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Gestão Privada de Serviços Públicos

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Abstract

This study evaluates the effects of transferring the management of public hospitals to Social Health Organizations (OSS) — nonprofit private entities contracted by the state. Using administrative data from 2005 to 2022 and a matched difference-in-differences design, we find that the OSS model increases hospital admissions by 40%, improves productivity (higher bed turnover and occupancy rates, shorter average length of stay), and reduces population mortality, especially in municipalities with lower installed capacity. These effects do not compromise care quality or alter the patient profile. We identify two mechanisms driving these results: the adoption of more flexible and efficient workforce management practices, and the managerial capacity of the contracted entities. Complementary evidence suggests lower costs per admission in OSS hospitals. However, the effectiveness of the model depends on implementation quality — including careful selection of managing organizations, government oversight capacity, and well-structured contracts. When these conditions are met, the model can improve the performance of public hospitals without compromising care quality or access equity.

Resumo

Este estudo avalia os efeitos da transferência da gestão de hospitais públicos para Organizações Sociais de Saúde (OSS) — entidades privadas sem fins lucrativos contratadas pelo Estado. Usando dados administrativos de 2005 a 2022 e um modelo de diferenças em diferenças com pareamento, encontramos que o modelo OSS aumenta em média as internações hospitalares em 40%, melhora a produtividade (maior rotatividade e ocupação de leitos, menor tempo médio de permanência) e reduz a mortalidade populacional, especialmente em municípios com baixa capacidade instalada. Esses efeitos não comprometem a qualidade do cuidado nem alteram o perfil dos pacientes atendidos. Documentamos dois mecanismos por trás desses efeitos: a adoção de práticas mais flexíveis e eficientes de gestão de pessoal e a capacidade gerencial das entidades responsáveis pela administração hospitalar. Evidência complementar indica menor custo por internação em hospitais OSS. Os efeitos, no entanto, dependem da qualidade da implementação da política — incluindo a seleção criteriosa das entidades gestoras, a capacidade de fiscalização do Estado e a existência de contratos bem estruturados. Quando essas condições são atendidas, o modelo pode melhorar o desempenho dos hospitais públicos sem comprometer a qualidade do cuidado ou a equidade no acesso.

1 Introduction

Governments worldwide have increasingly contracted out the provision of public goods and services to the private sector, employing models that range from different forms of public-private partnerships to full privatization (Fabre and Straub, 2023). The prevailing rationale is that private sector involvement enhances efficiency and expands access to public goods and services by overcoming government failures and leveraging managerial expertise (World Bank, 1995). Economic theory, however, has long called for trade-offs and more nuanced predictions. On the one hand, the control of the surplus rights may induce firms to increase efficiency through innovation and cost reduction (Hart and Moore, 1990). On the other hand, when contracts are incomplete and quality is hard to specify or enforce, outsourcing may introduce incentives for cost reductions at the expense of quality (Hart et al., 1997; Shleifer, 1998).

The provision of health care has long offered a prime example of this trade-off in theory. Due to incompleteness of contracts, potential non-contractible quality issues can arise, especially in higher complex services such as hospital care, where quality assurance is intrinsically difficult (Hart et al., 1997; Holmstrom and Milgrom, 1991). Recent empirical evidence supports these concerns. Knutsson and Tyrefors (2022), for instance, find that privately owned ambulances in Sweden outperform public ones on contracted quality measures, but perform worse on non-contracted outcomes such as mortality. Duggan et al. (2023) find that hospital privatization in the U.S. improves efficiency and profitability, but it may also reduce access for less profitable patients and compromise care quality. Yet, while these findings reinforce concerns about private sector participation in contractually challenging settings, theory can still call for ambiguity depending on the specifics of contract design and ownership incentives (Hart et al., 1997).

This paper assesses the Brazilian "Organizações Sociais de Saúde" (OSS) model, a distinctive contractual approach that transfers specifically the *management* of hospital services to private non-profit firms while retaining public ownership of assets and governmental control over surplus rights. Under this hybrid arrangement, hospitals remain publicly funded, with contracts linking payment to achieving contractible targets for output and quality goals. Firms are compensated based on pre-established contract values, cannot appropriate their surplus (budgetary savings) and must reinvest it in service improvements. Another feature of the Brazilian setting is that public hospitals do not charge fees, do not compete for patients, and remain universally accessible. These features limit incentives to restrict access for disadvantaged populations or to reduce costs at the expense of non-contractible quality. Instead, the OSS model primarily aims to improve hospital performance through better management practices, with private managers operating under civil legislation, which is more flexible than public administration laws, and exercising full control over workforce and procurement decisions. This unique setting allows us to assess whether and how a hybrid approach that combines public ownership with private management, under government control of surplus rights, affects input allocation, management practices, hospital performance, and health outcomes.

We use an array of administrative microdata sets on hospital inputs, outputs, and health outcomes to assess the performance of hospitals that transitioned from public to OSS management between 2005 and 2022. In addition, we leverage unique administrative identified microdata on physicians and nurses, including information on employment contracts, tenure, and specialization, and connect them with microdata on hospital admissions they handled. This allows us to investigate labor productivity at the worker level and changes in hospital personnel practices in an unprecedented way. Our empirical strategy leverages changes in hospitals' administration over time within a staggered difference-in-differences (DiD) framework. Following the approach employed in recent studies on privatization, ownership changes, and mergers and acquisitions (e.g. Olsson and Tåg, 2017; Craig et al., 2021; Arnold, 2022; Duggan et al., 2023; Olsson and Tåg, 2025), we combine DiD with matching to construct treated and control hospitals that are comparable across a broad array of covariates. Additionally, we incorporate recent advancements in the DiD literature, utilizing estimators that account for treatment effect heterogeneity across hospitals and time (Callaway and Sant'Anna, 2021). In support of the validity of our research design, we document that pre-trend differentials are statistically insignificant and close to zero across several outcomes, and that the timing of the transition to OSS is uncorrelated with key hospital characteristics and their pre-treatment dynamics. Our results are also robust to alternative modeling specifications, which include using different control groups, varying methods for adjusting covariate-specific trends, controlling for time-varying patient characteristics, and aggregating the analysis at the population level. Taken together, these tests indicate that unobservable time-varying shocks, endogenous selection, and spillover effects are not expected to play a relevant role in our setting.

We begin by examining the effects of the transition to OSS management on hospital production and productivity, and then consider its implications for care quality, equity, and population outcomes. Our analysis yields five main findings. First, hospital admissions rise substantially, by 40% relative to baseline. The effects are similar across different types of care (e.g., clinical vs. surgical) and admissions, including those related to more and less deferrable conditions. Second, OSS management improves hospital productivity. We observe a 23% increase in bed turnover and a 14% increase in occupancy rates, along with a reduction in the average length of stay. Third, these changes occur without any detectable deterioration in quality of care, as measured by inpatient mortality and readmission rates. This holds both when considering all conditions and when focusing specifically on acute cases, which typically require immediate care and are prone to high mortality. Fourth, we do not find any effects on the profile of patients, including their age, gender, income, and risk indicators. This allows us to discard patient selection and adverse impacts on equity. Fifth, we find that increased inpatient production under OSS management generates population-level benefits. OSS hospitals expand access to hospital care for the local population, particularly in underserved areas, and this expansion leads to measurable health improvements. Municipalities with OSS-managed hospitals experience a 3% reduction in overall mortality, with the largest gains concentrated in areas with initially low hospital capacity and driven by declines in deaths that would otherwise occur outside the health system. These results reinforce that increases in hospital production lead to gains in access to services, which translate into population health benefits.

We then examine potential mechanisms that could account for our findings. First, we examine whether new managers expand the hospital's operating capacity and evaluate whether observed gains in hospital outcomes primarily reflect such changes. We find that while OSS management increases bed capacity, the effect is small, and—holding bed turnover constant—accounts for only a small fraction of the observed growth in output volume. Consistent with that, we find no evidence of expansion in capacity on technologically advanced equipment. These findings, together with the substantial increase in productivity, suggest that the gains stem from a more efficient use of resources rather than scaled-up capacity.

Second, we investigate two potential pathways underlying efficiency gains. The first relates to innovation in management practices. This is particularly relevant for personnel organization, as OSS hospitals operate under private labor laws, granting them greater flexibility in human resource management. Consistent with that, we find that OSS introduces efficiency-driven changes in personnel management. OSS managers reshape the composition of physicians, prioritizing more qualified workers while shifting labor contracts away from rigid, long-term arrangements toward independent contracts, where compensation can be tied to deliverables. Autonomy in personnel management leads to an immediate increase in hiring, with new managers strategically reshaping the workforce and employment contracts as described above. At the same time, separation rates of incumbent physicians also increase immediately after the transition to OSS. This is concentrated among physicians in the lower tail of the baseline distribution of productivity, with exit rates decreasing monotonically as productivity increases. Finally, we document that overall hospital output per physician increases in the post-OSS period.

The second potential driver of efficiency gains is managerial capacity. Independent of contractual flexibility, the OSS model may attract more capable hospital managers. To explore this, we estimate whether the effects of the OSS model vary with the organizational capabilities of the firms. Specifically, we examine heterogeneity in outcomes based on prior experience of firms in hospital management. We find that the effects on hospital output and productivity are significantly larger in hospitals managed by highly experienced OSS firms. Notably, both high- and low-experience firms expand hospital operation capacity by similar proportions. However, in hospitals managed by less experienced OSS, capacity expansion accounts for most of the observed increase in output. In contrast, in hospitals managed by highly experienced firms, capacity expansion explains only a small portion of the output gains, reinforcing the role of increased productivity. In line with this, we find that experienced firms are significantly more likely to implement efficiency-driven personnel practices, such as hiring a more skilled workforce, the exit of less productive doctors, and the adoption of more flexible employment arrangements. Importantly, we also find substantially greater reductions in population mortality in municipalities where the transitioning hospital is managed by a highly experienced OSS.

Finally, we use the available data to assess OSS costing in comparison to hospitals directly managed by the state. We find that the cost per admission in OSS hospitals is approximately 12% lower than in state-managed hospitals. We estimate that achieving the same five-year increase in admissions observed in OSS hospitals would require state-managed hospitals to spend approximately 22% more.

This paper speaks to fundamental questions about the optimal boundary between state and market in public service provision, which is a central debate in economics. Our setting provides a rare opportunity to examine how private managerial practices operate within public ownership constraints. In doing so, we contribute to multiple streams of research. First, we add to the literature on ownership economics, which is rich in theory but remains surprisingly scarce in empirical evidence, particularly in the challenging context of healthcare services. Solid empirical studies on the performance of public *versus* private healthcare providers have been rare, with even fewer covering the impacts of contracting out and private-public partnerships. Most existing papers are descriptive or rely on weaker research designs, while more rigorous experimental studies typically focus on small-scale primary care providers and variations in payment schemes, rather than changes in ownership or managerial profile (see reviews by Lagarde and Palmer, 2009; Odendaal et al., 2018; Fabre and Straub, 2023). Closer to our case, Duggan et al. (2023) evaluate the outsourcing of hospital care in the U.S., and find that hospitals transferred to private firms increased profits but reduced their workforce and production, limiting access to inpatient services among low-income and Medicaid patients. These results align with previous work comparing differences in quality and efficiency of health service provision between public and private firms (e.g. Knutsson and Tyrefors, 2022; Chan et al., 2023).

We advance this literature in important ways. We study a unique governance model that specifically outsources the *management* of hospitals to the private sector. Unlike most settings, where different forms of privatization entail surplus appropriation and market-based incentives, OSS hospitals raise no revenue from patients and must reinvest their budgetary savings. Another relevant feature of our setting is that OSS hospitals do not face competition in the hospital market, an incentive that is usually active in other contexts and tends to strengthen the case for contracting out (e.g. Gaynor et al., 2013; Bloom et al., 2015; Chandra et al., 2016). Our findings indicate increased efficiency without adverse effects on quality or equity, particularly on non-contractible outcomes such as mortality, therefore diverging from previous results documented in settings where private entities had control over surplus rights. Our findings therefore provide new causal evidence on hybrid governance structures, expanding the empirical scope of ownership theory and documenting that private managerial autonomy under public control can mitigate the classic efficiency–quality trade-off in complex public services, even where salient contracting frictions exist.[1] Moreover, the richness of our data allows for a deeper investigation of performance outcomes and mechanisms, covering changes in hospital resources and management strategies, with detailed analyses on personnel. Also importantly, to our knowledge, this is the first paper to rigorously investigate the causal impact of management

[1]If we consider the intuitive model and predictions of Hart et al. (1997), the OSS hybrid approach can be thought of as a case of public ownership where private managers would not do much of the damaging cost reduction, therefore, potentially giving this case the edge over full private ownership; but would still have more autonomy and a relatively stronger incentive to make quality innovations, therefore, giving them the edge over government management.

outsourcing in a developing country, where limited state capacity and weak contract enforcement make such governance innovations both more challenging and more consequential.

Second, leveraging our rich dataset, we contribute to the literature on how privatization and ownership transfers affect incumbent workers and firm productivity. Past research finds that privatization, private equity buyouts, and mergers and acquisitions often lead to productivity and efficiency gains in acquired firms (e.g. Megginson and Netter, 2001; Brown et al., 2006). However, such ownership changes can also result in worker turnover, headcount reductions and economic costs for incumbent employees (e.g. Brown et al., 2009; Olsson and Tåg, 2017; Eliason et al., 2020; Arnold, 2022; Olsson and Tåg, 2025). So far, existing studies have relied on indirect proxies for worker productivity, such as educational level, cognitive and non-cognitive test scores, or workers fixed effects from longitudinal models. To our knowledge, this paper is the first to use an output-based measure of individual worker productivity. We show that less productive incumbents face disproportionately higher separation rates after transitions. We also document that hospital output per physician increases after transitions, directly connecting firm-level productivity increases to changes in workforce composition.

Third, our work contributes to the growing literature on the role of management in organizational performance. As noted by Syverson (2011), management's effect can operate through organizational-level management practices, manager-specific effects, or both. A strand of empirical research has established a causal link between management practices and higher firm-level productivity, with especially dense literature on the private sector—see Bloom et al. (2013), Bruhn et al. (2018) and Gosnell et al. (2020) for experimental evidence.[2] Another stream of empirical research has documented that individual managers also matter for performance through their observable and non-observable skills, with mounting evidence from both the private sector (e.g. Lazear et al., 2015; Bertrand and Schoar, 2003; Hoffman and Tadelis, 2021) and the public sector (e.g. Best et al., 2023; Fenizia, 2022). Closest to our work, Otero and Muñoz (2024) find positive effects on hospital performance of a reform in Chile that introduced a selection system to recruit CEOs in public hospitals. In contrast, Janke et al. (2020) assess the effects of CEO appointments in NHS hospitals in the UK, and find little evidence of impact on hospital production. Exploiting the unique OSS design, we assess the impact of *private management* within *public organizations*. We examine both management practices, with a focus on personnel practices and worker-level productivity, and heterogeneity in manager capacity within the same setting. We document that private management, operating under civil legislation and managerial autonomy, outperforms government management in terms of efficiency, without compromising quality or equity. However, by comparing managers' types, we also find that private management is not a sufficient condition for higher performance if management capacity and efficiency-driven practices remain limited.

Finally, our paper connects with a longstanding literature on productivity dispersion across

[2]See also rich descriptive evidence on the role of management practices in firm performance in McKenzie and Woodruff (2017), Bender et al. (2018) and Cornwell et al. (2021); for evidence on the healthcare sector specifically, see McConnell et al. (2013), Tsai et al. (2015), Bloom et al. (2020) and La Forgia (2023); for evidence on the public sector, e.g., see Rasul and Rogger (2018).

hospitals (Propper and Van Reenen, 2010; Skinner and Staiger, 2015; Chandra et al., 2016; Chandra and Staiger, 2020). Our findings indicate that differences in governance structures can lead to substantial variation in hospital efficiency. This is particularly relevant given the wide variation in governance models observed across and within healthcare systems worldwide. At a more granular level, our results suggest that variation in hospital administrators' managerial experience and innovation in personnel management are important drivers of productivity. Our paper also relates to work on how healthcare providers balance potential trade-offs between service quantity and quality. Recent evidence indicates that when hospitals increase the volume of care to boost revenue, they may undermine care quality (Aghamolla et al., 2024). In contrast, under the OSS-management scheme, we observe that hospitals substantially increased output production without eroding quality. These findings reinforce the idea that effective governance structures can mitigate the traditional quantity-quality trade-off in complex healthcare services.

The remainder of this paper is structured as follows. Section 2 describes the institutional background. Section 3 describes the data, while Section 4 lays out our empirical strategy. Section 5 details the effects of OSS on hospital performance. We investigate mechanisms in Section 6. Section 7 discusses costs and hospital expenditures. Section 8 concludes.

2 Institutional Background

2.1 The OSS Model

The Social Health Organizations (*Organizações Sociais de Saúde* – OSS) emerged to address productivity challenges within Brazil's public healthcare system, the *Sistema Único de Saúde* (SUS). This single-payer, tax-funded system provides free healthcare at the point of service to the Brazilian population through public and private providers.[3] SUS has expanded healthcare access nationwide since its conception in 1988, leading to significant improvements in health outcomes and reductions in health inequalities (Bhalotra et al., 2019; Castro et al., 2019b). Despite the achievements, SUS faces ongoing challenges such as the increasing demand from an aging population and rising healthcare costs (Rocha et al., 2021). Public hospitals have become a focal point in addressing these challenges, as they account for a significant share of healthcare expenditures and offer considerable potential for improving efficiency (Botega et al., 2020).[4]

In response to these challenges, Federal Law 9,637, enacted in 1998, established the OSS model as part of broader efforts to modernize the public sector, enhance flexibility in public contracting and service provision, and address productivity constraints (Sano and Abrucio, 2008; Barbosa and Elias, 2010). At its core, the OSS model introduces a novel form of public-private partnership grounded in a hybrid governance approach that shifts the management of health

[3]Those who opt for private care receive healthcare services covered by out-of-pocket payments or private health insurance plans. Approximately 25% of the Brazilian population have private health insurance. Most of the demand for private insurance comes from employer-provided coverage.

[4]Hospitals account for approximately a third of total government health expenditure in Brazil (Ministério da Saúde, 2018).

services from direct government administration to non-profit private organizations.

The adoption of the OSS model has expanded steadily over time and geographically across Brazil. In 2005, 24 hospitals operated under OSS management, all of which operating as OSS units since their construction. This changed in 2006, when new legislation allowed the transition of existing public hospitals to OSS management, marking a pivotal turning point in the expansion of the model. In 2006, the first hospital transitioned from direct government management to OSS management (located in the state of Bahia). In 2022, the model had been adopted in several regions, with OSS-managed hospitals accounting for approximately 9% of all public hospitals in Brazil. This includes both newly constructed and transitioned units, with the latter group making up approximately two-thirds of all OSS-managed hospitals. Figure 1, panel (a), shows the growth in the number of OSS-managed hospitals that transitioned from direct government management between 2006 and 2022, while panel (b) illustrates their geographical spread across Brazilian states. Figure A.1, panel (a), presents the evolution of the total number of hospitals managed by OSS, distinguishing between those established directly under OSS management (referred to as 'always-OSS'), and those initially managed by the state and that later transitioned to OSS (referred to as 'switchers').

2.2 A Hybrid Governance Model

The OSS model transfers the *management* of public hospitals to non-profit private organizations, while funding and facility ownership remain public. It differs from other forms of public-private partnerships by focusing exclusively on the operational management of services, without involving responsibilities such as construction or financing. In what follows, we outline the building blocks of the OSS model and conceptually discuss these elements in comparison to their counterparts under direct government administration.

OSS design and selection. To qualify as an OSS, a private non-profit organization must have at least five years of experience managing healthcare services. Eligible entities include non-profit foundations (often affiliated with medical schools and other educational institutions), philanthropic organizations acting in health and social assistance, and, to a lesser extent, non-profits linked to for-profit business groups. Many of these organizations rank among Brazil's largest healthcare providers and hold philanthropic certifications that grant them tax exemptions. These certifications are typically awarded to entities that allocate at least 60% of their services to the SUS (Contreiras and Matta, 2015; Morais et al., 2018). Fiscal incentives are therefore a key motivation for participation in OSS contracts, as services provided in OSS-managed hospitals can count toward certification requirements and eligibility for tax benefits.[5] The OSS contracting process takes place through competitive bidding, where candidates are selected

[5]For example, a philanthropic hospital may be required to offer 60% of its outpatient visits or inpatient admissions to SUS patients, free of charge or reimbursed through SUS contracts. OSS contracts can help organizations meet this threshold, as services delivered in public hospitals under their management count toward the required proportion. We conjecture that additional factors, such as reputation and alignment with institutional missions, may also incentivize participation in OSS contracts.

based on criteria that include operational cost estimates, previous experience, and assessment of work plans.

Contracting. Once selected, OSS are hired through a renewable five-year contract, which specifies a global budget for managing the hospital, annual output targets for different services, as well as other quality targets used for payments upon performance (WHO, 2014; La Forgia and Couttolenc, 2009; La Forgia and Harding, 2009). Output targets are set for different types of health services, including inpatient surgical and clinical care, day care, and urgent and emergency care. Outputs are measurable and verifiable, for instance, by the number of admissions or procedures. The overall budget is determined by assigning a percentage weight to each service type based on hospital size and capacity. Approximately 90% and 95% of the global budget is distributed monthly according to the achievement of output targets, with full disbursement for hospitals that meet over 85% of their targets and reductions up to 30% for performance below 70%.[6] Persistent underperformance may lead to contract termination. The remaining 5-10% of the OSS global budget is disbursed quarterly, based on the achievement of indicators for quality of care, organized into domains such as patient satisfaction, information quality (e.g., medical record completeness), clinical quality (e.g., reducing hospital-acquired infections), and productivity (e.g., length of stay) (La Forgia and Couttolenc, 2009).[7]

Anecdotal evidence suggests that the volume targets are set at aggressive levels, often exceeding the hospital's pre-OSS production standards. To examine this, we analyze the available data from eleven hospitals in our treated sample, covering nine Brazilian states. We assessed the original OSS contracts for these hospitals, which detail specific volume targets. We then manually coded the admission targets defined in each contract and compared them to the actual hospital production.[8] Figure A.2 presents the evolution of total hospital admissions along the upper and lower bounds of the output targets established in the OSS contracts.[9] The graph indicates a marked increase in average hospital admissions following the transition to OSS management. It also reveals a substantial alignment between hospital production and the target range, where admissions predominantly fall within the bounds that avoid penalties.

Contract monitoring. Oversight mechanisms were established to monitor performance and promote accountability. According to regulation, a supervisory body within each contracting municipal or state health secretariat is responsible for reviewing hospital data, negotiating budgets, and managing contract amendments. In addition, an independent evaluation committee must conduct annual compliance reviews and report its findings to the supervisory body. Annual

[6]The threshold for full disbursement may vary by contracting government. Contracts may specify thresholds ranging from 85% to 95% of target achievement for full disbursement.

[7]Note that not all contracts include the same domains, and within each domain, specific indicators and their assigned weights may vary across contracts.

[8]These hospitals are located in states that cover approximately 85% of our treated sample, and are representative of that sample based on the number of beds, workers, medical equipment, admissions, and performance indicators.

[9]The lower bound of the target represents the threshold below which the hospital incurs penalties for failing to meet volume requirements, while the upper bound sets the maximum target for full incentive alignment.

audits assess financial accounts and administrative procedures, providing an overall evaluation of institutional performance. Transparency requirements vary by local legislation, but OSS organizations are generally required to disclose performance data regularly, which is monitored through information systems managed by the Ministry of Health. It is important to note, however, that there is limited evidence on the effectiveness of these oversight and transparency mechanisms. Existing research is largely based on descriptive case studies, some of which suggest heterogeneous compliance by contracting authorities (Sano and Abrucio, 2008; Pahim, 2009).

Budget allocation. OSS-managed hospitals receive an annual global budget tied to performance measures. Budget allocation is flexible, granting managers autonomy to spend funds (e.g., in human resources, medications, and supplies) as needed. The only restriction is that payroll expenses must not exceed 70% of the budget. Importantly, any budgetary savings must be reinvested in service improvements. Government-managed hospitals, in contrast, have budgets set annually and earmarked in advance by functional categories (e.g., salaries, investment, and administration), with state or municipal health secretariats often determining these allocations and leaving hospital managers with minimal flexibility to reallocate funds (La Forgia and Couttolenc, 2009). Additionally, budgets lack ties to performance measures.

Market exposure. Both government-managed and OSS hospitals provide services to SUS, are open to all patients, and do not compete by selling services in the relevant market. Aligned with their public mission, they are prohibited from charging any fees. These characteristics mitigate concerns over reduced access for vulnerable populations, associated with hospital privatization in other contexts.[10]

Management practices: personnel. Public administration laws impose strict restrictions on managers in publicly managed hospitals, setting rigid guidelines for hiring and firing. Regarding hiring procedures, candidate workers must undergo a lengthy public examination process,[11] followed by a three-year probationary period. After this period, dismissing a public servant becomes possible only in cases of severe misconduct, and promotions require additional selection processes. Wage structures in the public sector are also highly rigid, with salary levels and progression predetermined and unrelated to productivity measures (World Bank, 2006). In contrast, OSS-managed hospitals operate under civil labor laws, which provide flexibility in personnel practices. Selection and hiring typically follow a formal interview process with a three-month probationary period, allowing for straightforward dismissals if needed. Promotions can be awarded at any time based on performance criteria, giving OSS-managed hospitals greater discretion (Malik et al., 2021).

[10] Hospital privatization models that allow for mixed revenue schemes, therefore serving both public and private patients (e.g., as in the U.S.), may create stronger incentives to optimize revenue streams (Duggan et al., 2023).

[11] The public service examination process includes several steps: identifying staffing needs, obtaining authorization from planning and finance departments and the governor/mayor, forming an organizing committee, selecting the examination board, drafting and publishing the public notice, and administering the exam. This process can be delayed or interrupted if errors or legal issues occur during recruitment processes (Malik et al., 2021).

Management practices: procurement of inputs. In OSS hospitals, managers are responsible for procuring all inputs (e.g., supplies, medicines, and services) under their own procurement and contracting policies. This autonomy enables more flexibility in purchasing and faster responses to market conditions. In contrast, publicly administered hospitals follow strict public administration norms, potentially resulting in inefficiencies. For example, delayed payments push suppliers to raise prices, making hospitals miss optimal purchasing opportunities. Additionally, centralized procurement policies may limit managers' autonomy, hindering timely acquisitions. Poor management and maintenance of stocks can worsen inefficiencies and mismatches between required and available supplies. These issues not only increase costs but can also disrupt service continuity and compromise the availability of essential inputs (World Bank, 2007).

3 Data

Our analysis is based on data at the hospital-by-year level covering the 2005-2022 period.[12] We combine administrative microdata on hospital resources, production, and performance from all Brazilian hospitals that provide services to SUS. Below, we describe the construction of the main variables and the auxiliary data used in our analysis.

Hospital performance. We use administrative data from the Hospital Information System of the Unified Health System (*Sistema de Informações Hospitalares*, SIH), which includes comprehensive information on all hospital admissions within the entire public health system, covering both public and private facilities that provide hospital services to SUS. This dataset provides details such as patients' age, gender, zip code of residence, and cause of admission (using ICD-10 codes), as well as SUS reimbursement values per admission.[13] Additionally, SIH records the type of care provided (e.g., clinical, surgical, obstetrical), final outcomes (discharge or death), the date of admission and discharge, and the health facility code of the admission. We use this data to analyze the number and composition of hospital admissions. In some analyses, we classify hospitalizations as sensitive to emergency care (ECSC), as defined by Vashi et al. (2019). ECSC admissions refer to conditions that are generally inevitable and severe, necessitating emergency care, such as heart attacks, accidents, and viral pneumonia. The selection of patients for inpatient care due to these conditions is typically non-discretionary (Card et al., 2009; Doyle Jr et al., 2015).

We also use SIH data to compute hospital productivity and quality of care measures commonly used by regulators and researchers (e.g. Gaynor et al., 2012; Bloom et al., 2015; Doyle Jr et al., 2015; Gupta, 2021; Otero and Muñoz, 2024). Specifically, we examine bed turnover rates, bed

[12] To mitigate the influence of the COVID-19 pandemic, we also perform analyses excluding data after 2019.

[13] The SUS reimburses private affiliated hospitals per patient according to the costs of delivered care. The reimbursement rate is highly correlated with patient risk (Titinger et al., 2015). Although public hospitals, including OSS-managed ones, do not receive payments based on these rates, the reimbursement variable is recorded in the data for all patients. This paper uses this variable as a proxy for patient risk. We adjust reimbursement values to January 2023 Reais using the consumer price index.

occupancy rates, and average length of stay. These metrics represent the average number of discharges per hospital bed, the proportion of available hospital bed time effectively utilized, and the average number of hospital days spent by discharged patients, respectively. Higher bed turnover and occupancy rates, along with a reduced length of stay, indicate increased productivity (Bloom et al., 2015).

For quality of care, we measure inpatient death rates and readmission rates. The inpatient death rate is the ratio of hospitalizations that result in patient death compared to patient discharge. The readmission rate is the proportion of discharged patients who are hospitalized again within 30 days. A potential concern is that changes in hospital quality may reflect endogenous patient selection. The Brazilian public health setting is particularly suitable for our analysis because the institutional design limits patient selection. Hospitals cannot reject patients or refer them to other hospitals at their discretion. Consistent with this, Section 5.3 shows that OSS does not affect the profile of patients based on the socioeconomic observables mentioned above. In addition, we show that our results remain robust when controlling for patient characteristics.

Hospital inputs. We gather data from the National Registry of Health Establishments (*Cadastro Nacional de Estabelecimentos de Saúde*, CNES) to investigate the effects of OSS on hospital inputs. This registry includes detailed data on all public and private health facilities in Brazil, encompassing their location, services, and human and physical resources. We select data on the number of hospital beds, medical equipment, and staff by area of practice. Staff is defined as the number of full-time equivalent (FTE) employees. In some analyses, we measure medical equipment and staff per 100 hospital beds, as they vary with hospital size and are standard measures in the literature.

CNES records also include identified information on all physicians working in health facilities in Brazil. We utilize this data to examine the availability of doctors at hospitals. We also use this data to investigate employment arrangements as we observe employment contracts. The first type of contract is regulated by *CLT* terms, a regime typically used by the private sector.[14] This type of contract is much less rigid compared to others used by public organizations, but still provides benefits such as severance pay and social security for employees. The second is *Estatutário*, a regime typically used by public facilities for formal employee hiring. This regime is less flexible than *CLT*, particularly in terms of hiring and firing, as it emphasizes job stability for public servants, making termination difficult and often involving a lengthy public examination process for hiring. Additionally, wages in the *Estatutário* regime are highly rigid: their levels and progression are predetermined and cannot be linked to productivity measures. The third type of arrangement is independent contracting, where hospitals contract with physicians' own businesses. This type offers the most flexibility for hospitals, as physicians are not formally recognized as employees but as firms, and thus do not have the same employment

[14]CLT stands for *Consolidação das Leis do Trabalho*, which is the legal framework that regulates formal private employment relationships in Brazil.

rights and benefits. This arrangement allows both doctors and hospitals greater autonomy in determining the terms of their contracts. The fourth and last category, labeled “Others”, refers to arrangements that are specific to interns and residents.

We further investigate the profile of physicians by gathering identified data from the Federal Council of Medicine (CFM), the National Commission of Medical Residency (CNRM), and the Brazilian Medical Association (AMB). The primary purpose of the CFM registry is to ensure compliance with regulatory standards for medical practice and to maintain accurate and up-to-date records of all licensed physicians in Brazil. It includes information such as physicians’ names, birth municipalities, registration dates (which mark the start of their medical practice), and registration statuses (active or inactive). Using this data, we construct a measure of physician experience as the number of years since registration with the CFM. Data from the CNRM and AMB provide details on physicians who have completed residency programs and fellowships, respectively, including the completion dates. This allows us to identify whether physicians hold a specialty title.[15] Finally, by linking identified data from CNES and SIH, we also observe the total number of inpatient cases taken by each doctor. We use this information to investigate doctors’ production per workload.

Identification of OSS hospitals. To identify the public hospitals managed by OSS, we use data from the Social Health Organizations Database Portal (BDOSS).[16] To ensure accurate categorization of OSS hospitals, the BDOSS relies on three sources of information: (i) the database constructed by Barcelos et al. (2022), which involves manual classification of OSS hospitals based on information from state and municipal health department websites, transparency portals, and the 2018 Municipal Information Survey by the Brazilian Institute of Geography and Statistics (IBGE); (ii) data from the Federal Audit Court (TCU) on governmental contracts with OSS;[17] and (iii) additional manual coding based on electronic platforms from state and municipal health secretariats, as well as information accessed through Brazil’s Access to Information Law.

The BDOSS dataset provides a unique identifier for each public hospital under OSS management and the year the OSS began operating the hospital. We identified 236 hospitals managed by OSS between 2005 and 2022 in the data, and applied a few restrictions to define our final sample. First, we included only hospitals that transitioned from direct public administration to OSS management (the switchers). This step excludes 73 always-OSS hospitals and 27 other public hospitals that were not previously managed by the public administration. Additionally, we removed 9 hospitals with substantial missing data in the pre-treatment period. These criteria

[15]To obtain a medical degree in Brazil, students complete a six-year undergraduate program, including clinical rotations and internships. Upon graduation, physicians can practice as generalists but must specialize through residency, fellowships, or a combination of both to work in specific fields. A medical residency is an in-service program lasting two to five years at a hospital or clinic, while fellowships are shorter, flexible training programs of one to two years. Unlike residencies, fellowships do not confer an official specialty title, requiring graduates to pass a specialist exam by the AMB to earn their specialty title.

[16]This dataset is managed by the Research Group on Health Economics and Crime (GEESC) at the University of Minas Gerais (UFMG) in collaboration with the Brazilian Institute of Social Health Organizations (IBROSS).

[17]TCU is Brazil’s supreme authority on public finances and government contracts, responsible for auditing and investigating contracts involving public funds, including those established with OSS.

result in a final treated sample of 96 hospitals, which corresponds to about 4.5% of the total number of public hospitals in Brazil.

The control group. To construct the control group, we initially identify all public hospitals in the country using data from CNES (nearly 2,800 hospitals in total). We then use matching to select control hospitals comparable to the OSS-managed ones, following recent literature on privatization. Specifically, we sequentially match each treated hospital with one control hospital without replacement based on proximity in the propensity score. The propensity score is calculated separately for each treatment cohort using key hospital characteristics averaged over the five years prior to the transition to OSS management, including number of patients, inpatient mortality rates, number of beds, number of employees, available medical equipment, and the hospital's macro-region.[18] We do not match hospitals based on fine-grained geographic locations to minimize concerns about spillovers. As a result, all treated hospitals are located in different cities from their matched controls. Nonetheless, we show below that treated and control hospitals are balanced across the country's macro-regions. In Section 5.4, we further show that spillovers are not a concern in our setting.

Table A1 provides descriptive statistics for OSS hospitals, the matched control hospitals, and all public hospitals. We observe that OSS management is more likely in hospitals with a higher number of patients, more resources, and those located in Southeastern Brazil (columns 1 and 3). Matching significantly reduces differences in observable characteristics between the treated and control groups (columns 1 and 2). In robustness checks, we show that our results are stable to using all state-managed public hospitals as the comparison group. The next sections further compare the treated and (matched) control groups in terms of pre-trends.

4 Empirical Strategy

Our goal is to quantify the causal effects of the OSS model. We take advantage of the staggered transition from public to private administration across hospitals and over time in a DiD setup, which, when combined with matching, has been commonly used in the literature on privatization, ownership changes, and M&A.[19]

Causal estimand. Define G_g as a dummy variable equal to one if a public hospital switches to OSS management at period g. Let $Y_w(1)$ and $Y_w(0)$ measure potential hospitals' outcomes at time w with and without the OSS model, respectively. The main building block of our framework is the average treatment effect for hospitals that are members of group g at a particular year w, denoted by

[18]Brazil is divided into 5 macro-regions, which cover its 26 states and the Federal District.

[19]See, for instance, Gaynor et al. (2012), Olsson and Tåg (2017), Craig et al. (2021), Arnold (2022), Duggan et al. (2023), Olsson and Tåg (2025).

$$ATT(g, w) := E[Y_w(1) - Y_w(0) | G_g = 1]. \quad (1)$$

We express our parameter of interest in terms of functionals of (1). In particular, we are mostly interested in

$$\tau_t := \sum_{g \in G} P(G_g = 1) ATT(g, g + t), \quad (2)$$

which is the average treatment effect of the OSS model on hospitals' outcomes measured $t > 0$ periods after the transition to OSS management, among all groups of hospitals that joined the OSS model.

Estimation strategy. To estimate τ_t, we follow the tools proposed by Callaway and Sant'Anna (2021) in staggered designs. In summary, for any period g when a group of hospitals transitions to OSS, and for a fixed event-time $t > 0$, we use standard 2×2 DiD to get an estimate for the treatment effect among hospitals of group g, t periods after OSS: $\widehat{ATT}(g, g+t)$. This is the result of comparing the average outcome evolution between periods $g - 1$ and $g + t$ for hospitals that switched to OSS at g with the corresponding evolution of their matched comparison hospitals. To estimate the average effect for *all* groups of treated hospitals, t periods away from the year they switched to OSS ($\hat{\tau}_t$), we aggregate these group-specific DiDs based on the relative sample size $\hat{P}(G_g = 1)$ of each treated group following equation (2). We repeat this procedure and compute $\hat{\tau}_t$ for each $t \in \{1, 2, 3, 4, 5\}$. This choice is primarily motivated by the typical duration of OSS contracts (5 years). Additionally, within this range, we can estimate dynamic effects without major changes in the composition of the treated group, as 67% of the OSS hospitals have data covering up to 5 post-treatment periods. In robustness checks, we show that our results remain virtually the same in a balanced panel over the event times.

Finally, to conduct asymptotically valid inference, we use a bootstrap procedure that computes simultaneous confidence bands for the entire path of group-time average treatment effects. Our inference procedure also accounts for the autocorrelation of the data by using clustered bootstrapped standard errors at the hospital level.[20]

Identification. Our study design is based on a *conditional parallel trends assumption*. That is, we assume that treated and control hospitals with the same baseline characteristics would follow the same trend in outcomes in the absence of the OSS model. We support our identification strategy with empirical evidence and robustness checks. We estimate the effects of the OSS model using pre-treatment periods (τ_t for $t < 0$). Finding coefficients statistically different from zero would indicate a violation of the parallel trends assumption. Throughout the paper, we show that these placebo effects are statistically indistinguishable from zero for several outcomes, supporting design validity. Further robustness checks confirm that we cannot reject the joint null hypothesis that all pre-treatment coefficients equal zero for key outcomes.

[20]Standard errors are barely affected when we implement alternative inference procedures: (i) clustering by micro-region; and (ii) clustering by matching pair. Results upon request.

We complement the pre-trends analysis by examining the determinants of OSS adoption and its timing, comparing treated and control hospitals in discrete-time survival models.[21] We examine both baseline and time-varying characteristics. Table A2 reports the results. We find that relevant baseline covariates do not predict OSS adoption, confirming that treated and control groups are fairly balanced. Although identification only requires that groups exhibit the same trends (not the same levels) in the absence of treatment, this mitigates concerns about unobserved trends that depend on or correlate with baseline characteristics. Furthermore, and fundamentally for our identification assumption, we do not observe any correlation between OSS adoption and pre-treatment *variation* in hospital inputs (beds, workforce, and medical equipment), production, and death rates. This is true irrespective of whether we consider long-term or short-term changes in these variables. These results again support the validity of our empirical strategy.

We also explore alternative specifications for our DiD model, such as different comparison groups and varying methods for adjusting covariate-specific trends. Reassuringly, point estimates remain stable across different specifications, suggesting that our results are unlikely to be driven by differential trends across treated and control hospitals. Taken together, these tests indicate that unobservable time-varying shocks are unlikely to play a significant role in our setting.

5 Effects on Hospital Performance

We present our main results in graphical form, plotting together in one figure dynamic treatment effects, placebo effects, and their 95% confidence bands. In the text, we report the average of the dynamic effects. In Appendix B we present and discuss the robustness checks.

5.1 Production Output and Productivity

Figure 2(a) and Table 1 present OSS effects on hospital production. We observe that the transition to OSS management leads to a sharp increase in hospital admissions. The average impact amounts to 1312 in the two years following the transition, and then to 1577 after five years. This corresponds to an increase of 40% relative to the baseline. These results differ from those of Duggan et al. (2023), who found that hospital admissions declined by 8.4% after the privatization of state hospitals in the US. Table 1 further shows that the positive impact on hospital admissions persists across different types of inpatient care, including surgical, clinical, obstetric, and other categories. All these categories experience a sharp increase following OSS management, proportionate to their contributions to overall admissions at baseline. Additionally,

[21]We perform this estimation by modifying our dataset so that each hospital leaves the sample after switching to OSS. Then, we estimate logit models controlling for a flexible polynomial of time, where the dependent variable is a dummy that equals one when a hospital becomes treated and the independent variables are hospital characteristics. We estimate two models: one includes changes in hospital characteristics between $t-2$ and $t-1$ as covariates ($\Delta_{-1,Short}$), and the other includes changes in hospital characteristics between $t-4$ and $t-1$ ($\Delta_{-1,Long}$). Both models include baseline characteristics as independent variables. Marginal effects are calculated on the averages of the independent variables.

we observe an increase of 397 admissions due to ECSC conditions following OSS (44% of baseline), while the impact on hospitalizations *not* due to ECSC is 1180 (39% of baseline).

The rise in the number of admissions could stem from a broader increase in operational capacity or enhanced operating efficiency. To start investigating this, the remaining plots of Figure 2 and results from Table 1 examine the effects of OSS on productivity measures. We find that bed turnover increases by an average of 8 additional admissions per bed annually following OSS, which is equivalent to a 23% increase from baseline. We also observe that transition into OSS management increases bed occupancy by 7.6 percentage points, or 14% of the baseline. At the same time, the average length of stay decreases by 0.566 days, representing a 9% reduction from baseline. To put these estimates into perspective, for example, Otero and Muñoz (2024) find that improving the quality of CEOs of public hospitals in Chile increased emergency room occupancy by 17%, while Bloom et al. (2015) show that increasing competition by public hospitals in the UK (which turned out to improve management quality) reduced average length of stay by 11%.

5.2 Quality of Care

Our results indicate that OSS management led to increased hospital production and productivity. In Section 6, we show that changes in hospital capacity play a limited role in explaining the increased production. Improved operating efficiency is thus a key factor driving the observed rise in admissions. Yet, there are concerns regarding a potential reduction in quality of care. Excessively high bed turnover and occupancy rates could burden staff and resources. In addition, shortened lengths of stay might indicate premature discharges, potentially leading to adverse patient outcomes.

We address these concerns in Figure 3 and Table 2, which investigate OSS effects on measures of quality of care. For both inpatient death and readmission rates, we find that point estimates fluctuate around zero with no discernible pattern suggestive of a systematic deterioration in quality. Based on average effects, we have economically small and insignificant estimates for deaths in general (-0.004) and due to ECSC (0.001), and for hospital readmission rates due to all causes (-0.001) and ECSC (-0.004). Table A3 further investigates mortality indicators that have been widely used in the literature to measure hospital quality: death rates for particular high-mortality conditions (heart attack and stroke), in surgeries, and emergency rooms. We do not find any statistically significant effects. The evidence, therefore, indicates that the transition to OSS management improved hospital production and efficiency without compromising quality of care.

5.3 Equity

We now consider changes in the profile of patients and equity concerns. Table A4 shows estimates of the impact of OSS on patient composition regarding specific characteristics. Results indicate that OSS is not associated with changes in the average age of patients, the distribution of patients across various age bins, the ratio of female patients, or the average income of patients' zip codes of residence. We also assess the impact of OSS on the average SUS reimbursement per patient (see footnote 13 for a description), serving as a proxy for patient severity (Titinger et al., 2015). There are neither statistically significant nor economically meaningful effects in this dimension. Together, these findings indicate that the transition into OSS management does not change the profile of patients. These results are important as they point out that hospital performance did not rise at the cost of restricting access to specific types of patients or affecting equity. Moreover, they help discard the interpretation that patient selection works as a potential mechanism behind the OSS effects on hospital performance and quality measures. Consistent with that, our results remain virtually the same when controlling for time-varying patient characteristics (see Appendix B). As previously mentioned, the absence of patient selection is consistent with the institutional background, as SUS hospitals cannot reject patients or unilaterally counter-refer them to other hospitals. In addition, OSS hospitals can only provide care within the public system. This restriction precludes the possibility of selectively admitting higher-paying patients, differing from the US context where privatization led to reduced access to hospitals for low-income Medicaid patients (Duggan et al., 2023).

5.4 Population-level Results

The results so far revealed substantial improvements in hospital production and productivity following the transition to OSS management, without any observable negative impacts on quality or equity. A key remaining question is whether the additional output creates value for consumers or instead indicates inefficient overuse of resources. To address this, we extend our analysis to population outcomes at the municipal level, the primary geographic unit for healthcare access within Brazil's decentralized public health system. We adapt our empirical strategy by defining municipalities as treated if they host public hospitals transitioning to OSS management. To maximize statistical power and investigate potential spillovers throughout the entire territory, we include all municipalities with public hospitals in the analysis, not just those in the matched control group.[22]

5.4.1 Hospital Admissions

We begin by examining the impact of OSS on municipal-level hospital admissions. Figure A.3 displays these results, alongside the corresponding hospital-level estimates for ease of comparison. We find strong positive effects on municipal patient volume. The estimates indicate an average annual increase of 1527 admissions, representing a 20% rise relative to baseline. Notably, our estimates closely match those from the hospital-level analysis, indicating that the OSS transition

[22]The analysis includes 2,170 municipalities with public hospitals, of which 166 have at least one hospital under OSS management. After excluding public hospitals that were always under OSS management and those that switched but were not previously managed by the state, we are left with 71 treated municipalities.

alone accounts for most of the aggregate increase in patient volume. This finding supports the interpretation that OSS improves access to hospital care at the local level, rather than merely reallocating patients from nearby facilities.[23]

To assess whether OSS hospitals expand access by addressing previously unmet demand, we estimate heterogeneous effects according to the baseline supply of hospital care at the local level. We split treated municipalities into two groups based on whether their baseline number of hospital beds per capita is below or above the median. Figure A.4 (panel a) reveals that in municipalities with a relatively higher scarcity of beds, OSS management increases patient volume by 2150 admissions annually (a 33% rise from baseline). For municipalities with a high initial supply of hospital care, the estimated increase is significantly smaller, by 1177 admissions or 13% relative to baseline. These results suggest that the increase in OSS hospital production primarily reflects improved access to hospital care, potentially from individuals whose demand had previously gone unmet due to hospital capacity constraints. This is consistent with existing evidence that insufficient access to specialized care has been a major constraint in Brazil's public health system (Castro et al., 2019a; Ministry of Health, Brazil, 2023).

5.4.2 Population Mortality

If the increased hospital production under OSS management indeed reflects the provision of services to previously unmet demand—and considering that this expansion occurs without any deterioration in hospital quality—then we should expect to observe improvements in population health. To test this, we examine the effect of OSS adoption on population mortality. Figure 4 and Table 3 present the results. We find that OSS is associated with a statistically significant reduction in mortality, particularly in the long run. On average, mortality falls by 1.8 deaths per 10,000 inhabitants, corresponding to a 3% decline relative to the baseline. Appendix B shows that this result remains remarkably stable to controlling for changes in municipal demographic composition, specific trends according to municipality baseline characteristics, and the timing of local health programs.

Figure 4 and Table 3 further show that the reduction in mortality is concentrated in deaths occurring outside the health system (i.e., at home or in public spaces), which decline by 1.2 per 10,000 inhabitants (6.6% of the baseline). In contrast, the estimated effect on deaths occurring at health facilities is smaller (−0.6 or about 1%) and not statistically significant. This pattern suggests that OSS hospitals improve outcomes for individuals who might otherwise die without accessing care, consistent with the interpretation that OSS addresses previously unmet demand. To further support this conjecture, Figure A.4 (panel b) explores heterogeneity in mortality effects according to the baseline supply of beds per capita at the local level. In municipalities with initially low bed availability, OSS reduces mortality by 4 deaths per 10,000 people (6.4% of baseline), whereas in areas with high initial supply, the reduction is smaller and statistically insignificant (0.5 or less than 1%). These results reinforce our earlier conclusion that OSS

[23] This mitigates concerns that our main results are affected by spillover effects.

improves access most in underserved areas and reinforce the view that these improvements in access translate into meaningful health gains.

Taken together, our findings indicate that the performance of public hospitals improved following the transition to OSS management. Not only did productivity increase without any deterioration in quality or equity, but the rise in output created value for patients—particularly for those who previously faced supply-side barriers to hospital care.[24]

6 Mechanisms and the Role of Management

How does the transition into OSS management map into changes in production output and hospital performance? In this section, we explore the resource and organizational changes that follow the transition into OSS management, and discuss how these changes may have acted as key mechanisms driving the effects on hospital performance. For ease of presentation, consider a simple conceptual framework based on a standard production function, in which hospital outputs depend on operating capacity (e.g. inputs such as human L and physical capital K) and the operating efficiency (α) with which these resources are deployed: $HospOutput = \alpha \times f(L, K)$. We assess three specific channels. First, we examine whether new managers expand the hospital's operating capacity and evaluate whether increases in production output and improvements in hospital performance primarily reflect such changes. Second, we examine the same question but now look at drivers of operating efficiency. The previous section has already shown that transitioning to OSS led to significant gains in operating efficiency. Here, we shed light on two different pathways behind these gains. First, the OSS model allows the use of new management practices and more flexible contracts. Second, and irrespective of the former pathway, the OSS model may have attracted more experienced hospital managers. We assess these conjectures with a particular focus on personnel management, employment contracts, and physician productivity, as the available data allows us to provide fine-grained analyses on these margins.

6.1 Operating Capacity

Physical Capital. Table A5 begins by investigating changes in the physical capital of hospitals. We first focus on the number of hospital beds, which typically indicates hospital scale. We find an average increase of 16 hospital beds, which corresponds to 13.9% of the baseline. However, this expansion pales in comparison to the 40% rise in the number of hospital admissions, suggesting that productivity is a relevant driver of the overall growth in hospital production. To illustrate this, we can consider a simple simulation. Based on the average baseline bed turnover rate

[24] These results also mitigate concerns that the observed gains reflect moral hazard or distorted incentives leading to inefficient increases in production. Other pieces of evidence discussed throughout the paper reinforce this interpretation. If moral hazard were driving the results, one would expect admissions to rise disproportionately in less severe or lower-cost categories, such as clinical rather than surgical cases, or deferrable rather than emergency conditions. The balanced nature of the observed effects on hospital output across different types of care and levels of urgency is not consistent with such strategic behavior. The absence of changes in patient composition also reinforces the view that access expanded without selectively increasing low-value admissions.

of 35, the additional 16 beds would yield roughly 550 extra admissions per year, accounting for only 34.8% of the overall increase in hospitalizations (1578). The expected production growth driven by the estimated increase in bed turnover (from 35 to 43) is much larger: 920 additional admissions per year, holding fixed the baseline hospital size of 115 beds. Applying the productivity gain to the extra beds would further boost hospitalizations by 128. Hence, a substantial share of the increase in production stems from more efficient utilization of hospital beds, not merely from an increase in the number of beds. Also consistent with that, in Appendix Section C we examine effects on other physical resources, and document that OSS hospitals do not significantly increase the availability of technologically advanced and costly equipment (e.g., MRI, CTI, hemodialysis machine, ECMO)—investments that could otherwise expand hospital treatment capacity and performance through large capital outlays (Chandra and Skinner, 2012). Instead, they exhibit substantial growth in bedside essentials, such as infusion pumps and ECG monitors. This pattern suggests that managers prioritized replenishing basic resources—which may have boosted productivity if beds were previously idle due to a lack of essential tools—rather than pursuing major capital expansions.

Human Resources. Table A5 also presents OSS effects on personnel. Estimates reveal a 23% increase in total staff size, amounting to an addition of 78 FTE workers from a baseline of 330. An important question is whether this increase merely matched the expansion in hospital size or the hospital disproportionately expanded its workforce relative to the number of beds to strategically change the mix between physical and human resources. To investigate this, we examine the number of FTEs per 100 beds. When adjusted for bed count, the effects become small and statistically insignificant, representing just a 4.8% increase over the baseline.[25] The effect is particularly negligible for key health professionals such as physicians and nurses, whose increases represent only 1% and 2% of the baseline, respectively. Therefore, the results confirm the increase in hospital operating capacity, but indicate that the expansion of the total workforce is aligned with the expansion in hospital beds. In the next sections, we further examine changes in the composition of the workforce and its productivity.

6.2 Efficiency-Oriented Management Practices

This section analyzes whether OSS management is associated with the implementation of efficiency-driven practices. We focus on personnel practices by examining changes in workforce

[25] Previous studies on hospital privatization have found negative effects on workforce size per beds (Heimeshoff et al., 2014; Duggan et al., 2023). We conjecture that this discrepancy does not imply different underlying fundamentals regarding public versus private administration in our context. The literature on privatization suggests that, in theory, the rigid contracts typically adopted by the public sector, along with the strong presence of unions, impose restrictions on the management of state-owned enterprises, resulting in a workforce that exceeds the optimal level. This inefficiency can be eliminated when the management of these enterprises transitions to the private sector. In our setting, however, privately managed hospitals face high-volume targets, which may require maintaining or increasing the workforce size to match the higher production standards. These results can coexist with the workforce being above optimal levels pre-outsourcing, given the lower production standards in place at the time.

composition, employment contracts, and hiring and separation patterns. We focus in particular on physicians, for whom we have access to identified microdata.

6.2.1 Medical Workforce Composition and Employment Contracts

Figure 5 and Table A6 investigate whether OSS management reshapes the composition of physicians in treated hospitals. Plots (a) and (b) of Figure 5 present the effects on the average experience and specialization of physicians, respectively. We define physician experience as the number of years since registration with the Federal Council of Medicine and specialization as holding certification from recognized associations that regulate residency and medical specialization in Brazil. We find that the average experience of physicians decreases by 1.7 years in the post-OSS period, representing a 9% decline relative to the baseline. This result suggests that new managers may prefer younger physicians, who generally represent lower immediate costs and may be more adaptable to organizational changes implemented by the new management (Chong et al., 2011). Existing evidence from Brazil suggests that exogenous variation in physician seniority within public hospitals does not significantly affect the quality of care (Branco et al., 2024). We also observe that the proportion of physicians with a specialty title rises by almost 6 percentage points, or 13% of the baseline. This pattern may reflect a strategic effort to sustain the quality of care. In the next section, we document that changes in the medical workforce composition are associated with an increase in average physician productivity. Finally, in Appendix Section C, we provide additional evidence of a shift in staff composition toward higher qualifications when examining nursing personnel, reinforcing the managerial preference for more skilled professionals.

Plots (c)–(f) of Figure 5 explore changes in employment regimes. Our analysis differentiates between two types of formal employment contracts: *Estatutário* and *CLT*. As previously mentioned, the former emphasizes job stability and is highly rigid, prohibiting managers from arbitrarily modifying salaries, linking pay to performance, and setting flexible schedules. In contrast, the *CLT* contract, typically employed by private companies, offers greater flexibility. We also examine independent contracts, where hospitals contract physicians as firms—a highly flexible arrangement where physician remuneration is closely tied to their output. After the OSS implementation, we observe a significant decline in the share of doctors under *Estatutário* contracts (by 24 percentage points). This decrease is partially offset by a 9 percentage point increase in the share of *CLT* workers. The remaining reduction is compensated by a substantial rise in the share of independent contractors, up by 17 percentage points, or 52%. These changes likely reflect efforts by OSS-managed hospitals to use employment contracts to connect payment with performance and productivity.

6.2.2 Hiring, Separation and the Characteristics of New Physicians

Hiring of new physicians. The autonomy granted to OSS in personnel management may manifest through hiring decisions, a critical element in building a productive workforce. Plot

(e) of Figure 5 reveals a sharp rise in the share of newly hired workers. One year after the transition to OSS, the share of new hires rises by 11 percentage points, equivalent to 30% of the baseline average. In Brazil, the hiring process for public sector workers is typically lengthy and bureaucratic. The transition into OSS likely eased these constraints, enabling the rapid recruitment of new physicians. A key question is how managers use this flexibility. While part of the observed rise may reflect a mechanical effect of capacity expansion and reduced bureaucratic constraints, it is important to understand whether new managers use hiring to strategically reshape the workforce. To explore this, Panel B of Table A6 presents OSS effects on physician composition, focusing solely on new hires. These estimates show how the recruitment of new physicians under OSS differs from baseline. The impact on experience is positive, but small and statistically insignificant. Thus, the previously observed decline in physicians' average experience is not driven by a hiring preference for younger workers. It actually reflects higher separation rates among older incumbent workers, as documented in the next section. Yet, the transition to OSS significantly changes hiring patterns along other dimensions. OSS hospitals recruit a higher share of doctors with specialty titles. Moreover, they significantly shift the types of labor contracts used for new hires. In particular, the share of physicians hired as independent contractors increases by almost 65%. OSS hospitals also increase their use of *CLT* contracts while relying less on *Estatutário* contracts. All these changes align with the broader shifts in physician composition described earlier.

Separation of incumbent physicians. Recent literature documents that incumbent workers face higher separation rates following privatization (Arnold, 2022; Olsson and Tåg, 2025). This reflects restructuring strategies by private firms to pursue a more efficient workforce. To determine whether OSS hospitals adopt similar strategies, we redefine our analysis and implement it at the physician level, following very closely previous studies. Using identified data from the CNES, we construct a panel of physicians, restricting the sample to those already employed in the hospitals during the two periods prior to the transition into OSS (referred to here as incumbents). We then adopt the empirical strategy outlined in Section 4. In particular, we estimate the counterfactual evolution of the retention of incumbent physicians in OSS hospitals based on the retention patterns of incumbent physicians in matched control hospitals. Our main outcome is a dummy indicating a doctor's exit from the hospital. Figure 6 presents the results. Plot (a) shows a significant spike in exit rates two years following the transition, with effects gradually declining over time. On average, OSS management increases the likelihood of incumbent separation by 11 percentage points. The magnitude and temporal pattern of our effects closely mirror findings by Arnold (2022) on the privatization of Brazilian firms in the 1990s. Brazil's public labor laws have historically emphasized job stability and imposed numerous barriers to job dismissal. OSS management introduces flexibility that reduces these barriers, allowing hospitals to achieve better matches.

Separation of low-productivity physicians. To further investigate if new managers leverage their autonomy to enhance efficiency, we examine exit rates among physicians of varying productivity levels in the baseline. We gather identified data informing the number of inpatient cases handled by each physician in the two years before treatment and define productivity as the number of cases per number of hours worked. We standardize this measure by the average within each physician's specialization to account for heterogeneity across different specializations.[26] Plot (b) of Figure 6 reveals stark heterogeneity across baseline productivity levels, with effects decreasing monotonically along the distribution. The average exit rate among doctors in the lowest productivity quartile is 15 percentage points, while in the top quartile, it is just 3.4 and not statistically significant. Consistent with these results, Figure A.5 shows that the average output per physician increased by 24% in the post-OSS period, reflecting gains in input productivity. The magnitude of this effect mirrors the improvement in bed turnover, reinforcing the positive impacts of OSS management on hospital efficiency.

Heterogeneity by other characteristics. Figure A.6 investigates whether the impact of OSS on separation rates varies according to other physicians' characteristics. Plot (a) shows that the effect is lower for physicians in the lowest quartile of experience, consistent with the decrease in the average experience of the physician pool. However, it is important to note that physician experience is uncorrelated with productivity (Figure A.7 and Table A7). We also find that exit rates are similar across employment contracts and specialization (plots b and c, respectively). Overall, the results reinforce the view that separations were mainly targeted at physicians at the bottom of the baseline distribution of productivity.

6.3 Management Capacity

While our results indicate that managerial autonomy facilitates the implementation of efficiency-driven personnel practices, it is not immediately clear that the quality of management itself has changed. It is possible that state managers were equally capable but constrained by rigid public sector regulations that limited their ability to enact similar changes. To examine whether changes in management quality influence the observed outcomes after outsourcing, we test if our results vary with the organizational capabilities of the private firms now managing public hospitals. Our analysis focuses on experience, a key dimension of a firm's productivity (Syverson, 2011).[27] We estimate heterogeneous effects by comparing hospitals managed by newer firms to

[26]Naturally, some specializations focus on more complex cases that might take more time for physicians to treat. Results remain nearly unchanged if we do not make such adjustments.

[27]The concept of "experience" aligns with the resource-based view (RBV) of the firm (Wernerfelt, 1984; Barney, 1991), which emphasizes how valuable, rare, inimitable, and well-organized resources drive sustained competitive advantage. Experience reflects not only accumulated operational learning—commonly linked to efficiency gains through learning-by-doing (Syverson, 2011)—but also firm-specific organizational capabilities that enhance adaptability to complex demands (Teece et al., 1997; Peteraf, 1993). These capabilities, critical in healthcare management, allow firms to implement personnel and operational adjustments more effectively. Thus, we hypothesize that greater accumulated experience enables firms to better leverage these capabilities, driving the efficiency gains observed under the OSS model.

those managed by older firms, using a median split on the number of years the OSS operates in the market.[28] In the following analyses, we exclude hospitals with extreme production outputs at baseline from our sample, which creates a more balanced comparison between hospitals managed by more and less experienced OSS.[29] We later show that our results remain stable with the inclusion of these extreme cases and robust to another strategy for balancing the sample.

Hospital performance. Figure 7 and Table 4 show that the effects of OSS on production output and bed turnover are driven by more experienced firms. Public hospitals managed by more experienced OSS saw an average increase of 2,016 admissions (54% of the baseline) in the five years following the transition, compared to a smaller increase of 694 admissions (21%) in hospitals managed by less experienced firms. The differences in productivity across firms are even more pronounced. Bed turnover in hospitals managed by experienced OSS increased by an average of 14.8 (40%), compared to only 1.1 (3%) in hospitals under less experienced firms. Table 4 also shows that the average length of stay decreases substantially more in hospitals managed by more experienced OSS firms. Importantly, we find no evidence of compromised quality, as measured by hospital mortality and readmission rates, with average effects being practically null and statistically insignificant. Yet, we observe substantially larger reductions in population mortality in municipalities where the transitioned OSS hospital is managed by a more experienced firm. In these municipalities, mortality declines by 2.8 deaths per 10,000 people, which is equivalent to a 4.5% decline relative to the baseline rate. In contrast, the effect is smaller and not statistically significant where the managing firm is less experienced (−0.6 deaths or 1% of the baseline).[30]

Operating capacity. We further examine whether heterogeneity in performance maps on heterogeneity in potential mechanisms. Panel A of Table A8 presents the results on aggregate hospital inputs. Both types of firms expanded hospital capacity in similar proportion, as measured by the number of beds. If anything, the impact among less experienced OSS firms was higher: 15.2 (14.7%) versus 12.2 (10.7%). The increased production output among the less experienced OSS firms seems to be almost entirely driven by enhanced operating capacity. Holding the baseline bed turnover constant, the extra beds should produce 530 new admissions, which refers to 77% of the total impact on production. We do not see substantial differences in the overall availability of employees across groups. These results reinforce the view that

[28]This measure relies on the year the primary holding of the OSS was registered. We gather this information from the Map of Civil Society Organizations, encompassing all third-sector firms in the country engaged in contractual agreements with the state to provide public services (including the OSS). The map records the registration year of each firm, with data sourced from the Brazilian Federal Revenue Service. The median OSS experience is 24 years. On average, older firms have 44 years of experience, while newer ones have 10 years.

[29]Specifically, we exclude hospitals in the bottom 10% and top 10% of the distribution. The largest hospitals in our sample are predominantly managed by more experienced OSS.

[30]Municipalities with hospitals managed by more and less experienced OSS firms have, on average, the same supply of hospital beds at baseline: 21 beds per 10,000 inhabitants. Therefore, this heterogeneity by firm experience does not reflect the heterogeneity in effects according to baseline bed availability, as previously discussed.

efficiency gains, more likely to be achieved by experienced firms, are the primary driver of hospital output growth.

Management practices. We also find stark heterogeneity across more and less experienced OSS in personnel practices. Table A8 explores heterogeneous effects on the composition of physicians (including their employment contracts) and hiring (Panel A). Although both groups substantially altered employment contracts of physicians, the shift away from rigid contracts was much less pronounced among the less experienced firms. Conversely, the use of independent contracts was more prevalent among the more experienced firms. We do not find significant differences between the groups in terms of the average experience of physicians and the share of specialists. The more experienced OSS are also more likely to increase hiring once they assume the management of public hospitals. Consistent with these findings, Panel B of Table A8 reveals that the positive impact on the exit rate of incumbent physicians is nearly four times higher in hospitals managed by more experienced firms compared to those managed by less experienced firms—and, as before, is driven by less productive doctors. Therefore, while the OSS model offers managerial flexibility, it does not automatically lead to the adoption of new management practices. Managerial skills seem to be crucial for the full capitalization of this autonomy. These findings align with the literature on management practices, which consistently documents a strong relationship between firm age, better management practices, and improved organizational performance (e.g. Bloom et al., 2016).

Robustness. A potential concern with previous results is that more experienced OSS firms might select into, and win bids for, hospitals already better positioned for performance gains. In our setting, hospitals managed by more experienced OSS firms have higher production outputs and bed turnover rates at baseline (as shown below). Although this might imply that such hospitals are harder to improve (contrary to the initial concern), we examine whether pre-existing differences across hospitals drive the observed heterogeneity in our results.

For ease of comparison, columns (1) and (2) of Table A9 replicate the primary findings from the previous section, which are based on a sample of treated hospitals comparable across OSS experience levels. Columns (3) and (4) then re-assess the heterogeneity analyses by including all the treated hospitals. A comparison of baseline means (in brackets) confirms that hospitals are not fully balanced across OSS experience levels. The differences across groups increase substantially relative to our baseline specification. Still, the results are virtually the same in both analyses, indicating that baseline differences across hospitals are unlikely to explain the heterogeneity in outcomes.

To further assess this issue, we implement an alternative specification. We estimate the propensity score for being managed by a high-experience OSS and apply an inverse probability weighting scheme.[31] Columns (5) and (6) of Table A9 present the results. Notably, this approach

[31] Hospitals managed by high-experience OSS receive weights based on the inverse of the propensity score, and hospitals managed by low-experience OSS receive weights based on the inverse of 1 minus the propensity score.

further improves the balance between groups. Yet, the observed heterogeneity in outcomes persists. If anything, it becomes more pronounced. For example, the effect on the number of admissions is 2,439 for hospitals with high-experience OSS, compared to 463 for hospitals with low-experience OSS. Similarly, the impact on bed turnover is 16 for hospitals managed by experienced OSS versus 0.19 for those with less experienced OSS. Overall, these findings suggest that the heterogeneity in outcomes reflects the influence of OSS experience rather than pre-existing hospital characteristics correlated with OSS experience.

7 Cost-Effectiveness

In this section, we assess the cost-effectiveness of the OSS model. Access to accurate hospital expenditure and cost data in Brazil is limited, as data sources are decentralized to local governments and are rarely disclosed at the facility level. To address this constraint, we compiled the available data from a sample of 18 public hospitals in the state of São Paulo, including both government-managed and OSS-managed facilities. These hospitals are comparable in size and scope to those in our main sample. We then examine trends in costs and service production across these units. Detailed calculations, data sources, and robustness checks are presented in Appendix Section D.

We find that, on average, OSS hospitals have a 12% lower cost per admission (R$15.89 thousand) compared to government-managed hospitals (R$18.14 thousand). Another way to assess cost-effectiveness is to compare how much investment each model would require to achieve a given improvement in service delivery. Due to differences in productivity, we estimate that government-managed hospitals would need to add 43 beds to increase admissions by 1,500 per year, whereas OSS-managed hospitals would need only 16 beds. Over a five-year period, the total present value of this expansion would be 22% higher for government-managed hospitals than for their OSS counterparts (R$372.6 million vs. R$306.6 million). Importantly, we also find expansion in access to services at the local level and reductions in population-level mortality rates, which means even greater benefits in terms of lives saved and access to hospital care at significantly lower costs per admission.

8 Concluding Remarks

Governments around the world have increasingly outsourced the delivery of public goods and services to the private sector, using a variety of models ranging from public-private partnerships to full privatization. Economic theory suggests that outsourcing can improve efficiency, but it may also incentivize cost-cutting strategies that compromise service quality and equity — particularly when private firms retain surplus rights. Against this backdrop, we study Brazil's OSS model, a distinctive governance approach that transfers hospital management to private non-profit organizations while retaining public control over surplus rights and enforcing contractible performance targets. To evaluate its effects, we built a new administrative dataset from Brazil's healthcare system and implemented a difference-in-differences design exploiting staggered transitions from government to OSS management over time.

Our findings show that the OSS model substantially increases hospital production and productivity without sacrificing quality or equity. The increase in production contributes to addressing previously unmet demand, expanding access to hospital care for the local population—particularly in underserved areas—and leading to a measurable reduction in population mortality. These performance gains are only partly explained by increased operational capacity. Although inputs such as bed supply expand following OSS transitions, they account for only a small share of the observed increase in hospital output. We find no evidence of large investments in advanced medical equipment, and the sizable productivity gains instead point to more efficient resource allocation. Managerial flexibility, particularly in personnel management, emerges as a key mechanism. OSS hospitals increasingly adopt flexible hiring arrangements, shift workforce composition toward specialized physicians, and exhibit higher exit rates among low-productivity incumbent workers. Managerial experience also plays an important role. More experienced OSS providers achieve larger gains in output and efficiency, and these gains translate into greater improvements in population health. They are also more likely to implement performance-oriented personnel policies. In contrast, less experienced firms rely more heavily on input expansion and show smaller productivity improvements. This heterogeneity has important policy implications and suggests that the careful selection of OSS providers—with a strong emphasis on experience and demonstrated managerial capabilities—is crucial for realizing the full potential of service outsourcing.

Our results underscore that the effects of outsourcing depend critically on governance design. The OSS model offers a middle ground between direct public provision and full privatization, combining managerial flexibility with public oversight and contractable performance targets. These findings suggest that well-designed governance arrangements can mitigate the classic efficiency–quality trade-off in healthcare delivery. This insight is particularly relevant given the substantial variation in outsourcing models observed across and within health systems worldwide.

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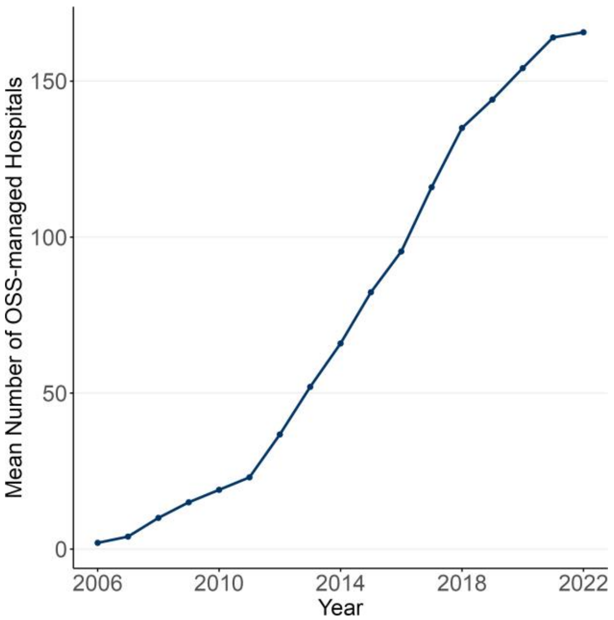
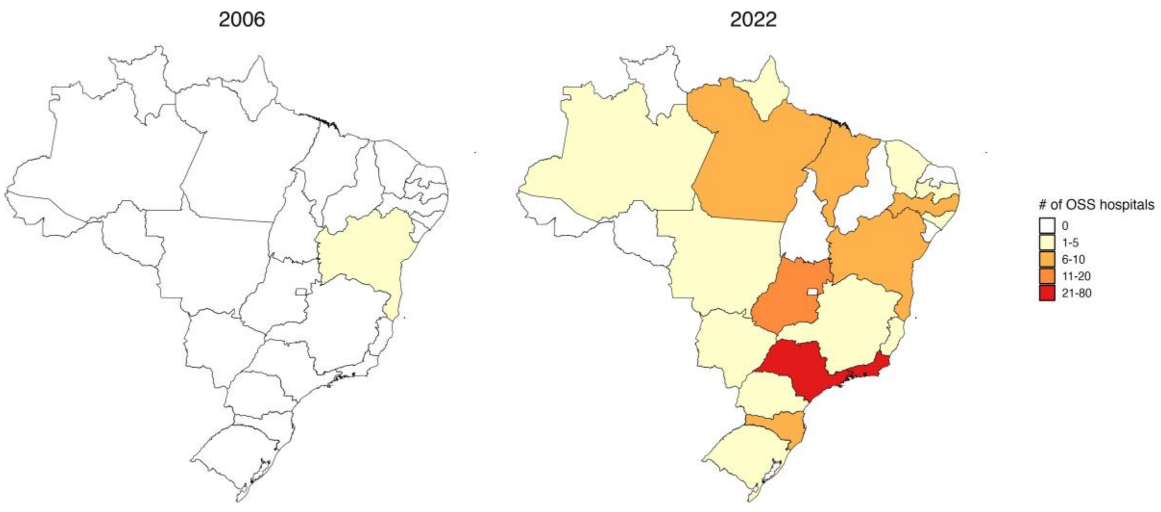
Figure (1) Hospitals Managed by OSS

Panel A: By year

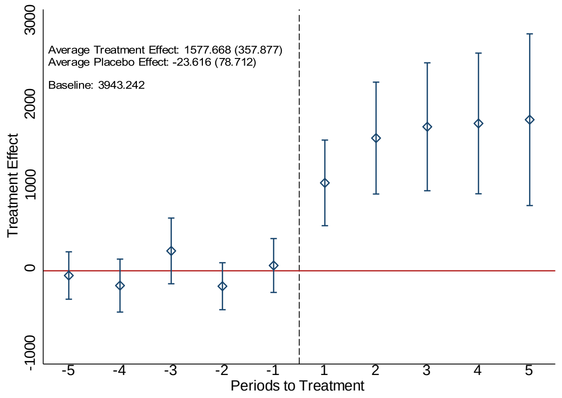


Panel B: By state

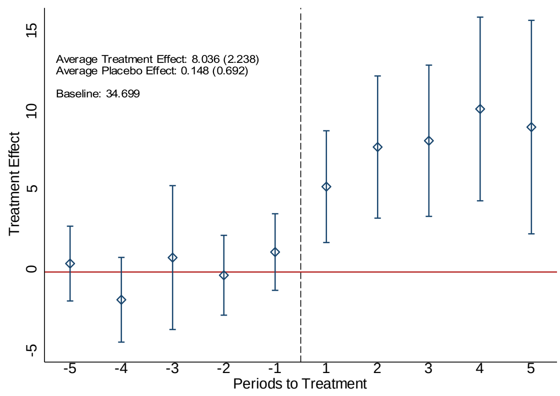


Notes: This figure presents the distribution of hospitals managed by OSS between 2006 and 2022. Panels A and B present the distribution by year and Brazilian states, respectively. The sample includes public hospitals initially operated by governments that transitioned to OSS management.

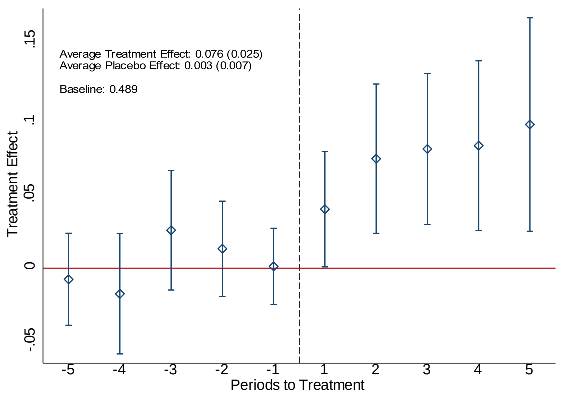
Figure (2) Treatment effects on hospital admissions and productivity measures



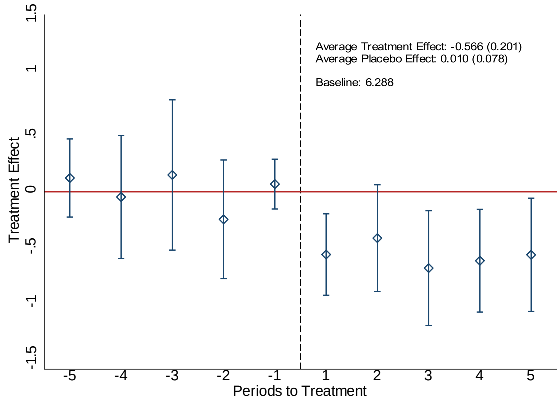
(a) Number of hospital admissions



(b) Bed turnover



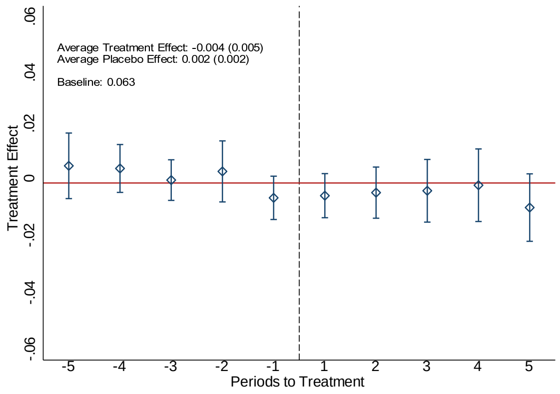
(c) Bed occupancy



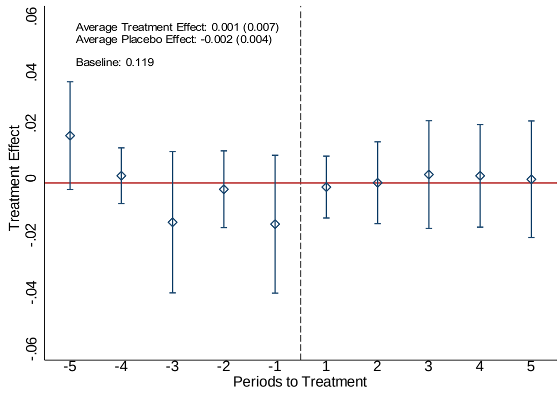
(d) Average length-of-stay

Notes: This figure plots 95% confidence bands computed with a hospital-level clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on the number of hospital admissions (panel a), bed turnover (panel b), bed occupancy (panel c), and average length-of-stay (panel d). The Average Treatment Effect computes an average of the estimators for each event-time ranging from one to five. The Average Placebo Effect is analogously defined for the negative event-times. In parenthesis, standard errors are computed with a hospital-level clustered bootstrap. The baseline indicates the sample mean for treated hospitals in the five years prior to OSS.

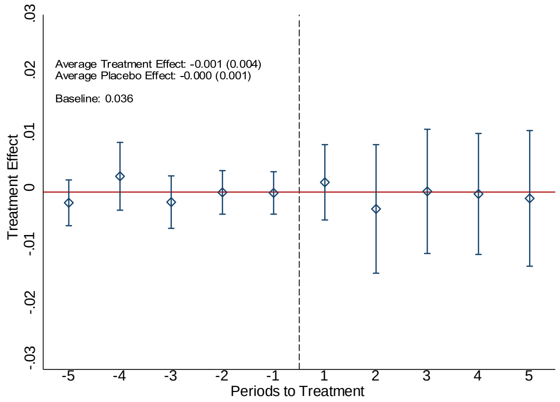
Figure (3) Treatment effects on hospital quality measures



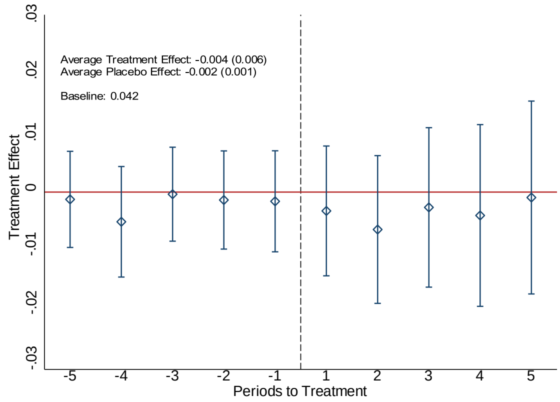
(a) Death rate all causes



(b) Death rate due to ECSC



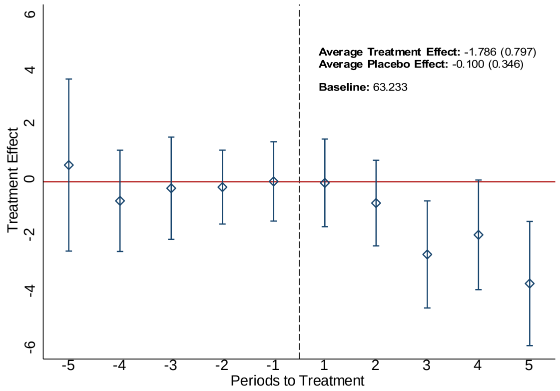
(c) Readmission rate all causes



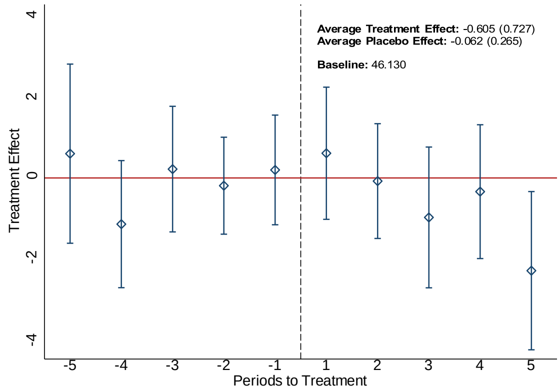
(d) Readmission rate due to ECSC

Notes: This figure plots 95% confidence bands computed with a hospital-level clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on in-hospital death rates for all causes (panel a), in-hospital death rates due to emergency care–sensitive conditions (panel b), readmission rates for all causes (panel c), and readmission rates due to emergency care–sensitive conditions (panel d). The Average Treatment Effect computes an average of the estimators for each event-time ranging from one to five. The Average Placebo Effect is analogously defined for the negative event-times. In parenthesis, standard errors are computed with a hospital-level clustered bootstrap. The baseline indicates the sample mean for treated hospitals in the five years prior to OSS.

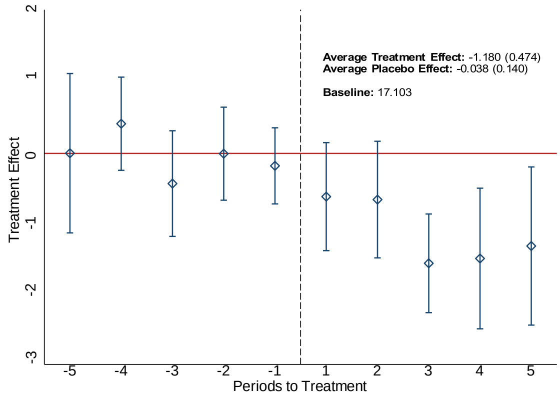
Figure (4) Treatment effects on population mortality



(a) Total



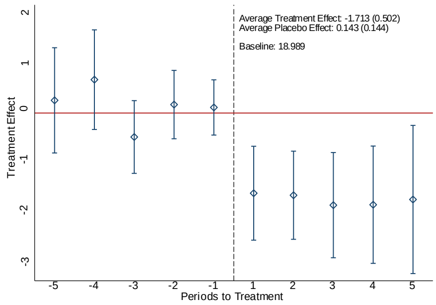
(b) At health facilities



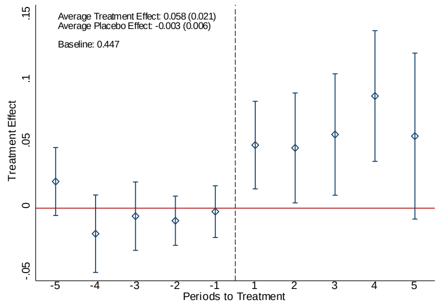
(c) At home or in public spaces

Notes: This figure plots 95% confidence bands computed with a municipality-level clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on the number of deaths per 10,000 inhabitants at the municipal level (panel a), deaths occurring in health facilities (panel b), and deaths occurring outside the health system (i.e., at home or in public spaces) (panel c). The Average Treatment Effect computes an average of the estimators for each event-time ranging from one to five. The Average Placebo Effect is analogously defined for the negative event-times. In parenthesis, standard errors are computed with a municipality-level clustered bootstrap. The baseline indicates the sample mean for treated hospitals in the five years prior to OSS.

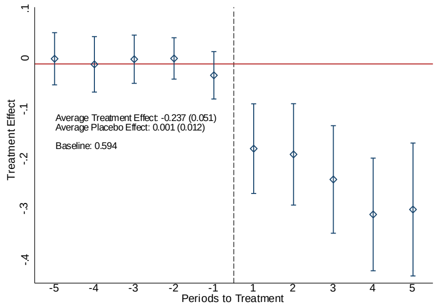
Figure (5) Treatment effects on physicians' composition



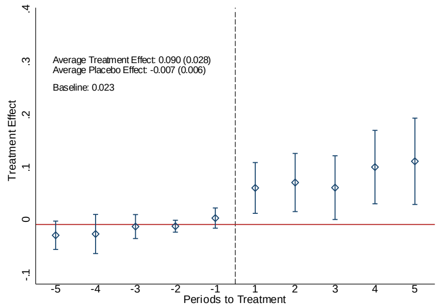
(a) Average Experience



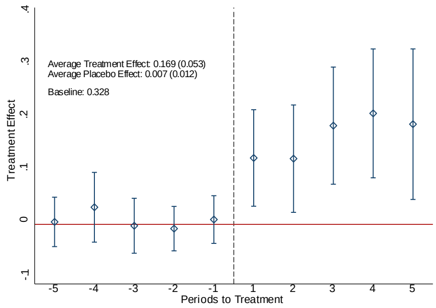
(b) % Specialty title



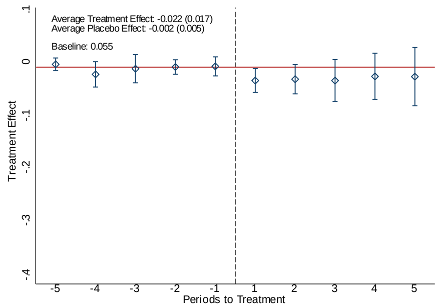
(c) Labor contract: % *Estatutário*



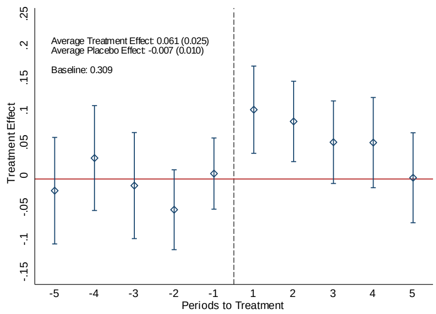
(d) Labor contract: % CLT



(e) Labor contract: % Independent



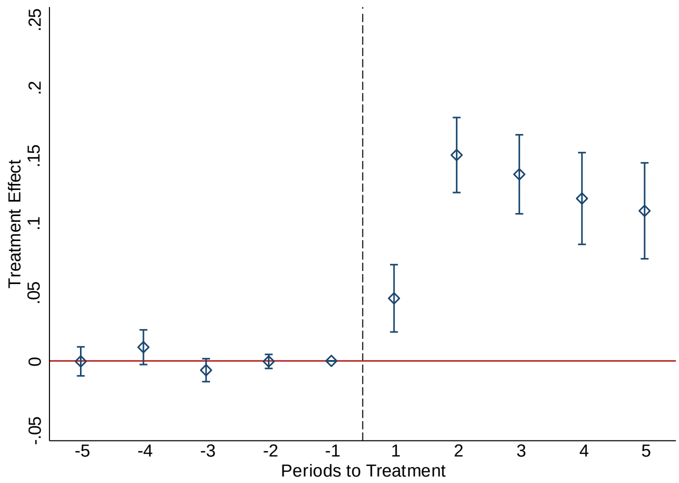
(f) Labor contract: % Other



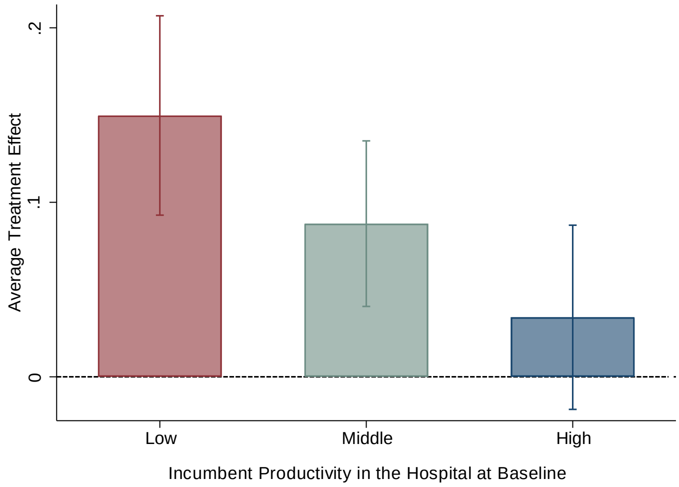
(g) Hiring probability: % new hires

Notes: This figure plots 95% confidence bands computed with a hospital-level clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on the average experience of physicians (panel a), the share of physicians with a specialty title (panel b), the share of physicians under four employment regimes—*Estatutário* (panel c), CLT (*Celetista*) (panel d), independent contractor (panel e), and other (panel f), and the share of newly hired physicians (panel g). The Average Treatment Effect computes an average of the estimators for each event-time ranging from one to five. The Average Placebo Effect is analogously defined for the negative event-times. In parenthesis, standard errors are computed with a hospital-level clustered bootstrap. The baseline indicates the sample mean for treated hospitals in the five years prior to OSS.

Figure (6) Treatment effects on the probability of a job transition or layoff among incumbent physicians —physician-level analysis



(a) Effects for all incumbents

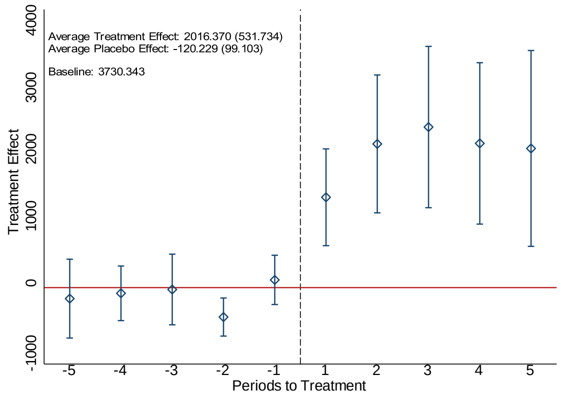


(b) Heterogeneous effects by baseline productivity

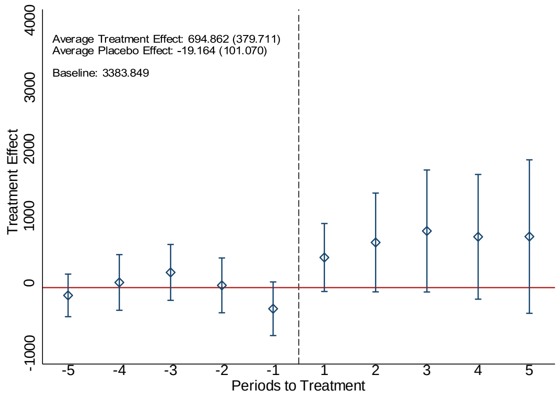
Notes: Panel A plots 95% confidence bands computed with a hospital-level clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on the probability that an incumbent physician transitions jobs or is laid off. Panel B plots the average treatment effects—computed as the mean of the estimates for each event-time ranging from one to five—for incumbents with low (first quartile), middle (second and third quartiles), and high (last quartile) productivity at baseline. Productivity is measured as the number of cases handled by an incumbent at baseline relative to hours worked. This measure is standardized by the average within each physician's specialization to account for heterogeneity across different specializations. Incumbent physicians are defined as those working at the hospital in the years $g-2$ and $g-1$, where g represents the treatment year. The analysis sample is restricted to incumbent workers in the treated hospitals and their respective matched controls.

Figure (7) Treatment effects on hospital admissions and productivity measures, by OSS experience

Panel A: Hospital admissions

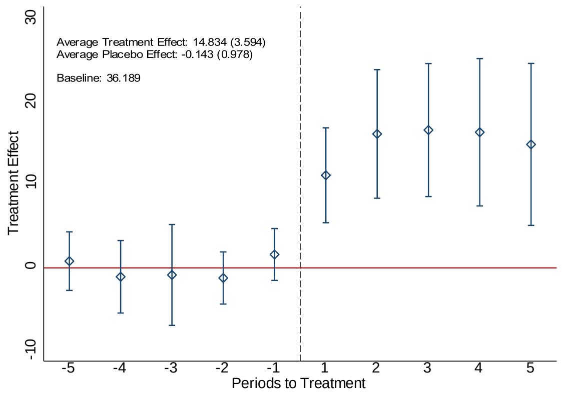


(a) OSS experience: High

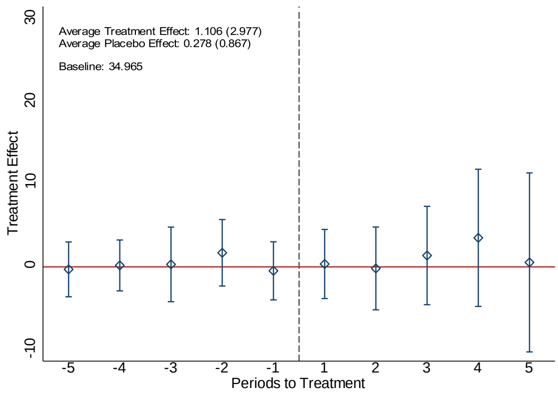


(b) OSS experience: Low

Panel B: Bed turnover



(c) OSS experience: High



(d) OSS experience: Low

Notes: This figure plots 95% confidence bands calculated with a hospital-level clustered bootstraps and DiD estimators for treatment and placebo effects of the OSS model on total hospital admissions (Panel A) and admissions per bed (Panel B), separately for hospitals managed by OSS entities with high and low experience. High- and low-experience groups are defined based on a median split in the number of years the OSS operate in the market. The Average Treatment Effect calculates an average of the estimators for each event time, ranging from one to five. The Average Placebo Effect is defined analogously for negative event times. In parentheses, standard errors are calculated with hospital-level clustered bootstraps. The baseline indicates the sample mean for treated hospitals in the five years prior to OSS.

Table (1) Treatment effects on admissions and productivity measures

	2-year effect (1)	5-year effect (2)	Placebo effect (3)	Mean at baseline (4)
Hospital admissions	1312.274	1577.668	-23.616	3943.242
	(288.763)	(357.877)	(78.712)	
Type of care				
Surgical	403.015	480.399	19.812	1182.867
	(124.191)	(147.480)	(31.115)	
Clinical	299.228	532.096	-37.876	1216.113
	(95.602)	(123.382)	(28.504)	
Obstetric	344.927	316.217	-17.496	890.904
	(122.282)	(142.503)	(31.599)	
Other	265.104	248.957	11.944	653.358
	(95.084)	(115.083)	(14.855)	
Emergency-care sensitive conditions				
Yes	262.873	397.047	4.298	894.956
	(75.801)	(101.398)	(19.303)	
No	1049.401	1180.621	-27.914	3048.287
	(232.274)	(289.110)	(64.014)	
Bed turnover rate	6.506	8.036	0.148	34.699
	(1.888)	(2.238)	(0.692)	
Bed occupancy rate	0.058	0.076	0.003	0.489
	(0.021)	(0.025)	(0.007)	
Average length-of-stay	-0.486	-0.566	0.010	6.288
	(0.198)	(0.201)	(0.078)	

Notes: This table reports the average effects of the OSS model on hospital production and productivity measures. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable in the five years prior to OSS.

Table (2) Treatment effects on hospital quality measures

	2-year effect	5-year effect	Placebo effect	Mean at baseline
	(1)	(2)	(3)	(4)
Death rate all causes	-0.004	-0.004	0.002	0.063
	(0.004)	(0.005)	(0.002)	
Death rate due to ECSC	-0.001	0.001	-0.002	0.119
	(0.006)	(0.007)	(0.004)	
Readmission rate all causes	-0.001	-0.001	-0.000	0.036
	(0.004)	(0.004)	(0.001)	
Readmission rate due to ECSC	-0.005	-0.004	-0.002	0.042
	(0.006)	(0.006)	(0.001)	

Notes: This table reports the average effects of the OSS model on in-hospital death and readmission rates. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable in the five years prior to OSS. ECSC refers to emergency care-sensitive conditions.

Table (3) Treatment effects on population mortality

	2-year effect (1)	5-year effect (2)	Placebo effect (3)	Mean at baseline (4)
Total	-0.401	-1.786	-0.100	63.928
	(0.770)	(0.797)	(0.346)	
At health facilities	0.263	-0.605	-0.062	45.664
	(0.792)	(0.727)	(0.265)	
At home or in public spaces	-0.664	-1.180	-0.038	18.264
	(0.468)	(0.474)	(0.140)	

Notes: This table reports the average effects of the OSS model on municipality-level deaths per 10,000 inhabitants. Standard errors in parenthesis are computed using a municipality-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable in the five years prior to OSS.

Table (4) Treatment effects on hospital performance, by OSS experience

	OSS Experience	
	High	Low
	(1)	(2)
Hospital admissions	2016.370	694.862
	(531.734)	(379.711)
	[3730.343]	[3383.849]
Bed turnover rate	14.834	1.106
	(3.594)	(2.977)
	[36.189]	[34.965]
Average length of stay	-0.772	-0.374
	(0.318)	(0.327)
	[5.810]	[6.211]
Death rate all causes	-0.006	0.003
	(0.008)	(0.006)
	[0.075]	[0.042]
Death rate due to ECSC	0.005	0.008
	(0.013)	(0.008)
	[0.134]	[0.102]
Readmission rate all causes	0.000	0.000
	(0.006)	(0.006)
	[0.030]	[0.040]
Readmission rate due to ECSC	-0.003	-0.006
	(0.006)	(0.010)
	[0.037]	[0.047]
Population mortality	-2.824	-0.591
	(0.915)	(1.148)
	[65.066]	[61.683]

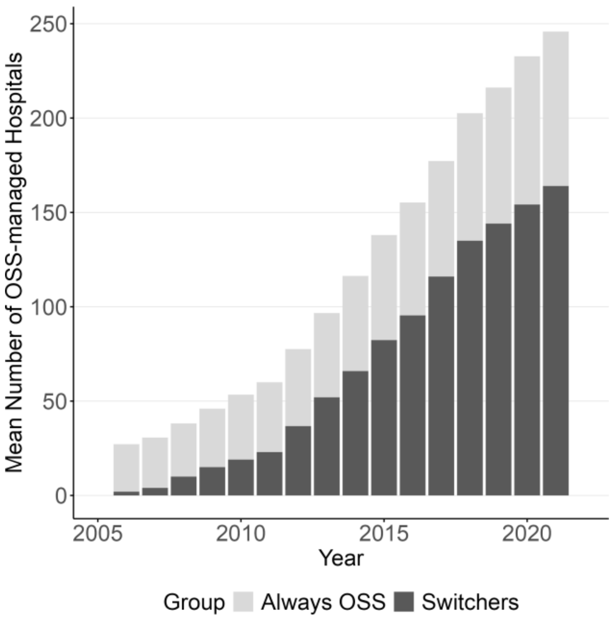
Notes: This table reports the average effects of the OSS model on hospital production, productivity, and care, separately for hospitals managed by OSS entities with high and low experience. High- and low-experience groups are defined based on a median split in the number of years the OSS operate in the market. Population mortality refers to the number of deaths per 10,000 inhabitants at the municipal level. The average effects are defined by the average of the DiD estimators for each event-time ranging from one to five. Standard errors in parentheses are calculated using hospital-level clustered bootstraps. The baseline mean for each variable is presented in brackets. The results consider a sample of hospitals that are more similar at baseline.

Online Appendix

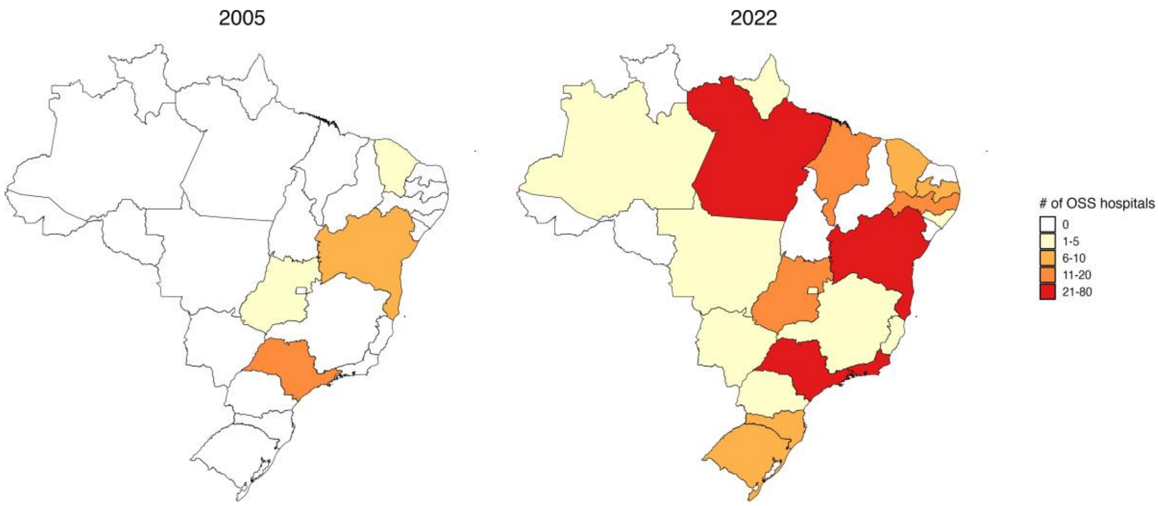
A Additional Figures and Tables

Figure (A.1) Hospitals Managed by OSS: Always-OSS and Switchers

Panel A: By year

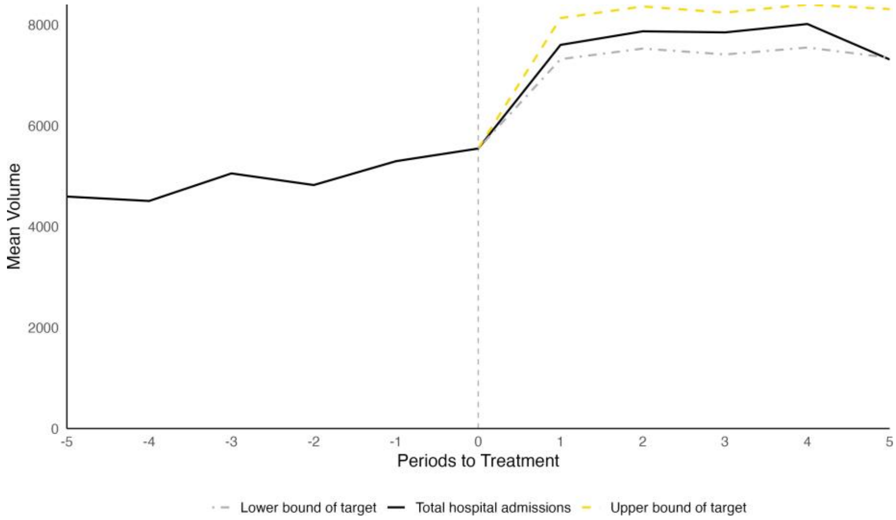


Panel B: By state



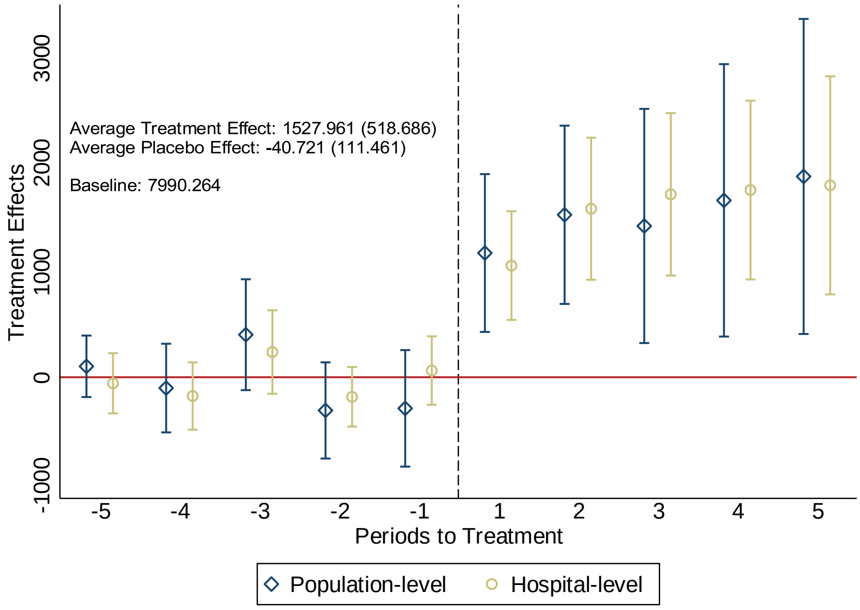
Notes: This figure presents the distribution of hospitals managed by OSS (switchers and always-OSS) between 2005 and 2022. Panels A and B present the distribution by year and Brazilian states, respectively. Always-OSS refer to hospitals that were created under OSS management. Switchers refers to public hospitals initially managed by the government and that transitioned to OSS management.

Figure (A.2) Hospital Admissions and Volume Targets



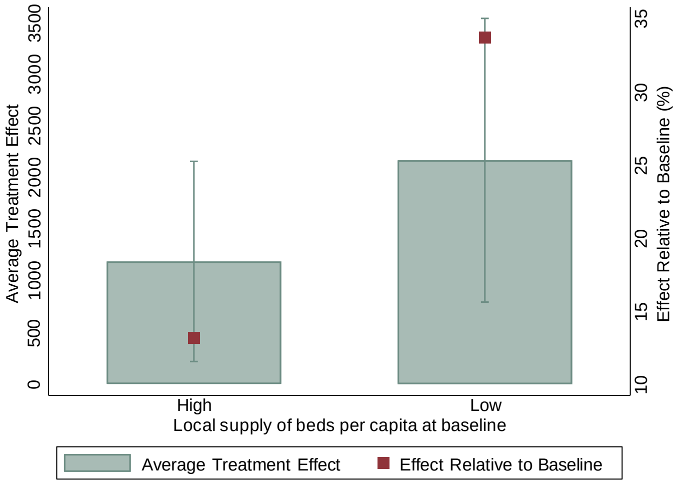
Notes:: This figure presents data from 11 hospitals in the treated sample. The vertical line marks the start of the OSS contracts. We manually extracted hospital admission targets from the OSS contracts and compared them with actual admission volumes, obtained from the Hospital Information System (SIH/Datasus). The contracts specify volume targets for all types of admissions. The lower bound of the target represents the threshold below which the hospital incurs penalties for failing to meet volume requirements, while the upper bound sets the maximum target for full incentive alignment.

Figure (A.3) Treatment effects on population-level hospital admissions

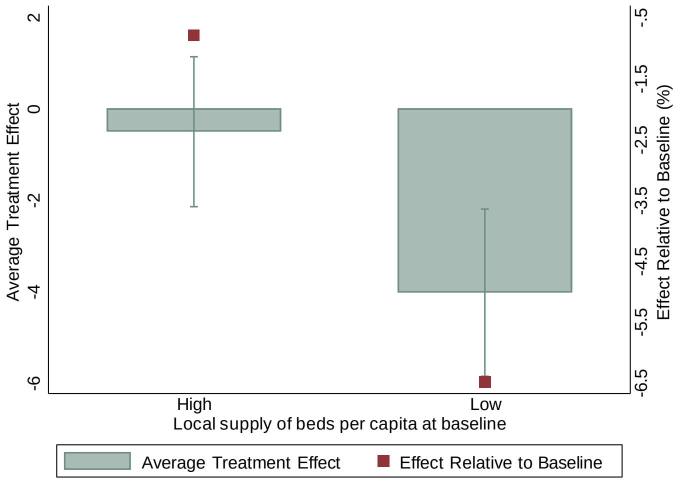


Notes:: This figure plots 95% confidence bands computed with a municipality-level (blue) and hospital-level (yellow) clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on total hospital admissions at both the municipality and hospital levels. The Average Treatment Effect computes an average of the estimators for each event-time ranging from one to five. The Average Placebo Effect is analogously defined for the negative event-times. In parenthesis, standard errors are computed using clustered bootstrap at the corresponding level. The baseline indicates the sample mean for treated hospitals in the five years prior to OSS.

Figure (A.4) Treatment effects on population-level outcomes, by local supply of hospital beds per capita at baseline



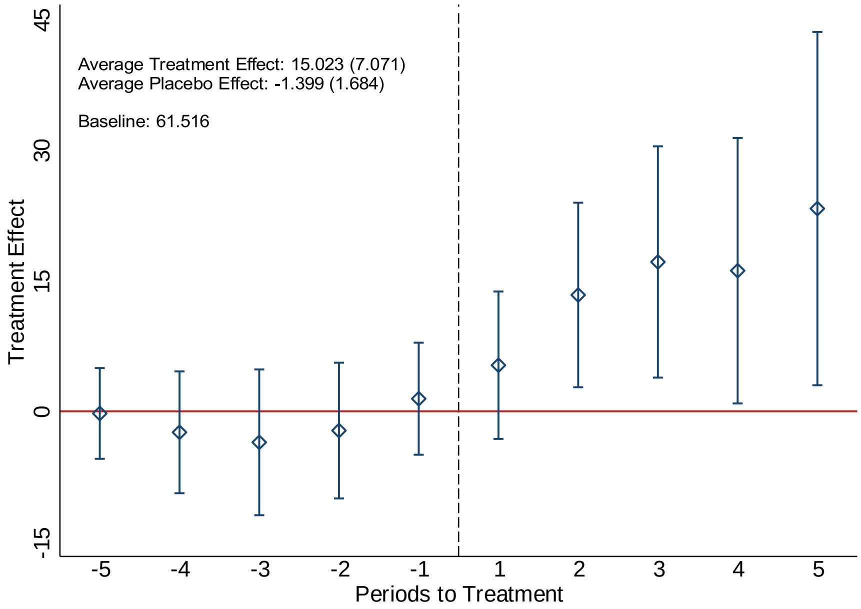
(a) Hospital Admissions



(b) Population Mortality

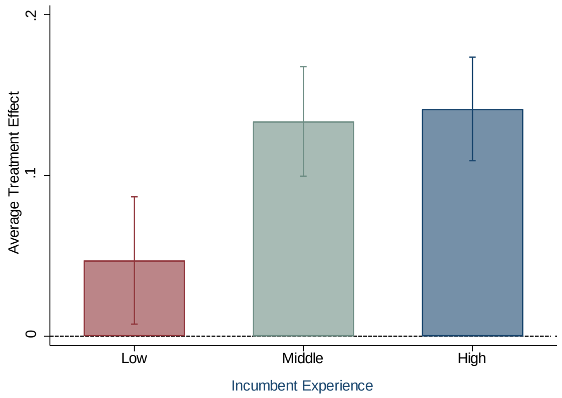
Notes: This figure plots population-level average treatment effects, calculated as the mean of event-time estimates from one to five years after OSS implementation, separately for municipalities with low (below-median) and high (above-median) baseline hospital bed supply per capita. Panel (a) presents results for hospital admissions; panel (b) for population mortality, measured as deaths per 10,000 inhabitants. Red dots indicate the estimated effect relative to the pre-treatment baseline mean in each group.

Figure (A.5) Treatment effects on output production per physicians

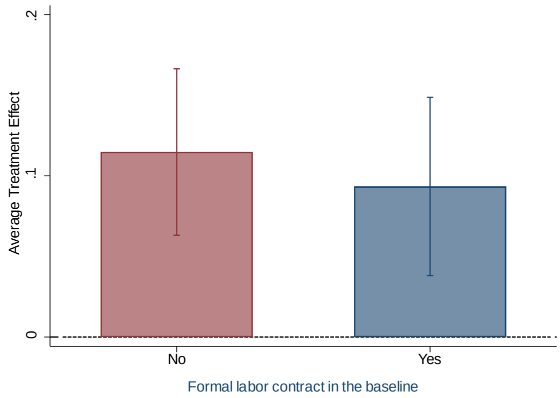


Notes: This figure plots 95% confidence bands computed with a health hospital-level clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on hospital admissions per physicians. The Average Treatment Effect computes an average of the estimators for each event-time ranging from one to five. The Average Placebo Effect is analogously defined for the negative event-times. In parenthesis, standard errors are computed with a hospital-level clustered bootstrap. Baseline indicates the sample mean value for the treated hospital in the years prior to OSS.

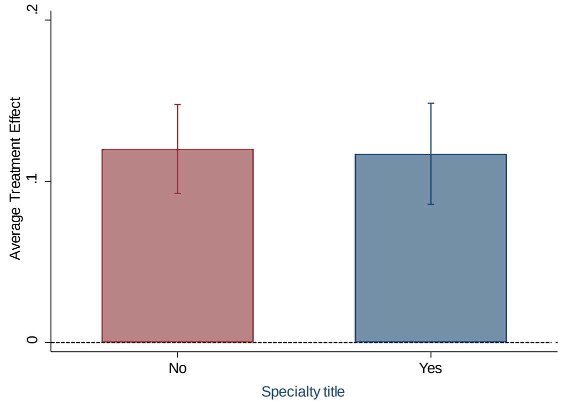
Figure (A.6) Heterogenous treatment effects on the probability of a job transition or layoff among incumbent physicians —physician-level analysis



(a) By experience



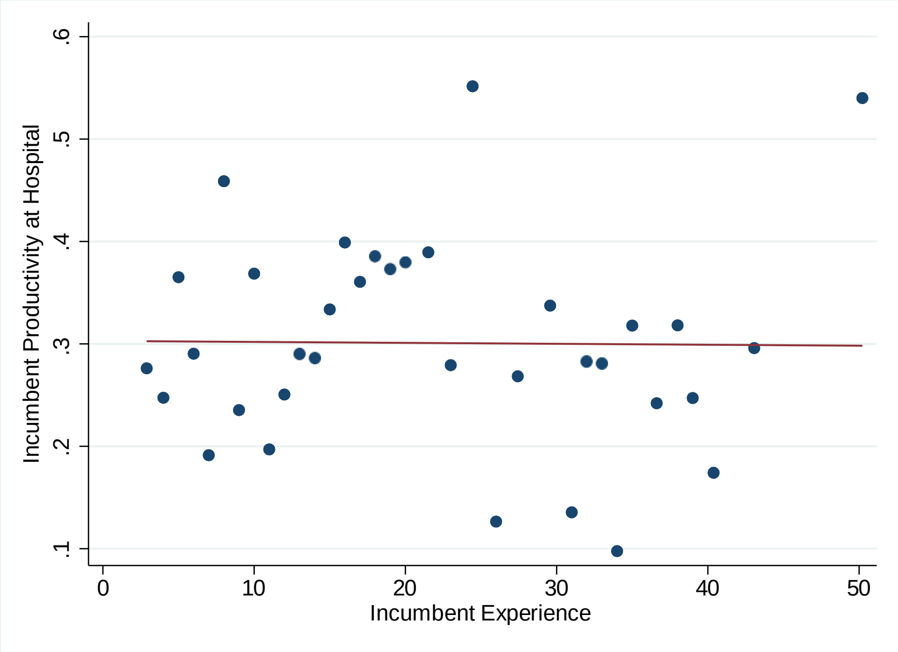
(b) By labor contract



(c) By speciality

Notes: This figure plots 95% confidence bands computed with a hospital-level clustered bootstrap and the average effects of the OSS model on the probability that an incumbent physician transitions jobs or is laid off. The average effects are defined by the average of the DiD estimators for each event-time ranging from one to five. Panel A plots the results for incumbents with low (first quartile), middle (second and third quartiles), and high (last quartile) experience (years of practice). Panel C plots the results for incumbents with formal and informal (independent arrangement) labor contracts at baseline. Panel B plots the results for incumbents with and without specialty titles. Incumbent physicians are defined as those working at the hospital in the years $g-2$ and $g-1$, where g represents the treatment year. The analysis sample is restricted to incumbent workers in the treated hospitals and their respective matched controls.

Figure (A.7) Association between incumbent physicians' productivity and experience at baseline



Notes: This figure plots binned scatterplots describing the mean relationship between incumbent productivity and experience at baseline. Productivity is measured as the number of cases handled by an incumbent at baseline relative to hours worked. This measure is standardized by the average within each physician's specialization to account for heterogeneity across different specializations. Experience is measured by the number of years of medical practice. Incumbent physicians are defined as those working at the hospital in the years $g-2$ and $g-1$, where g represents the treatment year. The analysis sample is restricted to incumbent workers in the treated hospitals and their respective matched controls.

Table (A1) Summary Statistics

	OSS Hospitals	Matched Comparison Hospitals	All Public Hospitals
Physicians	69.705	79.096	33.373
	(63.824)	(152.644)	(95.444)
Other workers	254.393	254.332	146.801
	(217.785)	(396.661)	(325.096)
Beds	114.514	109.392	69.494
	(75.304)	(116.466)	(97.219)
Medical equipment	159.380	147.214	80.585
	(168.424)	(254.540)	(217.456)
Hospital admissions	3955.732	4011.174	2164.273
	(3368.910)	(4464.456)	(3595.136)
Bed turnover	34.833	36.014	28.329
	(20.253)	(21.729)	(21.083)
Bed occupancy	0.488	0.416	0.306
	(0.247)	(0.258)	(0.264)
Average length of stay	6.222	4.987	4.513
	(4.204)	(3.516)	(4.401)
Death rate	0.042	0.057	0.028
	(0.032)	(0.043)	(0.044)
Readmission rate	0.035	0.041	0.045
	(0.027)	(0.024)	(0.050)
North	0.021	0.023	0.135
	(0.144)	(0.151)	(0.341)
Northeast	0.229	0.230	0.430
	(0.423)	(0.423)	(0.495)
Southeast	0.552	0.540	0.198
	(0.500)	(0.501)	(0.398)
South	0.063	0.080	0.107
	(0.243)	(0.274)	(0.309)
Centerwest	0.135	0.126	0.132
	(0.344)	(0.334)	(0.338)
Hospital-time pairs	1,531	1,531	33,340

Notes: In columns (1) and (2), variables are measured in the five years prior to OSS. In column (3), variables are measured during the entire period, with data from each year receiving weights according to the treatment size of that particular period. Standard deviations in parentheses.

Table (A2) Hazard estimation of the probability of public hospitals switching to OSS management (marginal effects)

	(1)	(2)
Beds	0.00023	0.00016
	(0.00017)	(0.00022)
Medical equipment	-0.00001	-0.00001
	(0.00004)	(0.00005)
Physicians	-0.00010	-0.00016
	(0.00008)	(0.00011)
Other workers	0.00001	0.00003
	(0.00003)	(0.00005)
Hospital admissions	-0.00000	0.00000
	(0.00000)	(0.00000)
Death rate	-0.00156	0.00748
	(0.01676)	(0.02240)
$\Delta_{-1,Short}$ Beds	-0.00002	
	(0.00034)	
$\Delta_{-1,Short}$ Medical equipment	0.00001	
	(0.00007)	
$\Delta_{-1,Short}$ Physicians	0.00004	
	(0.00012)	
$\Delta_{-1,Short}$ Other workers	0.00001	
	(0.00006)	
$\Delta_{-1,Short}$ Hospital admissions	0.00000	
	(0.00000)	
$\Delta_{-1,Short}$ Death rate	0.00239	
	(0.01496)	
$\Delta_{-1,Long}$ Beds		0.00003
		(0.00022)
$\Delta_{-1,Long}$ Medical equipment		0.00001
		(0.00004)
$\Delta_{-1,Long}$ Physicians		0.00015
		(0.00011)
$\Delta_{-1,Long}$ Other workers		0.00002
		(0.00004)
$\Delta_{-1,Long}$ Hospital admissions		0.00000
		(0.00000)
$\Delta_{-1,Long}$ Death rate		0.00475
		(0.01749)
Observations	1,630	1,201

Notes: This table reports the hazard estimation of the probability of public hospitals switching to OSS management. In this sample, units appear in the data until they transition to OSS and, after that, they leave the sample. We estimate two models: one includes changes in hospital characteristics between $t-2$ and $t-1$ as covariates ($\Delta_{-1,Short}$), and the other includes changes in hospital characteristics between $t-4$ and $t-1$ ($\Delta_{-1,Long}$). Both models include some baseline characteristics as independent variables. A logit model is estimated and the reported marginal effects are taken at the average of each variable.

Table (A3) Treatment effects on death rates

	2-year effect (1)	5-year effect (2)	Placebo effect (3)	Mean at baseline (4)
Death rate high mortality conditions	0.005	0.007	0.003	0.119
	(0.010)	(0.010)	(0.002)	
Death rate emergency room	0.000	0.004	0.003	0.062
	(0.004)	(0.006)	(0.002)	
Death rate surgery	-0.004	-0.002	0.001	0.019
	(0.005)	(0.003)	(0.001)	

Notes: This table reports the average effects of the OSS model on in-hospital death rates by high mortality conditions (AMI and stroke), in the emergency room, and in surgery. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable at baseline—i.e., the five-year period before the treatment.

Table (A4) Treatment effects on inpatient profile

	2-year effect (1)	5-year effect (2)	Placebo effect (3)	Mean at baseline (4)
Average age	0.132	0.067	-0.321	37.522
	(0.528)	(0.614)	(0.156)	
% 0–4	-0.010	-0.008	0.001	0.070
	(0.008)	(0.007)	(0.001)	
% 5–14	-0.011	-0.009	0.003	0.081
	(0.008)	(0.008)	(0.002)	
% 15–24	0.012	0.01	0.002	0.180
	(0.008)	(0.009)	(0.002)	
% 25–44	0.012	0.012	-0.000	0.278
	(0.009)	(0.009)	(0.002)	
% 45–64	-0.005	-0.007	-0.004	0.206
	(0.004)	(0.006)	(0.003)	
% 65+	-0.001	-0.001	-0.002	0.186
	(0.007)	(0.008)	(0.002)	
% Female	0.007	0.005	0.002	0.568
	(0.010)	(0.011)	(0.003)	
Average income (R$)	44.851	47.568	8.057	1219.470
	(98.455)	(119.166)	(8.416)	
Average reimbursement (R$)	14.058	26.395	-14.490	1315.65
	(67.841)	(78.796)	(46.900)	

Notes: This table reports the average effects of the OSS model on patients' characteristics. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable in the five years prior to OSS.

Table (A5) Treatment effects on hospital inputs

	2-year effect (1)	5-year effect (2)	Placebo effect (3)	Mean at baseline (4)
Beds	10.446	16.172	0.824	115.057
	(4.102)	(5.668)	(1.422)	
Total workers	52.272	78.269	4.310	328.865
	(22.828)	(32.447)	(6.087)	
Physicians	9.093	9.177	1.585	70.396
	(5.149)	(6.226)	(1.596)	
Nursing staff	25.468	37.377	0.684	168.662
	(13.461)	(17.797)	(3.200)	
Other health workers	1.025	-0.100	0.621	17.529
	(2.142)	(3.053)	(0.503)	
Other workers	16.686	31.815	1.420	72.279
	(10.560)	(15.816)	(2.896)	
Total workers per 100 beds	11.307	13.935	3.266	287.11
	(15.494)	(17.473)	(3.805)	
Physicians	2.317	1.229	0.121	59.905
	(3.549)	(4.413)	(0.852)	
Nursing staff	1.130	1.803	-0.287	145.701
	(8.682)	(9.318)	(1.889)	
Other health workers	0.610	-0.250	0.333	13.848
	(1.040)	(1.394)	(0.281)	
Other workers	7.250	11.153	3.098	67.656
	(7.258)	(8.280)	(2.062)	

Notes: This table reports the average effects of the OSS model on hospital inputs: beds, workers, and workers per 100 beds. Workers are measured as full-time-equivalent units. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable in the five years prior to OSS.

Table (A6) Treatment effects on physicians' composition

	2-year effect (1)	5-year effect (2)	Placebo effect (3)	Mean at baseline (4)
Panel A. *All physicians*				
Average experience	-1.608	-1.713	0.143	18.989
	(0.433)	(0.502)	(0.144)	
% Specialist	0.047	0.058	-0.003	0.447
	(0.018)	(0.021)	(0.006)	
Contract: % Estatutario	-0.177	-0.237	0.001	0.594
	(0.047)	(0.051)	(0.012)	
Contract: % CLT	0.075	0.090	-0.007	0.023
	(0.025)	(0.028)	(0.006)	
Contract: % Independent	0.126	0.169	0.007	0.328
	(0.048)	(0.053)	(0.012)	
Contract: % Other	-0.024	-0.022	-0.002	0.055
	(0.012)	(0.017)	(0.005)	
Share of new hires	0.097	0.061	-0.007	0.309
	(0.028)	(0.025)	(0.010)	
Panel B. *New hires*				
Average experience	0.133	0.370	0.535	15.961
	(1.194)	(1.055)	(0.255)	
% Specialist	0.073	0.089	-0.005	0.511
	(0.035)	(0.034)	(0.008)	
Contract: % Estatutario	-0.207	-0.275	0.005	0.582
	(0.054)	(0.057)	(0.013)	
Contract: % CLT	0.084	0.107	-0.008	0.025
	(0.028)	(0.030)	(0.006)	
Contract: % Independent	0.167	0.207	0.009	0.326
	(0.055)	(0.059)	(0.012)	
Contract: % Other	-0.045	-0.039	-0.006	0.067
	(0.021)	(0.025)	(0.006)	

Notes: This table reports the average effects of the OSS model on physicians' composition. Panel A uses the full sample of physicians. Panel B focuses only on new hires. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable in the five years prior to OSS.

Table (A7) Correlation between incumbent characteristics

	Productivity	Experience	Specialized	Formal contract
Productivity	1			
Experience	-0.001	1		
Specialized	-0.015	-0.356	1	
Formal contract	-0.094	0.457	-0.04	1

Notes: This table reports the correlation between pairs of incumbent characteristics, measured at baseline. Productivity is measured as the number of cases handled by an incumbent at baseline relative to hours worked. This measure is standardized by the average within each physician's specialization to account for heterogeneity across different specializations. Experience is measured by the number of years of medical practice. Specialized is a dummy indicating whether the physician has a specialty title or not. Formal contract is a dummy indicating whether the physician's labor contract is formal. Incumbent physicians are defined as those working at the hospital in the years $g-2$ and $g-1$, where g represents the treatment year. The analysis sample is restricted to incumbent workers in the treated hospitals and their respective matched controls.

Table (A8) Treatment effects on management, by OSS experience

	OSS Experience	
	High (1)	Low (2)
Panel A. *Aggregate inputs*		
Beds	12.292	15.186
	(5.794)	(8.622)
	[112.373]	[102.499]
Workers	18.232	14.900
	(26.021)	(23.574)
	[290.690]	[285.211]
Physicians	2.493	2.187
	(7.086)	(5.909)
	[69.680]	[54.218]
Panel B. *Personnel composition (all physicians)*		
Average experience	-1.231	-1.831
	(1.054)	(1.359)
	[19.313]	[18.286]
% Specialist	0.056	0.071
	(0.027)	(0.031)
	[0.411]	[0.470]
Contract: % CLT	0.117	0.074
	(0.035)	(0.047)
	[0.001]	[0.034]
Contract: % Estatutario	-0.305	-0.144
	(0.073)	(0.058)
	[0.592]	[0.617]
Contract: % Independent	0.217	0.106
	(0.072)	(0.068)
	[0.340]	[0.297]
% New hire	0.080	0.054
	(0.033)	(0.039)
	[0.320]	[0.290]
Panel C. *Probability of separation*		
Effects for all incumbent physicians	0.140	0.037
	(0.014)	(0.019)
Incumbents with high productivity	0.049	0.013
	(0.038)	(0.045)
Incumbents with low productivity	0.173	0.054
	(0.038)	(0.063)

Notes: This table reports the average effects of the OSS model on key outcomes from Section 6, separately for hospitals managed by OSS entities with high and low experience. High- and low-experience groups are defined based on a median split in the number of years the OSS operate in the market. Panels A and B use our baseline empirical strategy with data at the hospital level. Panel C uses data at the physician level, following the strategy outlined in the separation analysis of Section 6.2.2. Workers and physicians are measured as full-time equivalent units per 100 beds. The average effects are defined by the average of the DiD estimators for each event-time ranging from one to five. Standard errors in parentheses are calculated using hospital-level clustered bootstraps. The baseline mean for each variable is presented in brackets.

Table (A9)   Robustness of heterogenous results

	I: Main specification		II: Adding all treated hospitals		III: (II) + IPW	
	OSS Experience		OSS Experience		OSS Experience	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Hospital admissions	2016.370	694.862	2304.796	676.356	2439.422	463.128
	(531.734)	(379.711)	(535.803)	(348.737)	(501.061)	(442.908)
	[3730.343]	[3383.849]	[5148.819]	[2920.527]	[3794.771]	[3668.196]
Bed turnover rate	14.834	1.106	13.035	1.897	16.414	0.192
	(3.594)	(2.977)	(2.979)	(2.799)	(3.452)	(2.720)
	[36.189]	[34.965]	[38.370]	[31.828]	[32.877]	[35.057]
Average lenght of stay	-0.772	-0.374	-0.696	-0.402	-0.755	-0.203
	(0.318)	(0.327)	(0.259)	(0.304)	(0.253)	(0.314)
	[5.810]	[6.211]	[5.880]	[6.652]	[6.385]	[6.297]
Death rate all causes	-0.006	0.003	-0.007	-0.000	-0.005	0.004
	(0.008)	(0.006)	(0.007)	(0.006)	(0.006)	(0.008)
	[0.075]	[0.042]	[0.072]	[0.048]	[0.055]	[0.056]
Death rate due to ECSC	0.005	0.008	-0.001	0.005	0.003	0.004
	(0.013)	(0.008)	(0.011)	(0.008)	(0.011)	(0.008)
	[0.134]	[0.102]	[0.136]	[0.098]	[0.119]	[0.112]
Readmission rate all causes	0.000	0.000	-0.002	0.002	-0.003	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
	[0.030]	[0.040]	[0.032]	[0.040]	[0.029]	[0.040]
Readmission rate due to ECSC	-0.003	-0.006	-0.003	-0.005	-0.003	-0.006
	(0.006)	(0.010)	(0.006)	(0.009)	(0.006)	(0.010)
	[0.037]	[0.047]	[0.040]	[0.045]	[0.040]	[0.044]

Notes: This table reports the average effects of the OSS model on our main outcomes, separately for hospitals managed by OSS entities with high and low experience. High- and low-experience groups are defined based on a median split in the number of years the OSS operate in the market. Panel I excludes hospitals in the bottom 10% and top 10% of the patient volume distribution. Panel II employs the full sample of hospitals. Panel III also uses the full sample but implements an IPW specification. Specifically, we estimate the propensity score for being managed by a high-experience OSS and weight hospitals managed by high-experience OSS by the inverse of the propensity scores, while hospitals managed by low-experience OSS are weighted by the inverse of one minus the propensity score. Standard errors in parentheses are calculated using hospital-level clustered bootstraps. The baseline mean for each variable is presented in brackets.

B Robustness Checks

Pre-trends. Through the paper we documented pre-treatment estimates that consistently hover around zero. Table B1 provides additional validation tests of the parallel pre-trends. We conduct F-tests under the null hypothesis that the pre-treatment effects are jointly equal to zero for our main outcomes: hospitalizations, bed turnover, length of stay, hospital death and readmission rates for all causes and ECSC only, and population mortality. As the table shows, the F-statistic is insignificant for all these outcomes, mitigating identification concerns and strengthening confidence in our research design.

Robustness of the hospital-level results. We also assess the robustness of our main hospital-level results to alternative modeling assumptions and other concerns. Table B2 presents the corresponding results. Column (1) repeats the results for our baseline model for ease of comparison. The results shown in the following columns are reassuring, as the coefficients remain relatively similar to the baseline estimates of column (1) in all checks. Column (2) uses the entire control group instead of the matched sample. Column (3) also considers the whole control group and additionally controls for several covariate-specific trends. The stability of the results across columns 1-3 suggests that our findings are unlikely to be driven by differential trends across treated and control hospitals. Column (4) returns to our main strategy but further adjusts for time-varying patient characteristics (all the outcomes we investigate in Section 5.3). The stability of our results to this alternative specification confirms that our findings do not reflect endogenous patient selection. Another concern is that our estimates may stem not only from dynamic effects but also from compositional changes due to late hospital switchers having missing post-OSS years. To address this, column (5) considers a balanced panel over the event times. Results indicate that compositional changes do not impact our results. Finally, in column (6) we exclude data from 2020 onward. Since many public hospitals were already treated in the second half of our panel, there may be concerns that our estimates are influenced by differential changes in hospital behavior in response to the COVID-19 pandemic. However, this does not appear to be the case.

Robustness of the effects on population mortality. Finally, we test the robustness of the estimated impact of OSS on population mortality to a range of potential confounders. During the 2000s, Brazil underwent demographic change. If these changes varied systematically across municipalities and coincided with the timing of OSS adoption, they could bias our estimates through their relationship with mortality. To address this, we test the stability of our results to controlling for time-varying demographic composition, using variables that capture the share of the municipal population within each nine-year-by-gender age bin. We also consider the possibility that treated and control municipalities may exhibit differential trends due to pre-existing differences in socioeconomic conditions or public spending patterns. To address this, we test for the inclusion of linear trends specific to a broad set of municipal-level baseline covariates: GDP per capita, Theil index, poverty rate, illiteracy rate, share of rural population, total population, and per capita social and health expenditures. Additionally, we investigate whether our results are robust to the timing of other health initiatives implemented at the municipal level. One important program is the Family Health Program (*Programa Saúde da Família*—PSF), which expanded access to primary care throughout Brazil in the late 1990s and early 2000s (Rocha and Soares, 2010; Bhalotra et al., 2019). Even though the program came before the OSS expansion, we control for differential trends according to PSF adoption $\times$ year of adoption. We also account for the potential influence of the More Doctors Program (*Programa Mais Médicos*—PMM), which expanded physician supply in underserved areas by recruiting doctors from abroad, especially during the 2013–2014 period (Fontes, Conceição, and Jacinto, 2018; Carrillo and Feres, 2019). We similarly control for specific trends according to the adoption of PMM. Figure B.1 shows that our baseline estimates remain highly stable when each of these controls is included individually. These results suggest that our findings are unlikely to be driven by differential trends in demographics, baseline conditions, or concurrent health policies across treated and control municipalities.

Table (B1) Pre-Trend Tests

	F-statistic (1)	p-value (2)
Hospital admissions	0.830	0.528
Bed turnover rate	0.602	0.698
Average lenght of stay	0.346	0.885
Death rate all causes	0.961	0.440
Death rate ECSC	1.366	0.233
Readmission rate all causes	0.317	0.903
Readmission rate ECSC	0.476	0.795
Population mortality	0.587	0.710

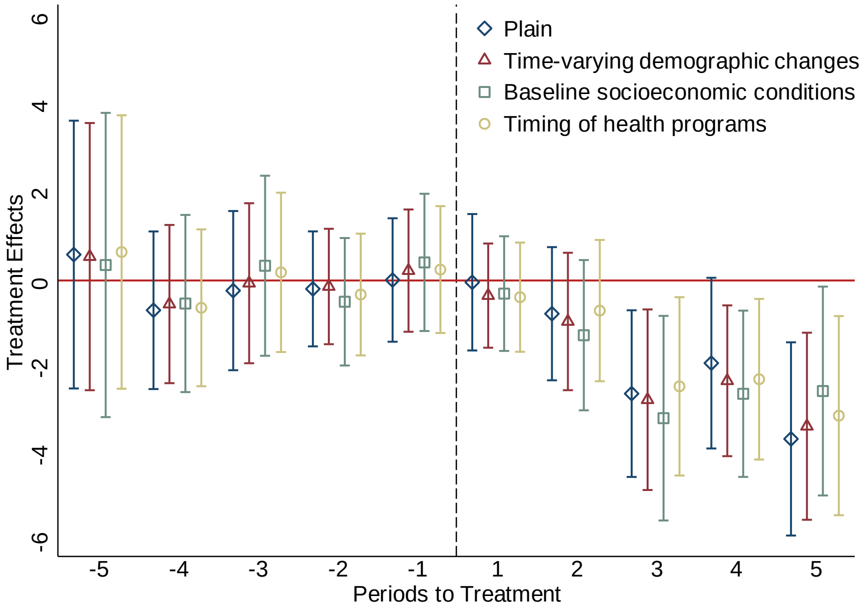
Notes: This table shows the results of pre-trend tests for key outcomes. Columns (1) and (2) report the F-statistic and p-value from F-tests under the null hypothesis that all five pre-treatment coefficients in our baseline specifications are jointly zero.

Table (B2) Robustness checks

	Main specification	Entire control group	Entire control group + covariates	Main + time-varying patient covariates	Main + balanced panel	Main + excluding Covid-19 data
	(1)	(2)	(3)	(4)	(5)	(6)
Hospital admissions	1577.668	1633.690	1413.607	1469.737	1735.945	1762.093
	(357.877)	(285.964)	(299.418)	(364.466)	(404.466)	(433.934)
Bed turnover rate	8.036	8.704	8.903	8.662	8.032	9.024
	(2.238)	(1.712)	(1.789)	(2.357)	(3.093)	(2.609)
Average length of stay	-0.566	-0.427	-0.492	-0.543	-0.782	-0.617
	(0.201)	(0.178)	(0.176)	(0.209)	(0.271)	(0.238)
Death rate all causes	-0.004	-0.008	-0.005	-0.005	-0.001	-0.006
	(0.005)	(0.004)	(0.005)	(0.005)	(0.008)	(0.005)
Death rate ECSC	0.001	-0.005	-0.001	0.002	0.008	0.001
	(0.007)	(0.006)	(0.006)	(0.007)	(0.010)	(0.009)
Readmission rate all causes	-0.001	0.006	0.004	-0.002	-0.003	-0.001
	(0.004)	(0.003)	(0.003)	(0.005)	(0.006)	(0.005)
Readmission rate ECSC	-0.004	0.003	0.000	-0.004	-0.006	-0.004
	(0.006)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)

Notes: This table reports the average effects of the OSS model on our main outcomes, across different specifications. The average effects are defined by the average of the DiD estimators for each event-time ranging from one to five. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Column 1 presents the results of our main specification. Column 2 tests a specification wherein we use the whole pool of control hospitals. Column 3 also uses all control hospitals and further adjusts for covariate-specific trends: number of hospital beds, medical equipment, workers, hospital admissions, in-hospital death rates, and the state where the hospital is located. Column 4 considers the same specification as Column 1 and further controls for time-varying patient characteristics (the same from Table A4). Column 5 considers a balanced panel over the event times and uses the same specification as Column 1. Column 6 excludes data from 2020 onward and uses the same specification as Column 1.

Figure (B.1) Robustness of the treatment effects on population mortality



Notes: This figure plots 95% confidence bands computed with a municipality-level clustered bootstrap and treatment and placebo DiD estimators for the effects of the OSS model on population mortality (number of deaths per 10,000 inhabitants at the municipal level) across different specifications. “Plain” refers to our baseline specification. ”Baseline socioeconomic conditions” controls for the share of the population by gender and 10-year age bins. “Socioeconomic trends” controls for linear trends specific to a broad set of municipal-level baseline covariates: GDP per capita, Theil index, poverty rate, illiteracy rate, share of rural population, total population, and per capita social and health expenditures. “Timing of health programs” controls for specific trends according to the adoption and adoption year of the Family Health Program (*Programa Saúde da Família*—PSF) and the More Doctors Program (*Programa Mais Médicos*—PMM).

C Other Margins of Adjustment

In Table C1 we present additional OSS effects on physical and human resources. In Panel A we examine changes in the availability of medical equipment. We observe an average increase of 25 pieces of basic bedside equipment (per 100 beds) over the five years following OSS transition, representing a 50% rise from the baseline. These items include essential equipment commonly attached to a patient's bed space: infusion pumps and ECG monitor. The shortage of such basic equipment may stem from protracted capital procurement processes in Brazilian public institutions. The transition to private administration likely alleviates these constraints, contributing to the rapid increase in bedside essentials. Such investments could reflect an effort to boost productivity, especially if some beds were previously idle due to a lack of appropriate equipment—a common issue in Brazil (e.g. Souza and Costa, 2011). Panel A also investigates high- and mid-tech specialized diagnostic and treatment equipment—including MRI, CTI, X-ray, hemodialysis machine, ECMO, and phototherapy devices. We do not observe a significant expansion in these technologically advanced and costly assets, suggesting that OSS managers did not enhance hospitals' treatment capacity through major capital investments.

In Panel B we find evidence of a shift in the nursing staff composition favoring higher qualifications. We estimate the effects of OSS management on nursing professionals, categorized into nurses, nurse technicians, and auxiliary nurses (each representing different qualification levels). Nurses complete a four-year college degree, nurse technicians obtain a two-year technical degree, and auxiliary nurses undergo shorter training courses of approximately six months. Our results reveal a significant reduction of almost 8.7 FTE auxiliary nurses per 100 beds, accompanied by increases of 5 FTEs for both nurses and nurse technicians (note that the point estimates for nurse technicians are not significant). Hence, while the total number of nursing professionals remains relatively stable, there is a clear shift toward a more qualified nursing staff. The share of auxiliary nurses within the nursing team decreases by 15% in the short-run and 10% in the long-run (borderline significant). These findings align with the positive effects on physician specialization and confirm the new management's move toward a staff with a higher level of technical proficiency and clinical capability.

Table (C1) Treatment effects on medical equipment and nursing staff

	2-year effect (1)	5-year effect (2)	Placebo effect (3)	Mean at baseline (4)
Panel A. *Medical equipment*				
Essential bed-level equipment	14.821	24.939	0.415	53.405
	(5.098)	(5.684)	(1.199)	
High-tech equipment	0.487	0.261	0.088	1.267
	(0.394)	(0.349)	(0.052)	
Mid-tech equipment	2.053	2.173	-0.474	19.752
	(1.166)	(1.294)	(0.424)	
Other	0.145	0.796	0.214	9.740
	(0.742)	(0.870)	(0.214)	
Panel B. *Nursing staff*				
Nurses	6.231	5.349	0.154	29.258
	(2.248)	(2.427)	(0.447)	
Nurse technicians	4.887	5.137	0.064	62.983
	(6.010)	(6.706)	(1.314)	
Auxiliary nurses	-9.988	-8.683	-0.504	53.460
	(4.349)	(4.663)	(1.181)	
% Auxiliary nurses	-0.055	-0.037	0.005	0.374
	(0.020)	(0.021)	(0.006)	

Notes: This table reports the average effects of the OSS model on medical equipment and full-time-equivalent nursing staff per 100 beds, as well as the share of auxiliary nurses among nursing staff. Standard errors in parenthesis are computed using a hospital-level clustered bootstrap. Columns 1 and 2 report the average effect after two years and after five years, respectively. Column 3 reports the placebo effect. Column 4 shows the mean of each variable in the five years prior to OSS.

D Cost-Effectiveness Analysis

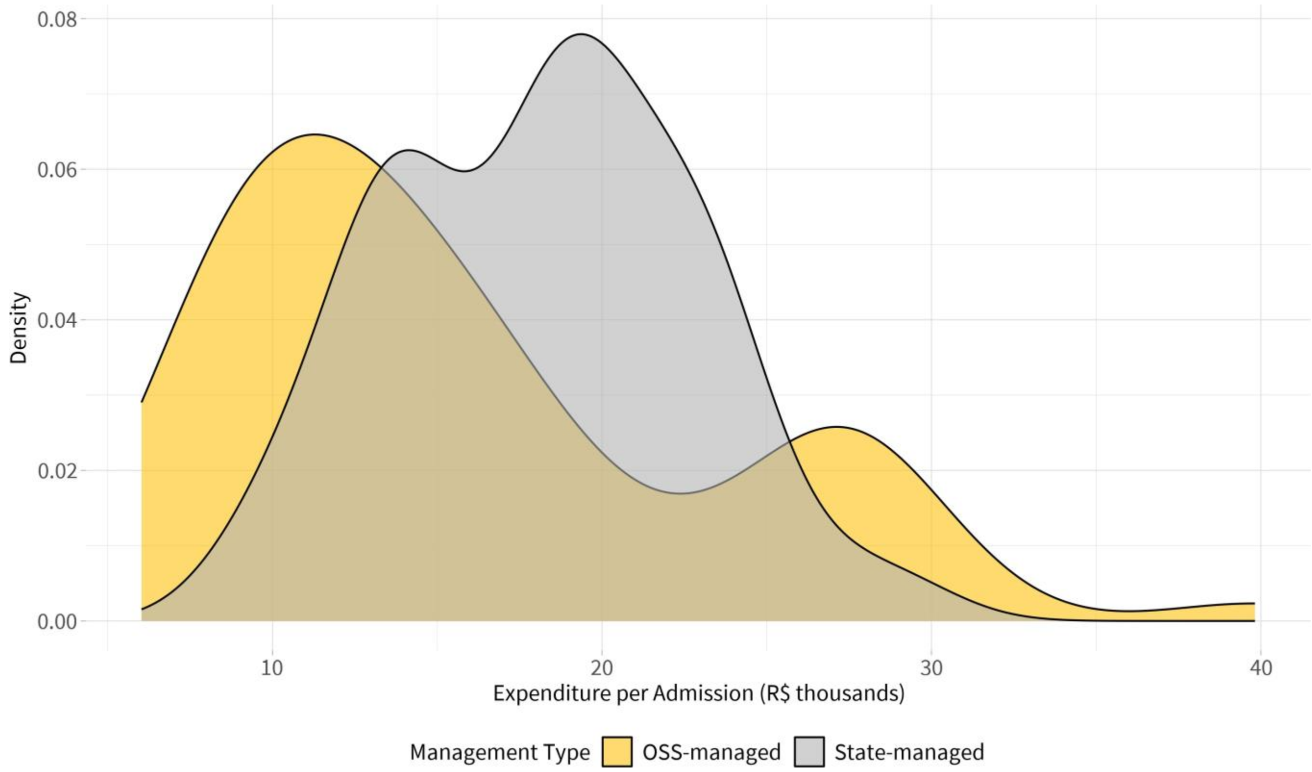
In this section, we provide a detailed assessment of the cost-effectiveness of the OSS model, including the description of methods and data. The sample includes 18 public hospitals located in the state São Paulo, managed by OSS or directly by the government, between 2013 and 2022. These hospitals are comparable in size to those in our main study (see Table D1). OSS expenditure data were obtained from São Paulo's Transparency Portal, while government-managed hospital data came from the Secretariat of Finance and Planning.[32] Expenditure data cover operational costs (e.g., human resources, materials, medications) and capital expenditures (investments in equipment and furniture), excluding bed expansion costs. The total transfers to OSS hospitals accurately reflect the value of management contracts. On average, OSS-managed hospitals spent R$ 119.31 million per hospital, with an expenditure per admission of R$ 15.89 thousand. This is 12% lower than the R$ 18.14 thousand observed for government-managed hospitals (Figure D.1 and Table D1).

We estimate the resources required to achieve 1,500 additional admissions annually. For government-managed hospitals, this would require additional 43 beds, based on a bed turnover rate of 35 (see Table 1, column 4). In contrast, OSS hospitals would achieve the same additional admissions with an increase of only 16 beds (see Table A5, column 2). Using data from São Paulo on costing of bed construction (R$ 1.04 million per bed) and operation costs (described above), we can calculate the net present value (NPV) of total expansion cost over five years.[33] The NPV expenditure for a 115-bed hospital was R$ 372.6 million under government management, compared to R$ 306.6 million for OSS management – an 18% cost difference. Overall, OSS management remains more cost-effective as long as expenditure per admission does not exceed R$ 19.48 thousand, i.e., a 23% increase over the sample average.

[32]Links to data sources are in Table D1.

[33]We apply a 13% discount rate and 4% inflation. The estimated construction cost is derived from the State Hospital of Sorocaba, delivered by the State of São Paulo government in 2018, with an investment of R$270 million. The hospital has 260 beds, providing medium and high complexity care. Retrieved from: [https://www.saopaulo.sp.gov.br/spnoticias/ultimas-noticias/em-sorocaba-alckmin-entrega-hospital-de-alta-complexidade-com-260-leitos/].

Figure (D.1) Public Expenditure per Admission



Notes: This figure presents the distribution of hospital expenditure per admission for public hospitals in São Paulo, categorized by management type: OSS-managed and state-managed. The sample includes 18 public hospitals in the State of São Paulo with 100-200 beds, covering the period from 2013 to 2022. Expenditure is adjusted to December 2022 values using a consumer price index (IPCA/IBGE).

Table (D1) Characteristics of OSS- and Government-Managed Hospitals for the Sample from the State of São Paulo

	OSS-managed hospitals (1)	Govnt-managed hospitals (2)	Baseline Mean (3)
Beds	151.33	149.85	115.06
	(26.19)	(28.35)	
Hospital admission per bed	56.99	38.95	34.7
	(22.39)	(11.59)	
Average hospital expenditure (R$ millions)	119.31	101.24	
	(41.19)	(33.10)	
Expenditure per admission (R$ thousands)	15.89	18.14	
	(7.51)	(4.56)	
Observations	11	7	

Notes: This table reports volume, resource, and expenditure indicators for hospitals in the State of São Paulo under OSS management and direct state administration, averaged between 2013 and 2022. The sample is restricted to hospitals with 100-200 beds. The data on volume and physical capital were extracted from SIH and CNES for both OSS and state-managed hospitals. Total expenditure refers to the total amount disbursed by the State of SP for hospital services, including operational costs (e.g., human resources, materials, and medications) and capital expenditures (investments in equipment and furniture). Expenditure data for OSS hospitals were extracted from the Transparency Portal of the State of São Paulo, in the Financial Manager Portal (https://portalfinanceirodogestor.saude.sp.gov.br). Expenditure data for directed managed hospitals were obtained from the State of São Paulo's Secretariat of Finance and Planning (https://www.fazenda.sp.gov.br/SigeoLei131/Paginas/FlexConsDespesa.aspx). Expenditure indicators are converted into December 2022 reais using the consumer price index. Column 3 shows the average of each variable for the treated units in the main study during the five-year period before the treatment (baseline). The values in the table represent means, and in parentheses, the standard deviation.

Appendix References

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