001)	(2.084)	(0.001)	(0.001)	(0.003)	(0.015)	(0.013)
PSF - Year +2	-0.002	-0.001	-1.876	0.001	-0.002	-0.003	0.004	-0.022
	(0.001)	(0.001)	(2.909)	(0.001)	(0.002)	(0.005)	(0.018)	(0.017)
PSF - Year +3	-0.003	-0.002	-2.953	0.001	-0.002	-0.004	0.016	-0.033
	(0.001)**	(0.001)*	(3.238)	(0.001)	(0.002)	(0.006)	(0.023)	(0.021)
PSF - Year +4	-0.004	-0.003	-5.075	0.001	-0.002	-0.005	0.010	-0.045
	(0.002)**	(0.001)**	(3.803)	(0.002)	(0.002)	(0.007)	(0.027)	(0.025)*
PSF - Year +5	-0.006	-0.005	-5.987	0.001	-0.004	-0.008	-0.005	-0.063
	(0.002)**	(0.002)**	(4.425)	(0.002)	(0.002)	(0.009)	(0.032)	(0.030)**
PSF - Year +6	-0.007	-0.006	-5.338	0.002	-0.005	-0.012	0.001	-0.061
	(0.003)***	(0.002)**	(5.059)	(0.002)	(0.003)*	(0.010)	(0.036)	(0.035)*
PSF - Year +7	-0.008	-0.006	-4.030	0.002	-0.003	-0.015	0.008	-0.082
	(0.003)**	(0.003)**	(6.054)	(0.003)	(0.003)	(0.012)	(0.043)	(0.041)**
PSF - Year +8	-0.010	-0.007	-6.643	0.003	-0.004	-0.016	0.003	-0.084
	(0.004)**	(0.003)**	(6.477)	(0.003)	(0.003)	(0.013)	(0.048)	(0.047)*
Observations	38,403	38,403	38,259	38,259	38,264	38,238	38,077	38,041
y_mean	0.0506	0.0375	3220	0.0720	0.487	0.937	8.067	9.208

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.10: Inequality in Access by Education of the Mother

	Low Educated Mothers (without any schooling)			High Educated Mothers (with incomplete secondary or higher)		
	Prenatal Visits 7+	Birth at Hospital	Share C-Sections	Prenatal Visits 7+	Birth at Hospital	Share C-Sections
	(1)	(2)	(3)	(4)	(5)	(6)
PSF - Year -8	0.008	0.013	-0.009	0.004	0.013	0.006
	(0.018)	(0.008)	(0.012)	(0.012)	(0.006)**	(0.008)
PSF - Year -7	0.007	0.013	-0.017	0.005	0.007	0.009
	(0.021)	(0.008)*	(0.016)	(0.014)	(0.005)	(0.008)
PSF - Year -6	-0.003	-0.004	-0.007	0.015	-0.006	0.009
	(0.019)	(0.008)	(0.013)	(0.010)	(0.008)	(0.007)
PSF - Year -5	-0.005	0.003	-0.002	0.010	-0.000	0.008
	(0.013)	(0.006)	(0.011)	(0.009)	(0.005)	(0.006)
PSF - Year -4	-0.008	-0.007	0.007	0.003	-0.005	0.021
	(0.011)	(0.006)	(0.014)	(0.008)	(0.006)	(0.007)***
PSF - Year -3	-0.001	-0.002	0.004	0.003	-0.005	0.007
	(0.009)	(0.004)	(0.011)	(0.007)	(0.003)*	(0.005)
PSF - Year -2	0.010	-0.002	0.017	0.005	-0.001	0.010
	(0.008)	(0.004)	(0.016)	(0.005)	(0.003)	(0.005)**
PSF - Year 0	0.010	-0.001	0.007	0.007	-0.002	-0.004
	(0.008)	(0.003)	(0.008)	(0.005)	(0.003)	(0.004)
PSF - Year +1	0.024	0.002	0.011	0.013	0.009	-0.000
	(0.011)**	(0.004)	(0.011)	(0.007)*	(0.003)**	(0.005)
PSF - Year +2	0.031	0.007	0.011	0.017	0.013	-0.004
	(0.012)***	(0.005)	(0.012)	(0.008)**	(0.005)***	(0.005)
PSF - Year +3	0.047	0.009	0.028	0.025	0.016	0.004
	(0.016)***	(0.007)	(0.015)*	(0.010)**	(0.006)***	(0.008)
PSF - Year +4	0.054	0.014	0.033	0.022	0.020	0.000
	(0.018)***	(0.008)*	(0.019)*	(0.012)*	(0.007)***	(0.009)
PSF - Year +5	0.067	0.018	0.053	0.016	0.025	0.003
	(0.021)***	(0.009)*	(0.025)**	(0.013)	(0.009)***	(0.011)
PSF - Year +6	0.071	0.021	0.053	0.012	0.029	-0.000
	(0.026)***	(0.010)*	(0.028)*	(0.015)	(0.010)***	(0.013)
PSF - Year +7	0.074	0.026	0.050	0.017	0.033	0.002
	(0.028)***	(0.012)**	(0.034)	(0.017)	(0.013)***	(0.014)
PSF - Year +8	0.095	0.029	0.065	0.024	0.040	-0.007
	(0.032)***	(0.013)**	(0.038)*	(0.019)	(0.015)***	(0.016)
Observations	32,563	32,979	32,951	36,358	36,575	36,564
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 $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.11: Inequality in Outcomes by Education of the Mother

	Less Educated Mothers (without any schooling)					More Educated Mothers (with incomplete secondary or higher)				
	Ln (maternal deaths)	Ln (infant deaths)	Ln(births)	Share Female Births	Birth Weight	Ln (maternal deaths)	Ln (infant deaths)	Ln(births)	Share Female Births	Birth Weight
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
PSF - Year -8	-0.113	-0.411	0.113	-0.012	12.177	-0.013	-0.211	0.064	0.004	-5.566
	(0.167)	(0.441)	(0.116)	(0.011)	(13.362)	(0.288)	(0.211)	(0.104)	(0.009)	(9.440)
PSF - Year -7	0.193	-0.094	0.060	-0.005	6.900	-0.193	0.133	-0.013	0.008	-13.373
	(0.170)	(0.247)	(0.097)	(0.011)	(12.883)	(0.286)	(0.181)	(0.091)	(0.007)	(7.053)*
PSF - Year -6	0.320	-0.189	0.153	-0.008	-6.565	0.033	-0.014	0.152	0.003	-5.749
	(0.352)	(0.269)	(0.154)	(0.009)	(10.318)	(0.203)	(0.178)	(0.135)	(0.006)	(7.450)
PSF - Year -5	0.355	-0.105	0.114	-0.004	-14.013	0.124	0.027	0.111	0.005	-8.840
	(0.264)	(0.233)	(0.102)	(0.008)	(9.238)	(0.190)	(0.153)	(0.106)	(0.006)	(5.603)
PSF - Year -4	-0.043	0.047	-0.092	-0.006	-10.905	-0.210	-0.075	-0.124	-0.001	-3.641
	(0.319)	(0.189)	(0.092)	(0.006)	(8.556)	(0.263)	(0.135)	(0.095)	(0.004)	(4.585)
PSF - Year -3	0.297	-0.136	-0.064	-0.005	2.512	-0.091	-0.172	-0.063	-0.004	-14.192
	(0.276)	(0.164)	(0.104)	(0.006)	(7.644)	(0.255)	(0.136)	(0.095)	(0.004)	(5.109)***
PSF - Year -2	-0.086	-0.241	-0.034	-0.001	-1.082	-0.192	0.050	-0.068	-0.000	-6.607
	(0.207)	(0.233)	(0.084)	(0.004)	(5.331)	(0.247)	(0.116)	(0.078)	(0.004)	(3.601)*
PSF - Year 0	-0.083	-0.213	-0.013	0.003	-11.003	-0.075	0.147	-0.077	-0.003	0.900
	(0.230)	(0.155)	(0.054)	(0.005)	(5.675)*	(0.211)	(0.112)	(0.055)	(0.003)	(3.817)
PSF - Year +1	-0.368	-0.143	-0.090	0.007	-12.516	-0.048	0.181	-0.146	-0.002	-1.421
	(0.321)	(0.184)	(0.082)	(0.007)	(7.106)*	(0.232)	(0.127)	(0.082)*	(0.004)	(5.416)
PSF - Year +2	-0.268	-0.018	-0.147	0.008	-13.839	0.030	0.243	-0.286	-0.003	5.283
	(0.289)	(0.221)	(0.087)*	(0.007)	(8.066)*	(0.259)	(0.151)	(0.087)***	(0.004)	(5.381)
PSF - Year +3	-0.261	-0.095	-0.273	0.011	-9.486	-0.296	0.299	-0.440	-0.007	8.031
	(0.314)	(0.280)	(0.121)**	(0.009)	(9.590)	(0.300)	(0.177)*	(0.120)***	(0.006)	(6.008)
PSF - Year +4	-0.388	-0.320	-0.235	0.015	-10.206	0.093	0.224	-0.495	-0.005	6.175
	(0.329)	(0.333)	(0.142)*	(0.010)	(11.213)	(0.361)	(0.200)	(0.138)***	(0.006)	(6.625)
PSF - Year +5	-1.349	-0.498	-0.301	0.020	-20.434	-0.190	0.345	-0.637	-0.007	5.720
	(0.694)*	(0.398)	(0.184)	(0.012)*	(12.739)	(0.432)	(0.242)	(0.175)***	(0.006)	(7.486)
PSF - Year +6	-0.628	-0.715	-0.344	0.016	-7.372	0.288	0.302	-0.737	-0.009	9.892
	(0.502)	(0.442)	(0.206)*	(0.014)	(15.352)	(0.510)	(0.263)	(0.195)***	(0.008)	(8.602)
PSF - Year +7	-2.514	-0.917	-0.336	0.011	-17.394	-0.062	0.203	-0.847	-0.004	10.855
	(1.121)**	(0.625)	(0.243)	(0.017)	(18.585)	(0.692)	(0.314)	(0.230)***	(0.009)	(9.920)
PSF - Year +8	-2.485	-1.281	-0.301	0.024	-33.912	0.208	-0.110	-0.972	-0.006	12.099
	(1.273)*	(0.555)**	(0.269)	(0.019)	(20.043)*	(0.756)	(0.355)	(0.255)***	(0.010)	(11.061)
Observations	38,403	38,403	38,403	32,985	32,911	38,403	38,403	38,403	36,578	36,558
y_mean				0.487	3171				0.487	3259

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^{h}_{pre,i}$s and β^{h}_{j}s and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.

Table B.12: Maternal (MHR) and Infant (IHR) Hospitalization Rates - in Ln(Number)

	Maternal Hospitalization Rate: ICD10="O"			Infant Hospitalization Rate			Maternal Hospitalization Rate: ICD10="O"			Infant Hospitalization Rate		
	Total (Non Deliveries)	ICSAP	Non-ICSAP	Total	ICSAP	Non-ICSAP	Total (Non Deliveries)	ICSAP	Non-ICSAP	Total	ICSAP	Non-ICSAP
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
	Poor Zipcodes						**Non-Poor Zipcodes**					
PSF - Year -8	0.227	0.550	0.214	0.124	-0.211	0.157	0.337	0.021	0.348	0.195	0.093	0.216
	(0.207)	(0.362)	(0.207)	(0.250)	(0.260)	(0.242)	(0.204)*	(0.422)	(0.205)*	(0.214)	(0.225)	(0.203)
PSF - Year -7	0.353	0.494	0.338	0.240	-0.137	0.300	0.655	0.614	0.661	0.353	0.133	0.359
	(0.169)**	(0.262)*	(0.169)**	(0.193)	(0.260)	(0.181)*	(0.218)***	(0.306)**	(0.219)***	(0.179)**	(0.213)	(0.177)**
PSF - Year -6	-0.026	-0.236	-0.155	-0.024	-0.250	-0.106	0.047	0.195	0.052	-0.314	-0.330	-0.242
	(0.216)	(0.332)	(0.303)	(0.205)	(0.211)	(0.278)	(0.284)	(0.300)	(0.284)	(0.312)	(0.279)	(0.295)
PSF - Year -5	-0.421	-0.491	-0.412	-0.203	-0.640	-0.164	-0.196	-0.012	-0.204	-0.166	-0.363	-0.134
	(0.222)*	(0.265)*	(0.223)*	(0.186)	(0.256)**	(0.179)	(0.197)	(0.313)	(0.197)	(0.160)	(0.209)*	(0.156)
PSF - Year -4	-0.058	-0.067	-0.041	-0.135	-0.349	-0.080	-0.133	-0.085	-0.125	-0.291	-0.338	-0.292
	(0.157)	(0.217)	(0.163)	(0.152)	(0.175)**	(0.148)	(0.155)	(0.232)	(0.154)	(0.163)*	(0.185)*	(0.167)*
PSF - Year -3	0.170	-0.101	0.175	0.135	0.039	0.161	0.144	0.133	0.161	0.038	0.014	0.063
	(0.101)*	(0.180)	(0.102)*	(0.090)	(0.104)	(0.089)*	(0.104)	(0.153)	(0.104)	(0.099)	(0.102)	(0.097)
PSF - Year -2	-0.039	-0.164	-0.039	0.069	0.052	0.087	-0.071	-0.116	-0.053	0.079	0.062	0.087
	(0.090)	(0.148)	(0.090)	(0.072)	(0.082)	(0.072)	(0.139)	(0.225)	(0.139)	(0.074)	(0.091)	(0.073)
PSF - Year 0	-0.031	-0.064	-0.032	-0.142	-0.146	-0.141	0.068	0.057	0.090	-0.054	-0.134	-0.042
	(0.086)	(0.140)	(0.086)	(0.077)*	(0.105)	(0.078)*	(0.095)	(0.152)	(0.093)	(0.075)	(0.093)	(0.074)
PSF - Year +1	-0.029	-0.032	-0.034	-0.134	-0.046	-0.111	0.071	0.048	0.090	-0.010	-0.013	-0.020
	(0.105)	(0.168)	(0.106)	(0.097)	(0.109)	(0.096)	(0.132)	(0.212)	(0.131)	(0.098)	(0.109)	(0.097)
PSF - Year +2	-0.047	-0.092	-0.058	-0.157	-0.012	-0.145	0.127	0.147	0.151	0.096	0.085	0.074
	(0.139)	(0.229)	(0.140)	(0.136)	(0.155)	(0.135)	(0.173)	(0.257)	(0.171)	(0.135)	(0.157)	(0.132)
PSF - Year +3	-0.050	0.147	-0.067	-0.205	0.064	-0.196	0.174	0.428	0.198	0.110	0.099	0.093
	(0.180)	(0.282)	(0.182)	(0.172)	(0.190)	(0.170)	(0.223)	(0.329)	(0.221)	(0.174)	(0.192)	(0.170)
PSF - Year +4	0.035	0.266	0.015	-0.141	0.180	-0.141	0.350	0.564	0.378	0.237	0.283	0.203
	(0.216)	(0.345)	(0.220)	(0.207)	(0.234)	(0.205)	(0.267)	(0.390)	(0.268)	(0.214)	(0.232)	(0.209)
PSF - Year +5	0.091	0.525	0.064	-0.102	0.291	-0.106	0.419	0.779	0.451	0.308	0.408	0.255
	(0.255)	(0.418)	(0.259)	(0.246)	(0.283)	(0.242)	(0.314)	(0.456)*	(0.316)	(0.257)	(0.280)	(0.250)
PSF - Year +6	0.103	0.702	0.070	-0.103	0.402	-0.118	0.428	0.810	0.460	0.343	0.530	0.251
	(0.292)	(0.459)	(0.296)	(0.287)	(0.325)	(0.285)	(0.362)	(0.520)	(0.361)	(0.294)	(0.319)*	(0.286)
PSF - Year +7	0.258	1.067	0.216	-0.010	0.583	-0.036	0.605	1.184	0.643	0.482	0.607	0.420
	(0.352)	(0.538)**	(0.357)	(0.335)	(0.374)	(0.333)	(0.425)	(0.593)**	(0.426)	(0.343)	(0.361)*	(0.336)
PSF - Year +8	0.397	1.197	0.353	0.109	0.815	0.064	0.721	1.481	0.761	0.550	0.770	0.447
	(0.404)	(0.566)**	(0.410)	(0.385)	(0.421)*	(0.387)	(0.477)	(0.659)**	(0.479)	(0.385)	(0.407)*	(0.378)
Observations	29,869	29,869	29,869	29,869	29,869	29,869	29,869	29,869	29,869	29,869	29,869	29,869
y_mean												

Notes: Standard errors in parentheses, clustered at the MCA level: *** p<0.01, ** p<0.05, * p<0.1. The estimated coefficients $\beta^h_{pre,i}s$ and $\beta^h_j s$ and their respective standard errors were defined as in equation 2. Our sample covers the interval between 1996 and 2004. All specifications include MCA fixed-effects and state*year fixed-effects.