

Economic Incentives and Organ Procurement: Evidence from a U.S. Reform*

Erkut Y. Ozbay[†]

Ariel Rava[‡]

Sergio Urzúa[§]

Emanuel Zur[¶]

October 13, 2025

Abstract

In 2019, the United States implemented new regulations for Organ Procurement Organizations (OPOs) aimed at increasing transparency and strengthening accountability. These rules introduced stronger performance incentives designed to improve organ procurement outcomes. This paper examines the impact of the reform on organ donations, transplant activity, and associated system costs, with a particular focus on kidneys, given their clinical characteristics and the structure of the reform's organizational incentives. We estimate that the new policy led to an average increase of 7.13 kidneys procured per OPO per month, relative to a baseline mean of 24.78. The largest effects are observed among top-performing OPOs prior to the reform, with similar patterns for transplanted organs. Consistent with these findings, we document an overall rise in total OPO costs, with statistically significant increases concentrated among low-performing OPOs. Finally, we present a back-of-the-envelope calculation estimating the fiscal impact of the reform.

*We thank seminar participants at the Universidad de Los Andes (Chile) for valuable comments.

[†]Department of Economics, University of Maryland. E-mail: ozbay@umd.edu.

[‡]Sy Sims School of Business, Yeshiva University. E-mail: ariel.rava@yu.edu.

[§]Department of Economic, University of Maryland and NBER. E-mail: surzua@umd.edu.

[¶]Robert H. Smith School of Business, University of Maryland. E-mail: ezur@umd.edu.

1 Introduction

Organ transplantation significantly improves quality of life and survival for patients with severe organ failure, representing a vital advancement in modern medicine (Meier-Kriesche and Schold, 2005; Tonelli et al., 2011).¹ The United States, performing over 45,000 transplants annually, operates the world’s largest transplantation market. This system currently relies on 56 Organ Procurement Organizations (OPOs), regulated by the Centers for Medicare and Medicaid Services (CMS).² OPOs hold monopolistic rights within designated service areas to recover deceased donor organs, supplying 287 transplant centers and managing a national waitlist of over 100,000 individuals, which grows by approximately 150 patients daily (DeRoos et al., 2021; Spardy et al., 2023).³ While intended to streamline operations, this monopolistic framework has faced criticism for inefficiencies, performance variability, and limited transparency and accountability (Goldberg et al., 2017), as well as for creating perverse incentives that inefficiently reduce both organ recovery and successful transplantations (Chan and Roth, 2024).

In this paper, we investigate the effects of the 2019 CMS reform of the organ procurement industry, which was aimed at revising OPO performance regulations and metrics. The reform targets systemic inefficiencies in how OPOs are evaluated by replacing inconsistent, self-reported metrics with standardized, independently verified measures—specifically, donation and transplantation rates (Goldberg et al., 2019; Lentine and Mannon, 2020). Under the newly introduced performance-based Tier Ranking System, high-performing OPOs receive automatic recertification, whereas lower-performing entities face potential decertification or intensified competitive pressure. Prompted by increased public scrutiny, investigative reporting, and legislative action, the reform sought to incentivize performance improvements and

¹For instance, kidney transplantation has been shown to increase survival rates for patients with chronic kidney disease compared to long-term dialysis, while liver and heart transplants are often life-saving interventions for patients with acute or progressive organ failure (Tonelli et al., 2011; Meier-Kriesche and Schold, 2005).

²Prior to December 31, 2020, there were 58 OPOs. On January 1, 2021, two OPOs merged, reducing the total to 57. A second merger, also involving two OPOs, occurred in 2023, bringing the total down to 56.

³See the Health and Human Services Administration’s website for the *National Transplant Waiting List Statistics*.

enhance accountability, competitiveness, and transparency among OPOs. However, concerns persist regarding the potential for increased market concentration and reduced competition following its implementation.⁴

Our empirical analysis combines multiple sources of information spanning more than a decade. In particular, using unique data primarily derived from standardized cost reports obtained through a Freedom of Information Act (FOIA) request, we analyze industry-wide costs and operations between 2015 and 2024.⁵ We also compile official monthly records on OPO-level procurement and transplant activities from 2011 to 2024. Using a difference-in-differences framework, we then assess the impact of the CMS reform on organ recoveries and transplants—particularly kidneys, which are used as the treated organ in our identification strategy—as well as on OPO performance tiers. This approach allows us to isolate the effects of the reform while controlling for pre-existing trends and regional variation in organ procurement practices.

Why kidneys? Kidney donation holds particular significance in the United States due to a combination of factors that are critical to our empirical strategy (Sönmez and Ünver, 2023).⁶ Medically, in addition to deceased donor recoveries (Agarwal et al., 2025), kidneys are unique in that individuals naturally have two, allowing one to be donated without compromising long-term health. Legally, kidney donation benefits from a robust regulatory framework established in 1984, with the United Network for Organ Sharing (UNOS) overseeing a standardized national allocation system. Financially, as discussed below, OPOs are incentivized to prioritize kidney recovery, and Medicare covers transplant costs for patients with end-stage renal disease (ESRD). As a result, kidney transplants are the most common in the country, accounting for approximately 30,000 procedures annually. Nonetheless, the average wait time for a deceased donor kidney remains three to five years, underscoring the ongoing importance of expanding efforts to increase kidney donation.

⁴Detailed information on the full rule and its history can be accessed in the Federal Register at [CMS's final rule \(42 CFR §486\)](#).

⁵For detailed information about the cost report, see next sections and [Form CMS 216-94](#).

⁶Kidney exchange arose as one of the first groundbreaking applications of market design (Roth et al., 2004, 2007).

A critical challenge in the current system lies in its financial structure and incentives, which may significantly impact organ recovery rates and transplant outcomes. OPOs largely determine their own reimbursement rates for transplanted organs, creating financial incentives that may influence clinical practices.⁷ For kidney procurement, the CMS provides full reimbursement for reported costs, while the reimbursement for other organs is negotiated directly between OPOs and transplant centers. This reimbursement disparity disproportionately emphasizes kidney procurement, despite other organs representing nearly half the market in quantity and cost.

Figure 1 shows trends in total costs (panel (a)) and the number of recovered organs (panel (b)) from 2015 to 2024 for kidneys, livers, hearts, lungs, and pancreases. The pronounced contrasts across organs in both panels motivate our identification strategy. In panel (a), kidney recovery costs have consistently exceeded—and risen more rapidly than—those for all other organs. From 2015 to 2018, costs for all organs increased along similar trajectories. After 2018, however, kidney procurement costs accelerated sharply, more than doubling between 2019 and 2024. panel (b) documents a parallel divergence in recoveries: totals rose from 37,858 in 2018 to 54,056 in 2023 and 43,555 in 2024 (measured through September, corresponding to an annualized level exceeding 57,600 organs), with kidneys accounting for much of this growth. Given the reform’s timing, incentive structure, and the relative “attractiveness” of kidneys for OPOs, a difference-in-differences design naturally follows.

The figure also allows us to assess whether the COVID-19 pandemic could account for our main results. Although transplant activity in 2020–2021 was disrupted (Boyarsky et al., 2020), we are not aware of systematic evidence documenting meaningful differential effects of the pandemic by organ type. Given the magnitude and persistence of the increase in procured kidneys, pandemic-related disruptions are unlikely to explain our findings. Moreover, these organ-specific patterns are absent in non-kidney recovery rates, reinforcing the view that post-reform procurement incentives—rather than COVID-related capacity constraints—were the primary driver.

⁷Rosenberg et al. (2020) suggest that this reimbursement structure may create perverse incentives, potentially influencing clinical practices and resource allocation decisions within OPOs.

Our study contributes to the ongoing discussion and proposes an evaluation framework to highlight the impacts of CMS reforms. Specifically, we provide the first comprehensive empirical analysis of the CMS Final Rule’s effects across all major organ types. We document positive trends in organ recovery and hospital interactions with OPOs from 2013 to 2024, with a notable acceleration following the reform. Importantly, growth primarily occurred within lower-performing OPO tiers, initially driven by kidneys. Improvements largely came from strengthening existing hospital relationships rather than establishing new partnerships. We estimate that the policy led to an average monthly increase of 7.129 organs per OPO per month compared to a baseline mean in the control group of 24.3 organs per OPO per month. This increase was accompanied by significant positive effects on costs and revenues, especially for the lowest-ranked OPOs. Our findings underscore the influence of Medicare’s guaranteed reimbursement on OPO behavior and resource allocation decisions.

We also provide an illustrative estimate of the broader social impact of increased kidney recovery by approximating its effect on healthcare spending. Between January 2019 and September 2024, the increase in kidney recovery is associated with about \$1.96 billion in reduced aggregate dialysis costs. After accounting for the corresponding increase in OPO operational spending, we obtain a back-of-the-envelope estimate of net savings of roughly \$374 million to U.S. taxpayers through 2024. While these figures should be interpreted cautiously, they suggest that the CMS Final Rule may have generated fiscal benefits alongside improved organ procurement outcomes.

Ultimately, this research informs policy design by examining how performance metrics and financial incentives interact to shape organ procurement practices, addressing the critical need for efficient and equitable organ distribution systems.

However, questions remain regarding the effectiveness of the reform, given the complex interactions among performance metrics, financial incentives, and operational practices. Critically, the reform’s focus on performance metrics may fail to address deeper structural issues such as cost-shifting and market consolidation.⁸ Additionally, increasing donor registrations,

⁸Recent anecdotal evidence suggests that OPOs may be incentivized to bypass the national organ waiting list to meet reform targets. For more information, see: [Organ Transplant System ‘in Chaos’...](#)

adopting innovative medical technologies, and refining allocation algorithms remain essential for improving system performance (Ozgur et al., 2023).

The paper is organized as follows. Section 2 provides an overview of the institutional background governing organ donation in the United States and discusses the 2019 reform. Section 3 describes our data sources, presents key trends, and offers initial exploratory analysis. In Section 4, we introduce our empirical model and identification strategy and report the main results for organ-related outcomes. Section 5 presents our findings on costs, while Section 6 examines heterogeneous impacts across OPO tiers. Section 7 concludes.

2 Background

The National Organ Transplant Act (NOTA) of 1984 established the framework for the U.S. organ donation and transplantation system, including the regulation of OPOs. Today, 56 OPOs operate nationwide, playing a critical role in coordinating organ donation and transplantation. Each OPO is responsible for identifying potential organ donors, obtaining family consent, coordinating surgical organ recovery, and ensuring the timely transportation of organs to transplant centers. Furthermore, NOTA grants OPOs monopoly rights within their designated service areas (DSAs). Figure 2 illustrates the geographic extent of these areas and their spatial distribution across the United States as of 2024. However, despite this geographical exclusivity, OPOs do not manage organ allocation. Instead, this responsibility falls to the Organ Procurement and Transplantation Network (OPTN) and the United Network for Organ Sharing (UNOS), while final acceptance decisions rest with individual transplant centers. These additional players add an important layer of oversight, ensuring equitable and ethical distribution of organs (Council et al., 2022).

However, unlike conventional economic markets, where supply and demand determine prices, the organ donation market operates under an altruistic model, relying on voluntary donations and the consent of the donor’s next of kin. Organ recovery has historically been managed by hospitals locally, without any federal oversight or ethical guidelines. The growing demand

for transplants, advancements in recovery technology, and variation in organ allocation have prompted government intervention, leading to the enactment of NOTA. Today, this market is regulated under NOTA by the Health Resources and Services Administration (HRSA) within the Department of Health and Human Services (HHS). NOTA prohibits direct financial transactions for organs to prevent exploitation and ensure equitable access to transplantation (Roth, 2007; Satz, 2010; Sönmez and Ünver, 2023).

The reliance on voluntary participation results in persistent organ shortages, leading to long waiting lists and ongoing policy discussions on optimizing donor rates while maintaining ethical standards (Becker and Elias, 2007; Held et al., 2021). Although more than 45,000 organ transplants are performed annually in the U.S., the market still faces a backlog of over 100,000 individuals on the national transplant waiting list, with approximately 7,500 people dying each year due to organ shortages (DeRoos et al., 2021; Spardy et al., 2023). Consequently, OPOs operate under immense pressure to balance the limited supply of donor organs with the high demand for transplants (Dickert-Conlin et al., 2019). Given the time-sensitive nature of organ viability, these organizations must operate with precision to maximize successful transplant outcomes.

An important critical challenge for the industry is the financial structure and incentives of OPOs, which can significantly shape the organ recovery market. For instance, under CMS's reimbursement model for kidneys—reflecting the substantial public cost burden associated with End-Stage Renal Disease (ESRD)—OPOs receive full reimbursement for all incurred costs related to kidney procurement, irrespective of whether these organs are ultimately transplanted (Bragg-Gresham et al., 2024). In contrast, other solid organs such as livers, hearts, and lungs are reimbursed predominantly through private insurance entities via real-time negotiated pricing with transplant centers, creating an additional layer of administrative and financial complexity. This difference in reimbursement policies initially designed to eliminate financial disincentives for kidney recovery, may inadvertently incentivize OPOs to prioritize kidneys over other organs, given the lower administrative burden and assured financial coverage. This skewed incentive structure could undermine efforts to maximize the recovery of all transplantable organs, particularly those with shorter viability windows that

require swift and complex negotiations ([Tonelli et al., 2011](#); [Held et al., 2021](#)). Ultimately, these operational and fiscal conditions raise broader concerns about whether existing financial incentives adequately align with the overarching goal of optimizing organ availability and equity in transplantation ([Cheng et al., 2021, 2022](#)).

In recent years, OPOs have faced increased scrutiny over performance disparities and operational inefficiencies. Investigations by the House Oversight Committee, the Senate Finance Committee, and the Office of Inspector General at the Department of Health and Human Services have highlighted concerns regarding variations in OPO performance, accountability, and financial transparency. ^{9,10,11,12} In response, performance standards for OPOs have been developed by CMS and HRSA. These metrics focus on donor identification, family consent rates, efficient recovery processes, and quality assurance programs ([Held et al., 2021](#)). Recent regulatory reforms aim to standardize efficiency, reduce disparities, and identify underperforming OPOs for corrective action ([Mathur, 2022](#)).

Despite periodic reviews by CMS, the different regulatory mechanisms and the U.S. operating the largest organ transplant program globally, a critical gap remains in evaluating the performance of the organ procurement market with most notably a lack of rigorous empirical analyses on the efficiency, cost-effectiveness, and quality of organ procurement across different organ types. Research on the cost and quality of procured solid organs—such as kidneys, livers, hearts, lungs, and pancreases—is limited. Most studies focus on kidney procurement, leaving other organs, which make up about 50% of the transplant market, under-researched ([Held et al., 2020, 2021](#); [Bragg-Gresham et al., 2024](#)). In addition, the market structure of OPOs, which operate as regional monopolies, raises concerns about inefficiencies and financial mismanagement, with U.S. Senate hearings and investigative reports highlighting issues with oversight and transparency in OPO practices.

⁹[Chairman’s News — Newsroom — The United States Senate Committee on Finance.](#)

¹⁰[The United States Senate Committee on Finance requests clarification regarding “Medicare Paid Independent Organ Procurement Organizations Over Half a Million Dollars for Professional and Public Education Overhead Costs That Did Not Meet Medicare Requirement.](#)

¹¹[Medicare Paid Independent Organ Procurement Organizations Over Half a Million Dollars for Professional and Public Education Overhead Costs That Did Not Meet Medicare Requirements, A-09-21-03020.](#)

¹²[Oversight Subcommittee Launches Investigation into Poor Performance, Waste, and Mismanagement in Organ Transplant Industry — House Committee on Oversight and Reform.](#)

2.1 The 2019 reform

In late 2018, media stories¹³ and legislative attention—most notably from Senator Todd Young’s announcement of a bill proposal for OPO reform¹⁴—highlighted perceived deficiencies in OPO performance. These developments led to a major federal policy initiative during the first Trump Administration, which issued the Advancing American Kidney Health Executive Order (Executive Order 13879) on July 10, 2019. The Executive Order directed the CMS to revise OPO performance regulations and metrics, signaling a major shift in how OPOs would be evaluated and held accountable.

In December 2019, CMS published a proposed rule under 42 CFR §486 (CMS, 2019)¹⁵, introducing new standards that OPOs must meet for recertification. After a period of public comment and debate, the Final Rule was announced on November 20, 2020, with implementation beginning on August 1, 2022. These revised regulations mark a departure from the previous system of self-reported data and introduce a 4-year transition period, culminating in an initial CMS review in 2026 that may result in the de-certification of underperforming OPOs.¹⁶ Thus, for the first time, OPO contracts are subject to competitive pressure based on transparent and standardized performance metrics rather than predominantly self-reported data and face potential de-certification.

Central to these reforms is the Tier Ranking System, which classifies OPOs into three performance tiers according to two primary outcome measures: (1) donation rate and (2) organ transplantation rate. The donation rate measures the number of actual deceased donors as a percentage of total inpatient deaths within the OPO’s DSA, whereas the organ transplantation rate measures the number of transplanted organs (rather than simply recovered organs) as a percentage of those same inpatient deaths. These metrics evaluate OPO ef-

¹³For example see [Organ transplant shortage could be fixed by expanding donor pool - Washington Post](#) and [Despite low performance, organ collection group gets new federal contract - The Washington Post](#) published in *The Washington Post*.

¹⁴<https://www.young.senate.gov/newsroom/press-releases/washington-post-young-demands-reform-of-organ-transplant-network/>

¹⁵<https://www.federalregister.gov/d/2020-26329>

¹⁶Note that OPOs receive their ranking with a two-year lag. This time lag exists because CMS relies on publicly available data from sources such as the CDC and SRTR, which are not immediately available.

fectiveness in both procuring organs from potential donors and ensuring those organs are transplanted successfully (Goldberg et al., 2017, 2019). Notably, the new rule bases these measures on independently verified data from the Centers for Disease Control and Prevention (CDC) rather than relying on OPO-reported “eligible deaths”, to address the historical lack of transparency and consistency in defining the donor-eligible pool.

Under this system, Tier 1 includes OPOs that rank in the top 25% for both donation and transplantation rates, and these OPOs are automatically re-certified for an additional 4 years and retain exclusive rights to their DSA. Tier 2 includes mid-performing OPOs that meet the median threshold for both donation and transplantation rates but do not reach the top quartile, and these organizations compete for their DSAs if they cannot demonstrate improved performance. Finally, Tier 3 OPOs, whose donation or transplantation rates fall below the median threshold, face de-certification and an immediate opening of their DSAs for competition. In line with the 4-year transition window, the initial data for recertification will rely on OPO performance from 2023 and 2024, with CMS ranking OPOs and conducting on-site surveys in early 2026. This timing ensures that OPOs have a defined period to implement performance-enhancing strategies before the first review under the new system.¹⁷

The Tier Ranking System introduces several policy changes to enhance OPO accountability and outcomes by replacing self-reported data with standardized, independently verified measures. First, the denominator for new performance metrics is based on inpatient death data from the CDC, ensuring consistency across OPOs and preventing manipulation of eligible death counts. Second, the donation rate measure now considers actual organ donors with at least one transplanted organ rather than focusing on donor yield, which previously discouraged the procurement of single-organ donors. Third, the organ transplantation rate prioritizes successful organ placement rather than just procurement, reducing waste and improving transplant outcomes. Finally, by relying on independently verified data and tracking actual transplants rather than organ recoveries, the system enhances transparency and accountability, ensuring a more accurate and trustworthy evaluation of OPO performance.

¹⁷OPOs are assigned to a specific tier based on how they perform on both measures relative to their peers. For example, to be in Tier 1, an OPO must be in the top 25% for both donation rate and organ transplantation rate. For Tier 2, OPOs must meet at least the median threshold for both metrics.

The Tier system changes the way OPOs are evaluated by introducing a new performance-based categorization that aims to foster improvement and hold underperformers accountable. The three-tier approach creates incentives for OPOs to improve their performance, as organizations in higher tiers are rewarded with recertification and retention of their DSAs, while those in lower tiers risk de-certification or competition for their DSAs. This system is intended to ensure that DSAs are served by OPOs capable of maximizing organ procurement and transplantation opportunities, ultimately striving to improve organ donation and transplantation rates.

Despite these efforts, initial analyses suggest that these new standards could have substantial ramifications. Studies modeling how OPOs would have performed under similar metrics in 2016–2017 show that over half of all OPOs might fail one or both new thresholds, potentially facing decertification (Snyder et al., 2020). Moreover, this approach also raises several concerns about the long-term impact of the Tier Ranking System. One risk is market concentration if high-performing OPOs acquire multiple DSAs. By opening the DSAs of mid- and low-performing OPOs to competition, high performers may consolidate control over larger regions. Such consolidation could diminish the incentive for OPOs to improve services and innovate, as fewer organizations control larger regions without the pressure of competitors. Furthermore, while the system encourages performance improvement, it does not provide a clear mechanism for introducing new competition within DSAs, as existing OPOs tend to have a stronghold in their regions.

Critical to this paper, the CMS metrics do not assign explicit weight to any specific organ, nor does the reform address the fundamental differences among organs or the financial incentives that influence OPO behavior. For instance, kidneys significantly impact performance metrics due to their high demand—they account for approximately 50% of all transplants and each donor can provide two. As a result, OPOs that effectively recover and place kidneys tend to achieve higher transplant rates. Although CMS employs a dual-metric system to balance donation and transplant rates, kidney transplants still disproportionately influence outcomes. Consequently, OPOs cannot attain high performance scores without recovering and placing kidneys at rates comparable to top-performing peers.

Organ viability also shapes OPO behavior. Kidneys are the most resilient, remaining viable for 24–36 hours, which allows time to identify recipients across greater distances. In contrast, hearts and lungs must be transplanted within 4–6 hours, and livers and pancreases within 8–18 hours. This means kidneys can be widely offered and accepted even after initial declines, whereas hearts and lungs must be placed quickly or risk being discarded—negatively affecting performance metrics.

Moreover, financial incentives play a critical role. Medicare guarantees full reimbursement for kidney procurement, even when efforts do not result in successful transplantation. This policy incentivizes OPOs to prioritize kidney recovery over other organs. The result is a potential imbalance: increased kidney donation rates alongside stagnant recovery of organs such as livers, hearts, lungs, and pancreases. OPOs may concentrate resources on kidneys, where costs are reliably covered, while underinvesting in the technologies and processes needed to improve non-kidney organ procurement. Therefore, although the CMS reform may enhance kidney transplantation rates, it may fall short in advancing the broader goals of the organ donation system and meeting the diverse needs of transplant patients.

3 Data and exploratory analysis

Our analysis draws on multiple data sources, at varying frequencies, that provide rich financial information for the vast majority of OPOs and detailed longitudinal records on organ-related activities for the universe of OPOs operating nationwide over the past decade.

Our first source of information provides detailed data on various cost items for the 51 private, non-hospital-based OPOs, covering the period from 2015 to 2024.¹⁸ As mandated by CMS regulations, each OPO must submit a standardized cost-reporting form (CMS 216-94), ensuring consistency in cost and operational comparisons. Through a FOIA request, we

¹⁸At the time of the reform, 58 OPOs were operating nationwide. Financial data are available only for the 51 independent, private OPOs that file separate cost reports with CMS. The remaining OPOs are hospital-based and do not submit standalone OPO cost reports. Instead, their financials are integrated into the hospital-level reports of their affiliated transplant centers, making OPO-specific financial data unavailable.

obtained over 12,000 pages of financial and operational data from these forms for the years 2015 to 2021. Using the Health Financial Services (HFS) software, we converted the FOIA-provided reports into machine-readable format by manually entering each figure from the reports into the software. We then verified our entries by comparing page-level sums with the FOIA source. As a quality assurance measure, a second individual randomly reviewed pages from each report. For the years 2022 and 2024, we used newly released data from CMS, which provides HFS software output of OPOs' standardized cost-reporting forms starting with 2020.¹⁹ We then mapped the HFS software output onto the FOIA data structure. Since we had data for 2020 and 2021 from both sources, so we were able to manually compare them to find a perfect match.

Form CMS 216-94 provides detailed data in Worksheet B on the total cost for each organ, covering organ-specific expenses, overhead expenses, and administrative and general expenses.²⁰ The form also includes data on the number of full-time employees and top management compensation in Worksheet S-1. We supplemented each OPO's financial and operational data with geographic information from the Scientific Registry of Transplant Recipients regarding population and coverage areas; hospital, donation center, and donor-specific data from the OPTN; wage index data from the CMS; and CEO salary data from IRS Form 990, in addition to the salary data obtained through FOIA. The final sample includes a total of 455 OPO-year observations.

To obtain more granular insights into OPOs' organ procurement and transplant activities, we employed monthly data from the OPTN, administered by the United Network for Organ Sharing (UNOS). This dataset covers the period from January 2013 through September 2024

¹⁹The information can be accessed through the CMS website: [Healthcare Cost Report Information System Dataset - Organ Procurement Organization](#).

²⁰The total cost for each organ is constructed as follows. First, we begin with organ-specific costs from Worksheet A-2 (Organ Acquisition Cost), which outlines costs that the OPOs have designated as directly associated with each organ acquisition, including surgeon fees, transportation, medical supplies, laboratory tests, preservation, and importation costs. Second, we incorporate the various overhead costs per organ, found in Worksheet A (Reclassification and Adjustment of Trial Balance of Expenses). Overhead costs are allocated based on the relative number of organs procured, with this allocation ratio calculated in Worksheet B-1 (Cost Allocation – Statistical Basis). Finally, administrative and general costs are allocated according to the relative size of the subtotal cost, which includes both organ-specific costs and relative overhead charges from the preceding stages.

and provides monthly organ procurement statistics for all 58 OPOs in the U.S., disaggregated by organ type and hospital of procurement for each OPO. We linked these data to Form CMS 216-94 by manually verifying OPO names and ZIP codes.

Finally, to examine the impact of the recent reforms in the organ procurement industry that were introduced in 2019, we classified the OPOs into the three Tiers based on CMS's final rule (42 CFR §486) that was published in December 2020 and used the OPOs' financial data from the 2018 fiscal year.²¹ The OPO Tier ranking system, based on data from 2018, classifies OPOs into three categories: Tier 1 (passing OPOs), Tier 2 (under-performing OPOs), and Tier 3 (failing OPOs).

We first document trends in total standard acquisition costs over the period 2013–2024. Table 1 presents summary statistics for the total acquisition costs across all organs, with a specific focus on kidneys. These costs are derived from Form CMS 216-94 and include, among other items, support personnel expenses, surgeon fees, laboratory testing, and public and professional education. The table shows that the total acquisition cost for all OPOs increased from \$1.03 billion in 2015 to \$2.52 billion in 2024. The data also indicate that kidney-related acquisition costs account for approximately 60% of the total organ procurement costs. Specifically, at the OPO level, total annual acquisition costs ranged from an average of \$20.2 million in 2015 to \$51.4 million in 2024. The table also notes changes in the total number of OPOs resulting from mergers in both 2021 and 2023, each involving two organizations.

Figure 1, already discussed in the introduction, highlights the significant increase in total system costs and organs recovered after 2018. In both cases, kidneys are the primary driver of this growth. While in 2018 total costs associated with kidney procurement were under \$700 million, by 2024 this figure had tripled. At the same time, the number of kidneys recovered rose from 20,000 in 2018 to over 30,000 in 2024. Positive trends in costs and recoveries are also observed among other organs, but none matches the magnitude of the increase seen for kidneys, which motivates our analysis.

To characterize the evolution of the organ donation system, Figure 3 presents trends over

²¹For the full Tier ranking see pages 77929 and 77930 in [CMS's final rule \(42 CFR §486\)](#).

time in the total number of donors (panel (a)), total organs recovered (panel (b)), and kidneys specifically (panel (c)). The patterns are clear: donor numbers increased at a moderate pace from 2011 through 2018, followed by a sharp increase in the number of donors. From 2018 to 2024, the number of donors rose by 59%—more than double the 24% growth observed between 2011 and 2018. Similarly, the total number of organs recovered grew by 51% in the later period, compared to 31% in the earlier years. Kidney recoveries showed the most pronounced increase, with a 63% rise between 2018 and 2024, compared to 33% previously. The variation across panels suggests that the CMS reform introduced in this period created targeted incentives for OPOs to engage more donors and increase organ procurement, particularly for kidneys.

Before proceeding with the formal evaluation of the reform’s impact on organ recovery, we present panel (a) of Figure 4, which shows the monthly trends in the total number of kidneys recovered. The solid line depicts the trend estimated using a nonparametric regression model, while the dashed line shows the projected trend based on pre-reform data (prior to January 2019). The gap between these two curves illustrates the deviation attributable to the reform. Based on this analysis, we estimate that the total number of additional kidneys recovered—defined as the deviation from the pre-reform trend—between January 2019 and September 2024 amounts to 22,975 organs, representing a 17.32% increase relative to projected levels in the absence of the reform.

Panel (b) of Figure 4 presents an analogous graphical analysis for all other organs combined (circles), as well as disaggregated by organ type (heart, liver, lungs, and pancreas). The comparison between panels (a) and (b) illustrates the logic underpinning our identification strategy. Given the incentives introduced by the 2019 reform and the distinctive characteristics of kidneys, OPOs were likely to prioritize kidney procurement over other organs, a pattern consistent with the trends shown in the figure. Accordingly, we consider kidneys as the treated organ, with the remaining organs serving as the control group.

While our data do not allow for an input-level analysis by organ type, they do permit an examination of changes in, for example, staffing patterns within OPOs, the associated salary

expenditures, administrative costs, and different overhead costs. Table 2 presents the evolution of the following variables that capture these dimensions: Total Full-Time Employees (TFE); Procurement Coordinators (PrC); Preservation Technicians and Other Operational Staff (PrT); Other Personnel—including Medical Directors, Administrative Medical Directors, Other Administrative Personnel, Executive Directors, and Clerical Staff (MeP); as well as overhead costs related to Procurement Coordinators (PCC); Total Procurement Costs (PRO); Administrative Costs (ADM), and Total Organ Acquisition Cost (OvC).²² In each case, the table reports the coefficients for year indicators (with 2015 as the baseline) in the context of an event study-type of regressions in which we control for OPO fixed effects. To provide a basis for comparison, the table’s last row reports the average of the respective dependent variable for the period 2015–2018.

The results reveal a substantial increase in most input categories and costs, particularly starting in 2019. By 2018, the total number of full-time OPO employees (Column 1) had increased by an average of 40 workers relative to 2015. By 2024, this figure had risen by 215%, reaching an average of 126.4 additional workers (relative to 2015). A similar pattern is observed for Procurement Coordinators (Column 2)—a critical group of employees responsible for the entire organ procurement process, from identifying potential donors to overseeing organ recovery and transportation. Their number increased from 1.7 additional coordinators in 2018 to 43.1 in 2024 (both also relative to 2015). For Preservation Technicians and Other Operational staff (Column 3), the pre-2019 declining trend reversed beginning in 2019. By 2023, the number of workers in this category had returned to levels comparable to

²²Our data includes information on *Administrative and General Costs*, which represent expenses associated with support personnel. These costs cover administration, accounting, medical director services, office salaries, and office professional education (sourced from Form CMS 216-94, Worksheet A1, titled “Admin and General Expenses”, Column 3, labeled “Total”). *Overhead Costs* is an aggregate of several items. First, it includes costs from Form CMS 216-94, Worksheet B, titled “Cost Allocation”, Column 2, labeled “Net Cost for Allocation”, Row 2, titled “Organ Acquisitions”. Second, it includes “Procurement Coordinators overhead” from Worksheet A, Column 7, labeled “Net Cost for Cost Allocation”, Row 9, titled “Procurement Coordinators”. Third, it includes “Public Education overhead” from Worksheet A, Column 7, Row 11, titled “Public Education”. Finally, it includes “Professional Education overhead” from Worksheet A, Column 7, Row 10, titled “Professional Education”. *Transplant Centers* captures the number of transplant centers to which the OPO provided organs in a given year, based on data provided by the United Network for Organ Sharing (<https://optn.transplant.hrsa.gov/data/view-data-reports/request-data/>). *Total Employees* measures the total number of employees at an OPO. This variable is drawn from Form CMS 216-94, Worksheet S1, Part 3, titled “Full Time Employees”, Row 2, labeled “Total FTEs.”

those in 2015. Column 4 shows that, by 2024, the number of additional personnel (including medical staff) (relative to 2015) was 20% higher than in 2018.

These staffing patterns are consistent with trends in the four measures of costs. Relative to the increase observed between 2015 and 2018, the average additional costs (also relative to 2015) rose by 555% for procurement coordinators (Column 5), 566% for total procurement (column 6), 406% for administrative spending (column 7), and 556% for net organ acquisition costs (Column 8).

Figure 5 presents point estimates and associated confidence intervals from event-study-type regressions examining full-time personnel (panel (a)) and total procurement coordinator costs (panel (b)) across OPO tiers. Each panel reports the estimated coefficients for the 2018 and 2024 year indicators for both outcomes. The results highlight substantial tier-level differences in the additional number of full-time employees and increased procurement costs following the reform. In both cases, the magnitude of the coefficients indicates larger increases in Tiers 2 and 3 relative to Tier 1. For example, while procurement coordinator costs in Tier 1 OPOs had more than doubled by 2018 (relative to 2015), the increases were smaller in Tiers 2 and 3. By 2024, however, these differences had narrowed significantly. As we argue throughout the paper, the incentives introduced by the reform may help explain these distinctive trends. We examine these differences in greater detail below.

While we are cautious in interpreting these shifts as causal effects of the 2019 reform, the results suggest a potential impact of the legislation on OPO operations.

4 The impact on organ-related outcomes

In this section, we evaluate the impact of the reform on OPO productivity, measured by monthly organ recovery and transplantation volumes. In addition to productivity, we also examine the consequences of the new regulatory framework on the cost structures faced by OPOs. Our empirical strategy focuses on kidneys as the treatment organ, using all other

organs—hearts, livers, lungs, and pancreases—as a control group to isolate the effect of the policy change. This focus on kidneys is motivated by their outsized role in the U.S. organ donation system. Kidneys account for approximately 60% of all transplants, making them central to OPO performance metrics. Their relatively long viability window (24–36 hours) also facilitates broader geographic allocation compared to other organs, which affects performance metrics. Moreover, Medicare fully reimburses kidney procurement efforts, even if they do not result in successful transplantation. This creates strong financial and operational incentives for OPOs to prioritize kidneys over other organs in the post-reform period.

Before presenting our main findings, we motivate our empirical strategy using Figure 6, which shows the evolution of the average number of kidneys and other organs recovered by OPOs from 2011 to 2024. It also displays the annual difference between the number of kidneys and other organs recovered, offering an initial view of our identification approach.

The figure reveals similar growth trends for both groups prior to the reform. From 2011 to 2017, the number of kidneys recovered increased from 14,780 to 18,684—a 26.41% growth. Over the same period, the number of other organs recovered rose from 14,071 to 17,741, reflecting a comparable increase of 26.08%. This parallel growth shows the similarity in the annual growth of the two groups and also the stability in the difference between the two groups during this time. Importantly, the figure reflects the overall expansion of the transplant market during this period, driven by increasing demand, improved clinical practices, and broader public awareness. As the need for organ transplants grew nationwide, OPOs responded with greater recovery efforts across all organ types. Thus, the observed upward trend in both kidney and non-kidney organ recoveries aligns with the general growth of the organ donation and transplantation ecosystem.

An uptick in kidney recoveries relative to other organs begins in 2018, suggesting that some OPOs may have anticipated the reform. From 2019 onward, the divergence becomes more pronounced. Between 2018 and 2024, kidney recoveries increased by 63.15%, while other organs increased by only 31.15%. The widening gap in bar heights reflects this growing divergence, which is central to our analysis.

Given the economic incentives in place and the previous findings, we next quantify the reform’s impact by estimating a Difference-in-Differences (DiD) model using observational data. We also explore dynamic effects using an extended two-way fixed-effects approach (Wooldridge, 2021). Formally, we exploit the data $\{y_{i(j),t}, d_{i(j),t}\}$ for time t , with $t = 1, \dots, T$, and unit $i(j)$, where j denotes the OPO and i the specific type of organ (kidney or all other organs). $y_{i(j),t}$ is the outcome of interest and $d_{i(j),t}$ is an indicator function that equals one if the unit is treated or zero otherwise at time t . Formally, we estimate the following model:

$$y_{i(j),t} = \alpha_{i(j)} + \gamma_t + \beta d_{i(j),t} + \epsilon_{i(j),t}, \quad (1)$$

where $\alpha_{i(j)}$ is the unit-level fixed effects and γ_t are time (year-month) fixed effects, and $\epsilon_{i(j),t}$ is the error term. Since the reform was implemented simultaneously across all OPOs, and our sample is close to a balanced panel—with annual cost data for approximately 50 OPOs and monthly organ data for 58 OPOs from 2013 to 2024—the coefficient β represents the parameter of interest. We rely on the parallel trends assumption and the absence of anticipatory behavior at the OPO level to interpret β as the average treatment effect on the treated (ATET) (Roth et al., 2023). To support these identifying assumptions, we construct event-study plots, examine the robustness of our results to various sample restrictions, and conduct formal statistical tests. Following standard practice, we use never-treated and not-yet-treated units as controls. We also explore heterogeneous effects by OPO tier.

Table 3 presents the main results for the full sample (panel (a)). Column (1) shows that the average monthly number of kidneys recovered per OPO increased by 7.129 organs following the reform, a statistically significant effect representing an increase of nearly 30% relative to the pre-reform average of 24.78 kidneys per month. For transplanted kidneys, the average monthly increase is 2.8 organs, corresponding to a 10% rise. This implies that only 39.2% of the newly recovered kidneys were transplanted, compared to 80.9% prior to the reform – indicating how the reform’s financial incentives operated. panel (a) also reports the results of the parallel trends tests. For both recovered and transplanted kidneys, the data support the validity of our empirical strategy.

Figure 7 illustrates the dynamic effects of the reform on kidneys recovered (panels (a) and (b)) and transplanted (panels (c) and (d)). Panel (a) shows that the monthly difference in kidney (treated organ) recoveries relative to other organs (control group) remained stable prior to 2019, with a clear divergence emerging in January 2019. After that point, the gap between the two series widened significantly, reaching a difference of more than ten organs by 2021. To highlight this pattern, Panel (b) presents the average monthly difference estimated using an event-study analysis implemented through a two-way fixed effects model. The figure reveals a growing and statistically significant divergence that eventually stabilizes around the same level—approximately ten additional kidneys per OPO.

Panels (c) and (d) replicate the analysis for transplanted kidneys. In this case, during the pre-reform period, the number of kidneys transplanted was lower than the number of other organs transplanted. This pattern reversed in 2019: from that year onward, more kidneys were transplanted than other organs. As panel (d) shows, although the magnitude of the effects is smaller than for recovered kidneys, the impact of the reform is in the same direction.

To assess the extent to which the estimated ATET may be influenced by the initial responses of OPOs to the reform, panels (b), (c), (d), and (e) of Table 3 present results from estimating equation (1) on different samples.

Panel (b) reports the findings when data from the first year of the reform (2019) are excluded. In this case, column (1) shows that the estimated impact on kidneys recovered is 8.132, which represents roughly one additional organ per OPO per month relative to the baseline estimate in panel (a). For transplanted organs (column (2)), the estimated effect is 3.135, also higher than the baseline point estimate. As expected, and consistent with the patterns shown in Figure 7, excluding the first year of the reform yields larger point estimates.

When data from 2020 are excluded (panel (c)), the point estimates again exceed those reported in panel (a) – 7.58 for recovered organs and 2.80 for transplanted organs – though they remain below those obtained when 2019 is excluded. Finally, when both 2019 and 2020 are excluded from the sample, the effects of the reform are the largest for both recovered and transplanted organs, consistent with a medium-term impact.

Finally, given the apparent uptick observed during 2018, as shown in Figure 6, panel (e) of Table 3 presents results obtained after excluding data from that year. Compared to the estimates in panel (a), we observe only modest increases in the effects for both recovered kidneys (6.9% relative to the full sample) and transplanted kidneys (0.3%), alleviating concerns about significant anticipatory actions by OPOs.

Importantly, across all these samples, we fail to reject the presence of parallel trends at conventional confidence levels for both recovered and transplanted organs. This provides further support for the validity of our empirical strategy.

4.1 Where are the extra kidneys coming from?

To understand how OPOs increased the number of recovered organs, specifically kidneys, following the 2019 reform, we examine the characteristics of the hospitals from which these organs originated.²³

We classify hospitals into three categories based on their historical interaction with OPOs. First, *New hospitals* are defined as institutions with which OPOs established their first recorded interaction after January 2019. *Regular hospitals* are those that provided donors and organs in more than 50% of the months between January 2011 and December 2018, indicating sustained engagement prior to the reform. In contrast, *Occasional hospitals* are those that supplied donors and organs in fewer than 50% of the months during the same pre-reform period.

Figure 8 decomposes the total number of donors (panel (a)), recovered organs (panel (b)), and recovered kidneys (panel (c)) by hospital type. The results indicate that the post-reform increase in organ recovery is not attributable to new partnerships formed with hospitals after 2019. Instead, the data suggest that much of the observed growth in donors and recovered organs originates from hospitals with which OPOs had only occasional contact prior to the

²³This analysis uses information on *Procurement Hospitals*, which refers to the hospitals from which the OPO procured organs in a given year, as provided by the United Network for Organ Sharing.

reform. This finding highlights a shift in OPO engagement strategies, whereby organizations intensified efforts in less frequently tapped sources rather than expanding into entirely new institutional relationships.

Figure 9 reinforces this interpretation by illustrating how the differential increase in kidney versus other organ recoveries is especially concentrated among hospitals categorized as “occasional” and “regular” partners. The trend is most pronounced among Tier 3 OPOs, which historically have underperformed relative to national benchmarks. The figure highlights that OPOs experienced significant gains in kidney recoveries from these mid- and high-frequency hospital partners. This pattern implies that reforms may have incentivized OPOs—particularly those with more room for performance gains—to optimize latent opportunities within their current hospital footprint, rather than seeking growth exclusively through new affiliations.

5 Cost consequences of the organ recovery expansion

Having established the reform’s impact on organ recovery volumes, we now examine its consequences for OPO-reported costs. These costs, which are reported annually and disaggregated by organ type, enable us to analyze how financial resource allocation changed post-reform—particularly for kidneys compared to other organs.

Panel (a) of Figure 10 illustrates average annual OPO-level costs for kidney recovery versus other organs between 2015 and 2024. Prior to 2021, costs for both groups followed similar trajectories. However, starting in 2021—a year after the reform was finalized and just before implementation—kidney-related costs began rising more sharply. Specifically, average kidney-related costs increased from approximately \$16 million in 2020 to more than \$30 million by 2024, amounting to an 87.5% increase over four years. In contrast, costs for other organs grew modestly and steadily, with no evident structural break.

Panel (b) of Figure 10 supports this divergence through a dynamic difference-in-differences

analysis, showing a significant and growing average treatment effect on the treated (ATET) for kidney-related costs relative to other organs. By the third year after the reform’s announcement, this relative increase amounted to approximately \$5 million per OPO, and doubled to approximately \$10 million within the subsequent two years, in 2024.

To evaluate the intensity of cost growth per recovered organ, panels (c) and (d) of Figure 10 present the trends in per-organ costs. While the absolute costs per kidney do rise post-reform, the increase largely mirrors the volume growth—suggesting that the rise in total kidney-related costs is a near-linear function of expanded procurement activity, rather than inflated per-unit expenses.

Table 4 reports regression estimates of the average annual cost impact. Panel (a) presents results for total annual OPO-level costs. Using the full sample (column 1), the reform is estimated to increase total costs by \$3.85 million per OPO per year, statistically significant at the 5 percent level. Excluding 2019 (column 2) raises the estimate to \$4.62 million, while excluding 2020 (column 3) yields \$4.75 million. When both 2019 and 2020 are excluded (column 4), the estimated effect increases to \$5.99 million, consistent with growing divergence in later post-reform years. In all specifications, we fail to reject the null of parallel pre-trends at conventional levels, supporting again the validity of the identification strategy.

Panel (b) reports estimates using costs per organ as the outcome. The point estimates are positive and increase when early treatment years are excluded, but they are not statistically distinguishable from zero. Accordingly, the aggregate cost effects documented in panel (c) cannot be attributed to higher per-organ costs. Instead, the evidence suggests that cost escalation primarily reflects increased volumes, facilitated by financial incentives and regulatory pressure.

5.1 Back-of-the-envelope cost-benefit analysis

In Section 3, we quantify the monthly increase in kidneys recovered after the 2019 reform by calculating the difference between the total reported number of kidneys and the estimated

trend based on pre-reform data (see Figure 6). To estimate the corresponding social benefit, we repeat the analysis for transplanted kidneys and combine the resulting figures with the average annual public cost of dialysis per patient during the period covered by our sample. Since other potential benefits are excluded, this proxy provides a conservative estimate.

According to [United States Renal Data System \(2023\)](#), the annual per capita Medicare fee-for-service spending (in 2021 dollars) for beneficiaries with End-Stage Renal Disease (ESRD) was \$83,390 in 2019, \$80,554 in 2020, and \$82,167 in 2021. In the absence of more recent estimates, we apply the 2021 figure to the period spanning 2022 to 2024. On the other hand, the estimated annual number of additional kidney transplants during this period is as follows: 1,074 (2019), 1,233 (2020), 1,607 (2021), 1,749 (2022), 2,421 (2023), and an estimated value of 2,254 (2024).²⁴ Using these figures and accounting for the stream of savings generated by each additional kidney transplanted between January 2019 and December 2024, we estimate that the reduction in aggregate dialysis demand results in total savings of approximately \$2,165 million.²⁵

Conversely, the reform also led to higher government expenditures, both due to implementation costs and its effect on the number of organs recovered—specifically, kidneys. To account for this, we perform a parallel exercise to the one used for estimating kidney-related savings, this time applied to total costs per Organ Procurement Organization (OPO).

The results are presented in Figure 11. As in Figure 6, cost projections are based on a linear model with a year trend as the independent variable, estimated using pre-2019 data. The annual differences between observed and predicted OPO-level costs indicate that the reform generated additional expenditures of \$38.34 million in 2019, \$30.43 million in 2020, \$212.02 million in 2021, \$354.81 million in 2022, \$495 million in 2023, and \$617.26 million in 2024.²⁶

²⁴In 2024, a total of 1,786 kidney transplants were performed between January and September. To project the figure through December, we first compute the average monthly number of transplants during the third quarter of 2024 and then extrapolate this value (156 transplants) to the final three months of the year.

²⁵The estimated savings reflect the cumulative reduction in dialysis spending from the month of each transplant through the end of the sample. For instance, for kidneys transplanted in January (February) 2019, savings are calculated through December 2024, covering 72 (71) months. To do so, we compute monthly per capita Medicare spending from the corresponding annual figure.

²⁶For 2024, the number of organs is annualized based on data covering January to September.

In total, these figures amount to \$1,587.84 million in additional spending (in 2021 dollars). Based on our saving estimates for the 2019–2024 period, the net fiscal effect of the reform corresponds to overall savings of \$577 million.

6 Heterogeneous effects: Incentives across tiers

Given the design of the CMS reform and its reliance on a tiered performance evaluation system, OPOs responded differently based on their assigned Tier. This section explores the heterogeneous impact of the 2019 policy changes on kidney recovery, transplantation, and cost metrics across Tiers 1, 2, and 3.

Figure 12 provides a tier-specific replication of the main trends from Figure 7, plotting monthly average recovered kidneys (treatment) and other organs (control) for each Tier. Panels (a), (c), and (e) compare the average number of kidneys recovered (treatment group) with the average number of other organs recovered (control group) for OPOs in Tiers 1, 2, and 3, respectively. Panels (b), (d), and (f) display the results of the event study analysis within each tier. As the different panels show, all tiers experienced a post-reform increase in kidney recoveries, with Tier 2 OPOs displaying the sharpest and earliest growth. The trajectory levels off around 2022 across all three Tiers, suggesting that it took approximately three years for OPOs to adapt to the new regulation.²⁷

Table 5 reports the estimated average effects, with panel (a) presenting results for recovered organs and panel (b) for transplanted organs. Panel (a) confirms that the 2019 CMS reform significantly increased the number of kidneys recovered across all OPO tiers, with the strongest gains in Tier 2 OPOs (8.7 additional kidneys per month), followed by Tier 1 (7.4) and Tier 3 (6.0). All increases in recovered organs were statistically significant. The parallel trends test was rejected for Tier 2 at a conventional level (p-value of 0.0506), indicating possible anticipatory behavior or divergent pre-trends in that group. This issue is related to

²⁷Table A1 in the Appendix presents the evolution of OPO-level average monthly donors from 2011 to 2023 across tiers. The results reveal an upward-sloping trend that accelerates sharply after 2019 across all tiers.

the specific incentives faced by OPOs in this group.²⁸

Panel (b) shows that only Tier 1 and Tier 2 OPOs showed significant increases in transplanted organs, while Tier 3’s transplant gains were not statistically meaningful. These results suggest that while all tiers responded to the reform by increasing procurement, only higher-performing OPOs were effective in translating recoveries into successful transplants, suggesting that some capacity or systemic limitations hindered the lowest-performing OPOs.

Figure 13 plots trends in average annual OPO-level costs by tier from 2015 to 2024 (left-hand panels). Consistent with the aggregate patterns, cost differences between kidneys (treatment group) and other organs (control group) remained stable prior to 2019. Beginning in 2019, costs increased sharply, particularly in Tiers 1 (panel (a)) and 2 (panel (c)), where a crossover occurs between the two series. The right-hand panels display estimated effects from the regression model. Positive treatment effects are observed across all tiers, with the largest and statistically significant increase – nearly \$15 million – estimated for Tier 1 (panel (b)). Although estimated effects for Tier 3 (panel (f)) are also positive and sizable, they are not statistically distinguishable from zero at the 5 percent level, partly reflecting the muted response in 2019 and 2020, both within the treatment period.

Table 6 summarizes the estimated effects of the reform on annual OPO-level costs by tier, along with results from parallel-trends tests. Panel (a) shows that, in the full sample, average annual increases range from \$3.1 to \$4.6 million, with statistically significant effects in Tiers 1 and 3. However, the parallel-trends assumption is rejected for Tier 1.

Panels (b)–(d) sequentially exclude data from 2019, 2020, and 2019–2020, respectively. As expected, the estimated impacts increase when early reform years are omitted, with statistically significant effects for Tiers 1 and 3 in panels (b) and (c). In Tier 2, although the point

²⁸Following the analysis in Table 3, we estimate the ATET by tier, excluding data from 2018. The resulting point estimates are 7.496 for Tier 1, 8.972 for Tier 2, and 6.116 for Tier 3—marginally larger than those reported in panel (a) of Table 5. All three estimates are statistically significant at the 1% level. The corresponding p-values for the parallel trends tests are 0.990 (Tier 1), 0.194 (Tier 2), and 0.764 (Tier 3), indicating that we cannot reject the null of parallel trends across any tier when using the restricted sample. In light of this, and despite the lack of support for parallel trends in Tier 2 when using the full sample, we favor the more conservative estimates reported in Table 5 over those obtained from the sample excluding 2018.

estimate exceeds \$4 million annually, limited statistical power precludes significance. Panel (d) reports the largest estimated impacts: \$8.0 million (Tier 1), \$5.7 million (Tier 2), and \$4.2 million (Tier 3), all statistically significant at least at the 10 percent level.²⁹

To explore the source of new organs and tier-level differences, we examine hospital interaction patterns. Figure 14 analyzes differences in the number of kidneys and other organs recovered annually across tiers. A sharp increase in this gap is observed after 2020 across all tiers. Tiers 1 (panel (a)) and 3 (panel (c)) show stable pre-reform trends, while Tier 2 (panel (b)) exhibits signs of anticipatory behavior, with a noticeable increase in 2018 relative to 2017. Across all tiers, the relative growth in kidney recoveries is largely driven by hospitals with which OPOs had only occasional pre-reform interactions.³⁰

7 Conclusions

This study provides the first comprehensive evidence on the effects of the 2019 CMS reform targeting the U.S. organ procurement industry. The reform aimed to address long-standing inefficiencies by replacing inconsistent, self-reported metrics with standardized, independently verified measures, specifically, donation and transplantation rates (Goldberg et al., 2019; Lentine and Mannon, 2020). A key ingredient of the reform was the introduction of a tiered performance ranking system that classifies OPOs based on comparative performance. Under this framework, high-performing OPOs receive automatic recertification, while lower-tier OPOs face increased oversight or potential decertification, thereby creating direct incentives for improved outcomes.

²⁹Table A2 in the Appendix reports the corresponding estimates for annual costs per organ. No effects are statistically significant, although the point estimates become more positive when 2019 and/or 2020 are excluded.

³⁰To further examine differences across tiers, Figure A1 in the Appendix presents the total number of organs and kidneys recovered, disaggregated by tier and hospital type. The figure confirms that the number of kidneys recovered increased more sharply than total organs during the post-reform period. This increase is largely driven by interactions with hospitals classified as “occasional” in the pre-reform period. Figure A2 shows the evolution of the average number of hospitals with which OPOs interact. Consistent with limited engagement with new hospitals, the upward-sloping trends appear unaffected by the reform—except for Tier 2 OPOs, which experienced the largest increase in hospital partnerships during the post-reform period.

To evaluate the reform’s impact, we leverage data sources central to the CMS evaluation process and supplement them with additional information, including a unique FOIA-obtained dataset of standardized cost reports. Using a difference-in-differences approach and data spanning for most of a decade, we isolate the causal effect of the reform on organ recovery outcomes.

Our findings suggest that the reform significantly boosted organ procurement activity, particularly kidneys. We estimate that the policy led to an average monthly increase of 7.129 recovered organs per OPO, relative to a baseline mean of 24.3 organs per OPO per month in the control group during the post-2019 period. These gains were driven primarily by strengthened relationships with existing hospitals, rather than the formation of new partnerships. Importantly, growth was concentrated among lower-tier OPOs, those most at risk of decertification under the new framework. Furthermore, the increase in organ recovery was accompanied by significant increases in costs—particularly for the lowest-performing OPOs. We also estimate that the reform was associated with a \$2.165 billion reduction in aggregate dialysis costs—a substantial fiscal impact on the healthcare system. After accounting for the corresponding increase in OPO operational spending, we estimate net savings of approximately \$577 million to the U.S. taxpayer through 2024.

These improvements align with the reform’s goals of enhancing accountability and incentivizing performance through standardized evaluation metrics. However, the increase in OPO costs, especially among lower-tier organizations, raises questions about the financial sustainability of these gains and potential long-term consequences, such as consolidation or reduced market diversity. Overall, the evidence suggests that well-designed performance-based regulation can improve efficiency and outcomes in complex, monopolistic healthcare markets—though careful monitoring is essential to avoid unintended structural imbalances. Future research should evaluate the downstream operational and financial consequences of the reform, including how changes in procurement activity affect long-term transplant outcomes, OPO financial stability, and hospital-OPO dynamics. Additionally, regulators may consider placing greater emphasis on improving recovery rates for non-renal organs, ensuring that performance gains extend across all organ types and not just kidneys.

8 References

- Agarwal, N., Hodgson, C., and Somaini, P. (2025). Choices and outcomes in assignment mechanisms: The allocation of deceased donor kidneys. *Econometrica*, 93(2):395–438.
- Becker, G. S. and Elias, J. J. (2007). Introducing incentives in the market for live and cadaveric organ donations. *Journal of economic perspectives*, 21(3):3–24.
- Boyarsky, B. J., Po-Yu Chiang, T., Werbel, W. A., Durand, C. M., Avery, R. K., Getsin, S. N., Jackson, K. R., Kernodle, A. B., Van Pilsum Rasmussen, S. E., Massie, A. B., et al. (2020). Early impact of covid-19 on transplant center practices and policies in the united states. *american Journal of Transplantation*, 20(7):1809–1818.
- Bragg-Gresham, J. L., Peters, T. G., Vaughan, W. P., Held, P., McCormick, F., and Roberts, J. P. (2024). The cost of procuring deceased donor livers: Evidence from us organ procurement organization cost reports, 2013–2018. *Clinical Transplantation*, 38(9):e15452.
- Chan, A. and Roth, A. E. (2024). Regulation of organ transplantation and procurement: A market-design lab experiment. *Journal of Political Economy*, 132(11):3827–3866.
- Cheng, X. S., Han, J., Braggs-Gresham, J. L., Held, P. J., Busque, S., Roberts, J. P., Tan, J. C., Scandling, J. D., Chertow, G. M., and Dor, A. (2022). Trends in cost attributable to kidney transplantation evaluation and waiting list management in the united states, 2012-2017. *JAMA network open*, 5(3):e221847–e221847.
- Cheng, X. S., Held, P. J., Dor, A., Bragg-Gresham, J. L., Tan, J. C., Scandling, J. D., Chertow, G. M., and Roberts, J. P. (2021). The organ procurement costs of expanding deceased donor organ acceptance criteria: evidence from a cost function model. *American Journal of Transplantation*, 21(11):3694–3703.
- Council, N. R. et al. (2022). *Realizing the promise of equity in the organ transplantation system*.

- DeRoos, L. J., Zhou, Y., Marrero, W. J., Tapper, E. B., Sonnenday, C. J., Lavieri, M. S., Hutton, D. W., and Parikh, N. D. (2021). Assessment of national organ donation rates and organ procurement organization metrics. *JAMA surgery*, 156(2):173–180.
- Dickert-Conlin, S., Elder, T., and Teltser, K. (2019). Allocating scarce organs: How a change in supply affects transplant waiting lists and transplant recipients. *American Economic Journal: Applied Economics*, 11(4):210–239.
- Goldberg, D., Kallan, M., Fu, L., Ciccarone, M., Ramirez, J., Rosenberg, P., Arnold, J., Segal, G., Moritsugu, K., Nathan, H., et al. (2017). Changing metrics of organ procurement organization performance in order to increase organ donation rates in the united states. *American Journal of Transplantation*, 17(12):3183–3192.
- Goldberg, D., Karp, S., Shah, M. B., Dubay, D., and Lynch, R. (2019). Importance of incorporating standardized, verifiable, objective metrics of organ procurement organization performance into discussions about organ allocation. *American Journal of Transplantation*, 19(11):2973–2978.
- Held, P. J., Bragg-Gresham, J. L., Peters, T., Chertow, G. M., McCormick, F., and Roberts, J. P. (2020). The cost of procuring deceased donor kidneys: Evidence from opo cost reports 2013-2017. *American Journal of Transplantation*, 20(4):1087–1094.
- Held, P. J., Bragg-Gresham, J. L., Peters, T. G., McCormick, F., Chertow, G., Vaughan, W. P., and Roberts, J. P. (2021). Cost structures of us organ procurement organizations. *Transplantation*, 105(12):2612–2619.
- Lentine, K. L. and Mannon, R. B. (2020). The advancing american kidney health (aakh) executive order: promise and caveats for expanding access to kidney transplantation. *Kidney360*, 1(6):557–560.
- Mathur, A. K. (2022). New metrics to measure opo performance are here: How do we ensure organizations receive feedback and improve organ donation?

- Meier-Kriesche, H.-U. and Schold, J. D. (2005). The impact of pretransplant dialysis on outcomes in renal transplantation. In *Seminars in dialysis*, volume 18, pages 499–504. Wiley Online Library.
- Ozgun, O. S., Namsrai, B.-E., Pruett, T. L., Bischof, J. C., Toner, M., Finger, E. B., and Uygun, K. (2023). Current practice and novel approaches in organ preservation. *Frontiers in Transplantation*, 2:1156845.
- Rosenberg, P., Ciccarone, M., Seeman, B., Washer, D., Martin, G., Tse, J., and Lezama, E. (2020). Transforming organ donation in america. *Bridgespan. org*.
- Roth, A. E. (2007). Repugnance as a constraint on markets. *Journal of Economic perspectives*, 21(3):37–58.
- Roth, A. E., Sönmez, T., and Ünver, M. U. (2004). Kidney exchange. *The Quarterly journal of economics*, 119(2):457–488.
- Roth, A. E., Sönmez, T., and Ünver, M. U. (2007). Efficient kidney exchange: Coincidence of wants in markets with compatibility-based preferences. *American Economic Review*, 97(3):828–851.
- Roth, J., Sant’Anna, P. H., Bilinski, A., and Poe, J. (2023). What’s trending in difference-in-differences? a synthesis of the recent econometrics literature. *Journal of Econometrics*, 235(2):2218–2244.
- Satz, D. (2010). *Why some things should not be for sale: The moral limits of markets*. Oxford University Press.
- Snyder, J. J., Musgrove, D., Zaun, D., Wey, A., Salkowski, N., Rosendale, J., Israni, A. K., Hirose, R., and Kasiske, B. L. (2020). The centers for medicare and medicaid services’ proposed metrics for recertification of organ procurement organizations: Evaluation by the scientific registry of transplant recipients. *American Journal of Transplantation*, 20(9):2466–2480.

- Sönmez, T. and Ünver, M. U. (2023). Influencing policy and transforming institutions: Lessons from kidney/liver exchange. Technical report, National Bureau of Economic Research.
- Spardy, J., Concepcion, J., Yeager, M., Andrade, R., Braun, H., and Elkbuli, A. (2023). National analysis of recent trends in organ donation and transplantation in the united states: toward optimizing care delivery and patient outcomes. *The American Surgeon™*, 89(12):5201–5209.
- Tonelli, M., Wiebe, N., Knoll, G., Bello, A., Browne, S., Jadhav, D., Klarenbach, S., and Gill, J. (2011). Systematic review: kidney transplantation compared with dialysis in clinically relevant outcomes. *American journal of transplantation*, 11(10):2093–2109.
- United States Renal Data System (2023). 2023 usrds annual data report: Epidemiology of kidney disease in the united states. <https://adr.usrds.org/2023>. National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health.
- Wooldridge, J. M. (2021). Two-way fixed effects, the two-way mundlak regression, and difference-in-differences estimators. *SSRN Electronic Journal*.

Table 1: Summary Statistics

Year	Number of OPOs	Costs (MMUS\$)							
		Total		Mean		Min.		Max.	
		All	Kidney	All	Kidney	All	Kidney	All	Kidney
2015	51	1,028.47	504.14	20.17	9.89	4.04	2.14	62.43	36.97
2016	51	1,117.86	548.37	21.92	10.75	4.50	2.56	66.12	38.30
2017	51	1,224.41	594.31	24.01	11.65	4.42	2.81	71.45	43.37
2018	51	1,327.07	637.81	26.02	12.51	4.49	2.74	74.79	50.04
2019	51	1,477.74	721.24	28.98	14.14	4.33	2.92	85.01	58.09
2020	51	1,577.69	758.03	30.94	14.86	4.47	3.39	93.33	51.87
2021	50	1,841.90	969.17	36.84	19.38	4.72	3.63	100.85	50.09
2022	50	2,097.96	1,155.78	42.81	23.12	8.52	3.74	111.42	63.89
2023	49	2,347.66	1,322.78	47.91	26.99	5.32	4.04	133.31	78.64
2024	49	2,517.39	1,488.08	51.37	30.36	6.03	4.48	133.31	86.93

Note: Total costs represent the annual aggregate across all OPOs. Mean, minimum, and maximum costs reflect OPO-level annual averages, minimums, and maximums, respectively. From 2015–2020: Tier 1 = 20 OPOs, Tier 2 = 11, Tier 3 = 20. From 2021–2022: Tier 2 = 10 OPOs. In 2023-2024: Tier 3 = 19 OPOs.

Table 2: The Evolution of OPO Personnel and Monetary Costs: Yearly trend, 2016-2024

Year	Personnel				Costs			
	TFE (1)	PrC (2)	PrT (3)	MeP (4)	PCC (5)	PRO (6)	ADM (7)	OvC (8)
2016	25.25** (10.48)	-0.520 (4.131)	-14.93* (8.161)	40.63*** (13.94)	532.6 (518.6)	679.5 (627.6)	530.2 (485.4)	608.1 (581.3)
2017	29.17*** (10.48)	1.993 (4.131)	-17.05** (8.161)	43.98*** (13.94)	943.6** (518.6)	1,279*** (627.6)	854.4** (485.4)	1,263*** (581.3)
2018	40.54*** (10.48)	1.740 (4.131)	-16.62** (8.161)	55.65*** (13.94)	1,613*** (518.6)	1,973*** (627.6)	1,522*** (485.4)	1,866*** (581.3)
2019	39.67*** (10.48)	5.100 (4.131)	-16.04* (8.161)	49.12*** (13.94)	2,290*** (518.6)	2,848*** (627.6)	1,985*** (485.4)	2,598*** (581.3)
2020	47.43*** (10.48)	12.86*** (4.131)	-11.48 (8.161)	44.38*** (13.94)	2,702*** (518.6)	3,157*** (627.6)	2,436*** (485.4)	3,005*** (581.3)
2021	55.91*** (10.54)	15.75*** (4.155)	-9.246 (8.209)	48.08*** (14.02)	3,824*** (521.6)	4,580*** (631.3)	3,237*** (488.3)	4,310*** (584.7)
2022	73.63*** (10.54)	21.84*** (4.205)	-0.878 (8.209)	51.52*** (14.02)	5,570*** (521.6)	7,045*** (631.3)	4,834*** (488.3)	6,418*** (584.7)
2023	99.94*** (10.60)	35.66*** (4.230)	0.127 (8.256)	61.75*** (14.10)	8,115*** (524.6)	10,138*** (634.9)	5,834*** (491.1)	9,389*** (588.1)
2024	126.40*** (10.60)	43.10*** (4.230)	9.347 (8.256)	66.92*** (14.10)	10,562*** (524.6)	13,154*** (634.9)	7,712*** (491.1)	12,256*** (588.1)
Obs.	504	498	504	504	504	504	504	504
R-squared	0.932	0.806	0.492	0.869	0.874	0.893	0.938	0.883
\bar{y} (2015-18)	141.8	32.26	40.94	63.59	5,356	8,117	7,196	7,139

Notes: The table displays the estimated $\{\beta_t\}_{t=2016}^{2023}$ obtained from $y_{jt} = \alpha + \sum_{t=2016}^{2023} \beta_t D_t + \alpha_j + \mu_{jt}$, where $\{D_t\}_{t=2016}^{2023}$ is a set of year indicators and α_j represents OPO fixed-effects. The year 2015 is used as baseline. The columns denote: (1) TFE: Total Full Time Employees, (2) PrC: Number of Procurement Coordinators, (3) PrT: Number of Preservation Technician and Other Operational Employees, (4) MeP: Number of Medical Directors, Medical Director Administrative Personnel, Executive Director Administrative Personnel, Clerical Administrative Personnel, and Other Administrative Personnel, (5) PCC: Procurement Coordinators Cost, (6) Procurement (PRO): Procurement Coordinators Cost, Professional Education Cost, Public Education Cost, Other Acquisition Cost, (7) Administrative (ADM): Administrative General Costs, Employee Benefits, Housekeeping Spending, Other Administrative Overhead Cost, (8) OvC: Total Organ Acquisition Overhead Cost. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: The impact of the reform on OPO-level organs

Organs:	Recovered (1)	Transplanted (2)
A. Full Sample		
DiD	7.129*** (1.195)	2.795*** (0.901)
Observations	16,208	16,208
\bar{Y} : Control group in pretreatment period	23.267	21.533
\bar{Y} : Treatment group in pretreatment period	24.781	20.054
H_0 : Parallel trend (p-value)	0.422	0.681
B. Excluding 2019		
DiD	8.132*** (1.300)	3.135*** (0.966)
Observations	14,818	14,818
H_0 : Parallel trend (p-value)	0.422	0.680
C. Excluding 2020		
DiD	7.580*** (1.306)	2.795*** (0.981)
Observations	14,816	14,816
H_0 : Parallel trend (p-value)	0.422	0.680
D. Excluding 2019 and 2020		
DiD	8.989*** (2.241)	3.230*** (1.095)
Observations	13,426	13,426
H_0 : Parallel trend (p-value)	0.406	0.704
E. Excluding 2018		
DiD	7.624*** (1.268)	2.804*** (0.967)
Observations	14,818	14,818
\bar{Y} : Control group in pretreatment period	22.708	20.984
\bar{Y} : Treatment group in pretreatment period	24.086	19.496
H_0 : Parallel trend (p-value)	0.660	0.459

Note: The table reports the estimated coefficient β from equation (1), using monthly data on recovered and transplanted organs at the OPO level across different samples. Panel (a) reports results for the full sample; panel (b) excludes data from 2019, and panel (c) excludes 2018. “Kidneys” constitutes the treatment group, while “Other Organs” serves as the control group. The treatment period begins in January 2019. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4: The impact of the reform on OPO-level costs

Sample:	Full	Excluding	Excluding	Excluding 2019
	(1)	2019	2020	and 2020
	(1)	(2)	(3)	(4)
A. Total costs (MMUSD)				
DiD	3.825** (1.180)	4.629*** (1.355)	4.735*** (1.320)	5.995*** (1.589)
H_0 : Parallel Trend (p-value)	0.269	0.269	0.269	0.281
\bar{Y} : Control group in pretreatment period			11.829	
\bar{Y} : Treatment group in pretreatment period			11.199	
B. Cost per organ (USD)				
DiD	20.97 (132.7)	55.38 (152.4)	102.7 (143.3)	168.4 (152.4)
H_0 : Parallel Trend (p-value)	0.596	0.596	0.569	0.587
\bar{Y} : Control group in pretreatment period			3,284	
\bar{Y} : Treatment group in pretreatment period			3,018	
Observations	1,007	905	905	803

Note: The table reports the estimated coefficient β from equation (1), using annual data on total procurement costs (panel (a)) and costs per organ (panel (b)) at the OPO level across different samples. “Kidneys” constitutes the treatment group, while “Other Organs” serves as the control group. The treatment period begins in January 2019. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Heterogeneous Effects by Tier
The impact of the reform on organs

Variables	Tier 1 (1)	Tier 2 (2)	Tier 3 (3)	Overall (4)
A. Recovered				
DiD	7.414*** (1.873)	8.705*** (2.431)	5.996*** (2.047)	7.129*** (1.195)
\bar{Y} : Control group in pretreatment period	28.041	23.688	17.817	23.267
\bar{Y} : Treatment group in pretreatment period	29.789	24.615	19.395	24.781
H_0 : Parallel Trend (p-value)	0.849	0.0506	0.584	0.422
B. Transplanted				
DiD	3.243** (1.428)	3.900** (1.780)	1.733 (1.542)	2.795*** (0.901)
\bar{Y} : Control group in pretreatment period	25.768	22.327	16.468	21.53
\bar{Y} : Treatment group in pretreatment period	23.971	20.211	15.684	20.054
H_0 : Parallel Trend (p-value)	0.502	0.473	0.927	0.681
Observations	6,726	3,286	6,196	16,208

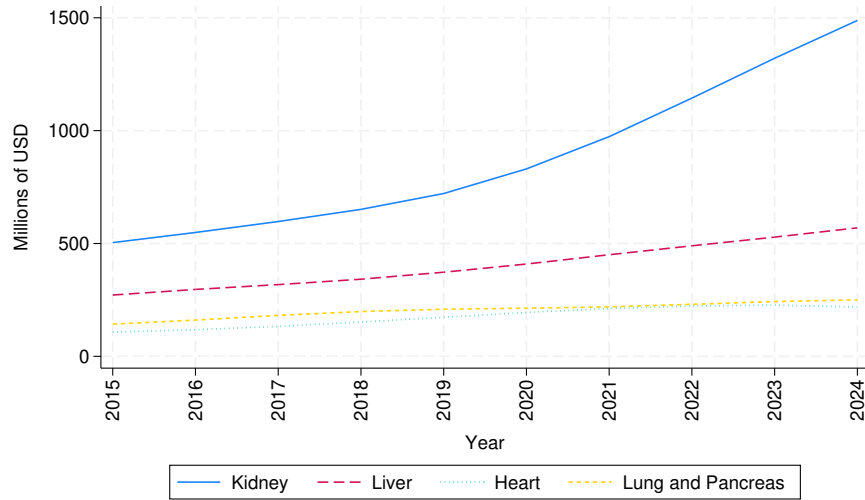
Notes: The table reports the estimated coefficient β from equation (1), using monthly data on recovered (panel (a)) and transplanted (panel (b)) organs at the OPO level, disaggregated by Tier. “Kidneys” constitute the treatment group, while “Other Organs” serve as the control group. The treatment period begins in January 2019. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Heterogeneous Effects by Tier
The impact of the reform on OPO-level costs

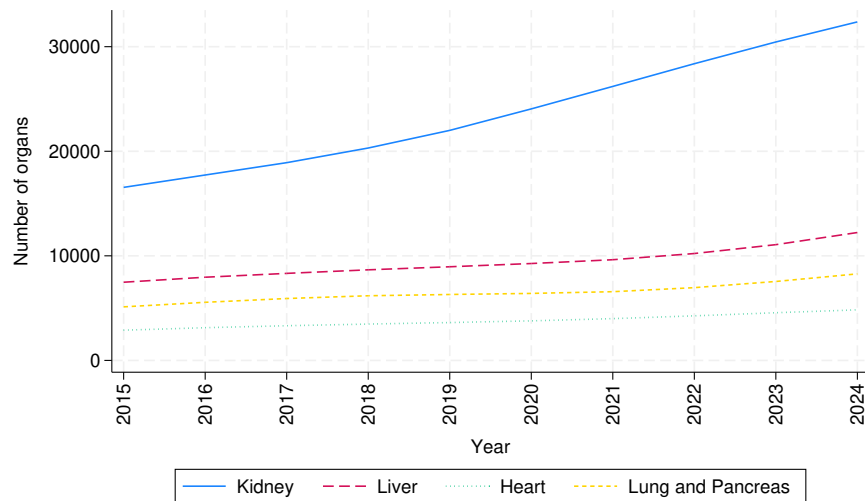
Tiers:	Tier 1 (1)	Tier 2 (2)	Tier 3 (3)
A. Full sample			
DiD	4.606*** (2.195)	3.173 (2.509)	3.121** (1.422)
H_0 : Parallel Trend (p-value)	0.0261	0.946	0.297
Observations	396	212	399
B. Excluding 2019			
DiD	5.846*** (2.514)	4.429 (2.871)	3.540** (1.651)
H_0 : Parallel Trend (p-value)	0.0261	0.946	0.297
Observations	356	190	359
C. Excluding 2020			
DiD	6.083*** (2.951)	4.507 (2.735)	3.533** (1.615)
H_0 : Parallel Trend (p-value)	0.0261	0.946	0.297
Observations	356	190	359
D. Excluding 2019 and 2020			
DiD	8.023*** (2.951)	5.696* (3.294)	4.162** (1.961)
H_0 : Parallel Trend (p-value)	0.0261	0.994	0.298
Observations	316	168	319
\bar{Y} : Control group in pretreatment period	14.93	13.11	8.018
\bar{Y} : Treatment group in pretreatment period	13.20	11.46	9.051

Notes: The table reports the estimated coefficient β from equation (1), using annual information on procurement costs at the OPO level, disaggregated by Tier, across different samples. Panel (a) reports results for the full sample; panel (b) excludes data from 2019, and panel (c) excludes 2018. “Kidneys” constitute the treatment group, while “Other Organs” serve as the control group. The treatment period begins in January 2019. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure 1: The Evolution of Costs and Recovered Organs, 2015-2024



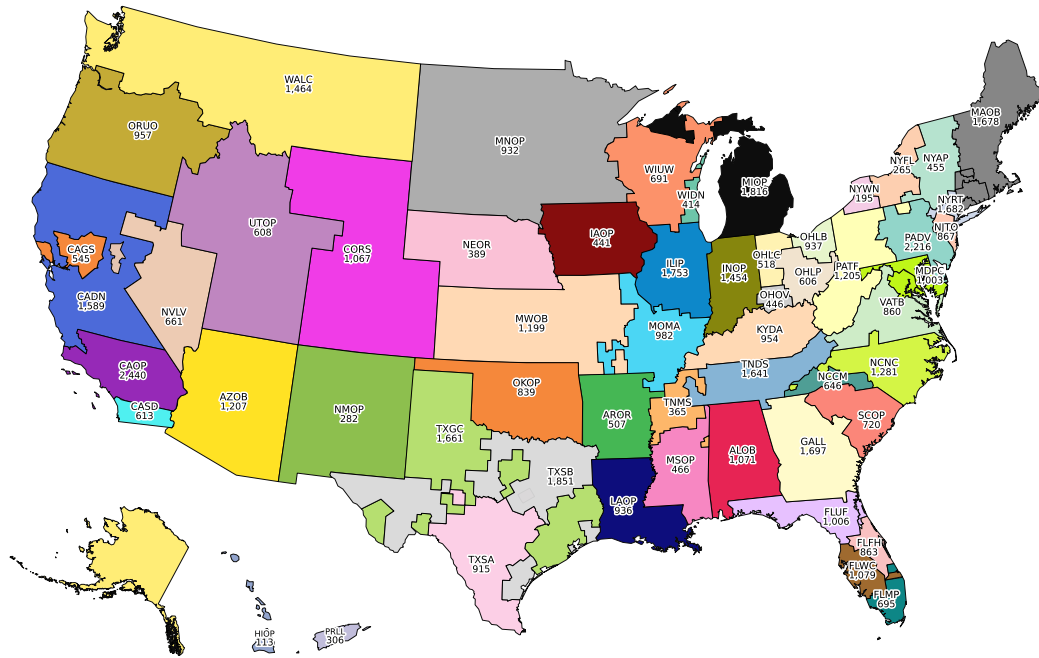
(a) Annual Costs by Organ



(b) Total Recovered Organs

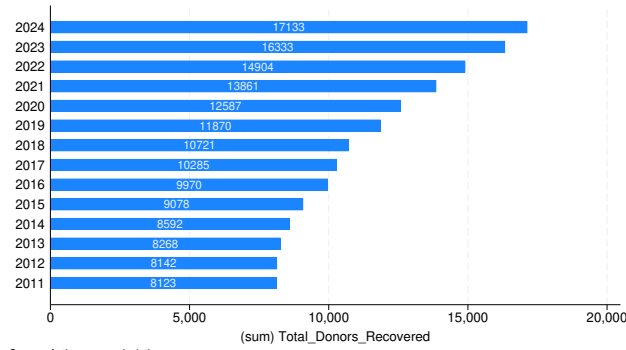
Note: Panel (a) displays total annual costs by organ, aggregated across Organ Procurement Organizations (OPOs) from 2015 to 2024. Panel (b) displays the total number of recovered organs for each year. For 2024 (panel (b)), we annualize the total number of organs based on data available through September, the most recent month reported.

Figure 2: Geographical Distribution of Organ Procurement Organizations across the U.S., 2023

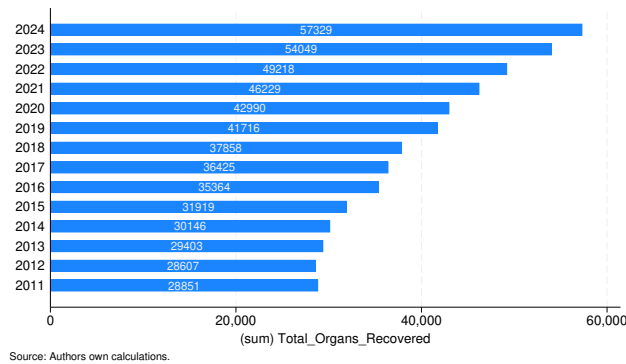


Note: The figure presents the distribution of OPOs across the U.S., including the total number of organs recovered during 2023. The following is the lists of OPOs: ALOB – Legacy of Hope (Alabama); AROR – Arkansas Regional Organ Recovery Agency; AZOB – Donor Network of Arizona; CADN – Donor Network West (California); CAGS – Sierra Donor Services (California); CAOP – OneLegacy (Los Angeles, CA); CASD – Lifesharing (San Diego, CA); CORS – Donor Alliance (Colorado); FLFH – OurLegacy (Florida, Orlando); FLMP – Life Alliance Organ Recovery Agency (Miami, FL); FLUF – LifeQuest Organ Recovery Services (Florida, Gainesville); FLWC – LifeLink of Florida (Tampa, FL); GALL – LifeLink of Georgia; HIOP – Legacy of Life Hawai’i; IAOP – Iowa Donor Network; ILIP – Gift of Hope Organ & Tissue Donor Network (Illinois); INOP – Indiana Donor Network; KYDA – Kentucky Organ Donor Affiliates; LAOP – Louisiana Organ Procurement Agency; MAOB – New England Donor Services; MDPC – Infinite Legacy (Maryland); MIOP – Gift of Life Michigan; MNOP – LifeSource (Minnesota); MOMA – Mid-America Transplant (Missouri); MSOP – Mississippi Organ Recovery Agency; MWOB – Midwest Transplant Network (Kansas); NCCM – LifeShare Carolinas (Charlotte, NC); NCNC – HonorBridge (Durham, NC); NEOR – LiveOn Nebraska; NJTO – NJ Sharing Network; NMOP – New Mexico Donor Services; NVLV – Nevada Donor Network; NYAP – Center for Donation and Transplant (Albany, NY); NYFL – Finger Lakes Donor Recovery Network (NY); NYRT – LiveOnNY (New York City); NYWN – ConnectLife (Buffalo, NY); OHLB – Lifebanc (Cleveland, OH); OHLC – Life Connection of Ohio (Dayton/Toledo, OH); OHLP – Lifeline of Ohio (Columbus, OH); OHOV – LifeCenter Organ Donor Network (Cincinnati, OH); OKOP – LifeShare of Oklahoma; ORUO – Cascade Life Alliance (Oregon); PADV – Gift of Life Donor Program (Philadelphia, PA); PATF – CORE, Center for Organ Recovery & Education (Pittsburgh, PA); PRLI – LifeLink of Puerto Rico; SCOP – We Are Sharing Hope SC (South Carolina); TNDS – Tennessee Donor Services; TNMS – Mid-South Transplant Foundation (Tennessee); TXGC – LifeGift (Houston, Lubbock, Fort Worth, TX); TXSA – Texas Organ Sharing Alliance (San Antonio, TX); TXSB – Southwest Transplant Alliance (Dallas, TX); UTOP – DonorConnect (Utah); VATB – LifeNet Health (Virginia Beach, VA); WALC – LifeCenter Northwest (WA, AK, MT, N. Idaho); WIDN – Versiti Wisconsin, Inc. (Milwaukee, WI); WIUW – UW Health Organ and Tissue Donation (Madison, WI).

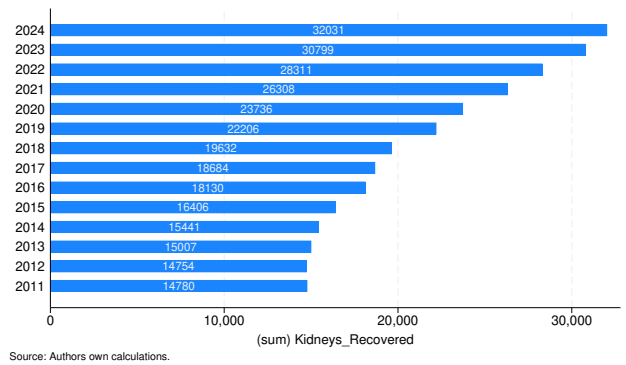
Figure 3: Annual Donors and Recovered Organs, 2011 to 2024



(a) Donors



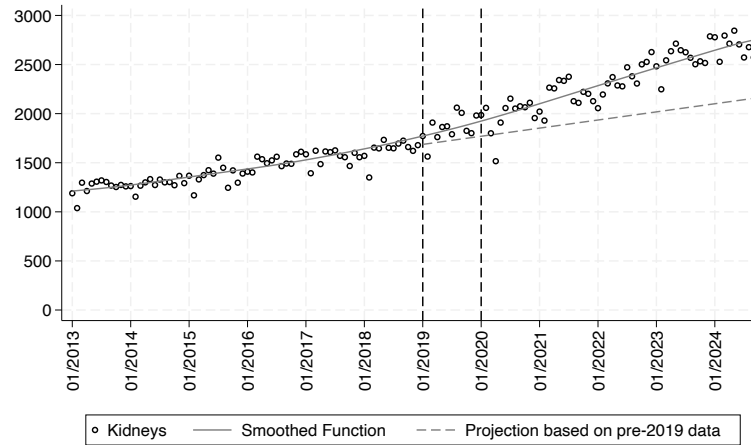
(b) All Organs



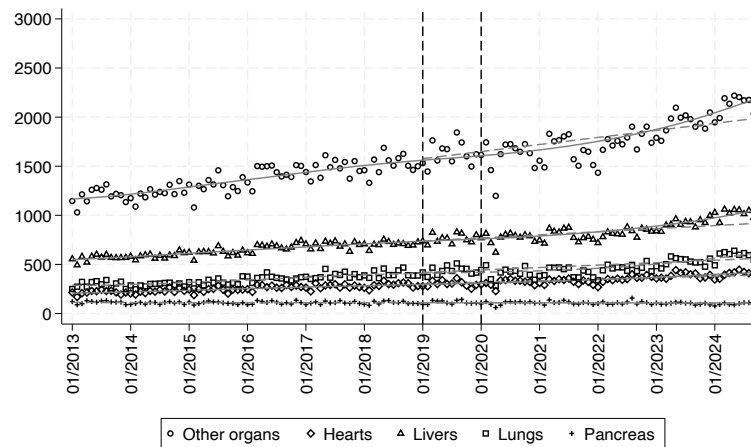
(c) Kidneys

Notes: Authors' calculations. Panel (a) displays the number of annual donors; panel (b), the number of annual recovered organs; and panel (c), the number of annual recovered kidneys. For 2024 we annualize the total number of donors, organs, and kidneys using information available up to September, the most recent month of data.

Figure 4: Monthly Recovered Organs, January 2013 to September 2024



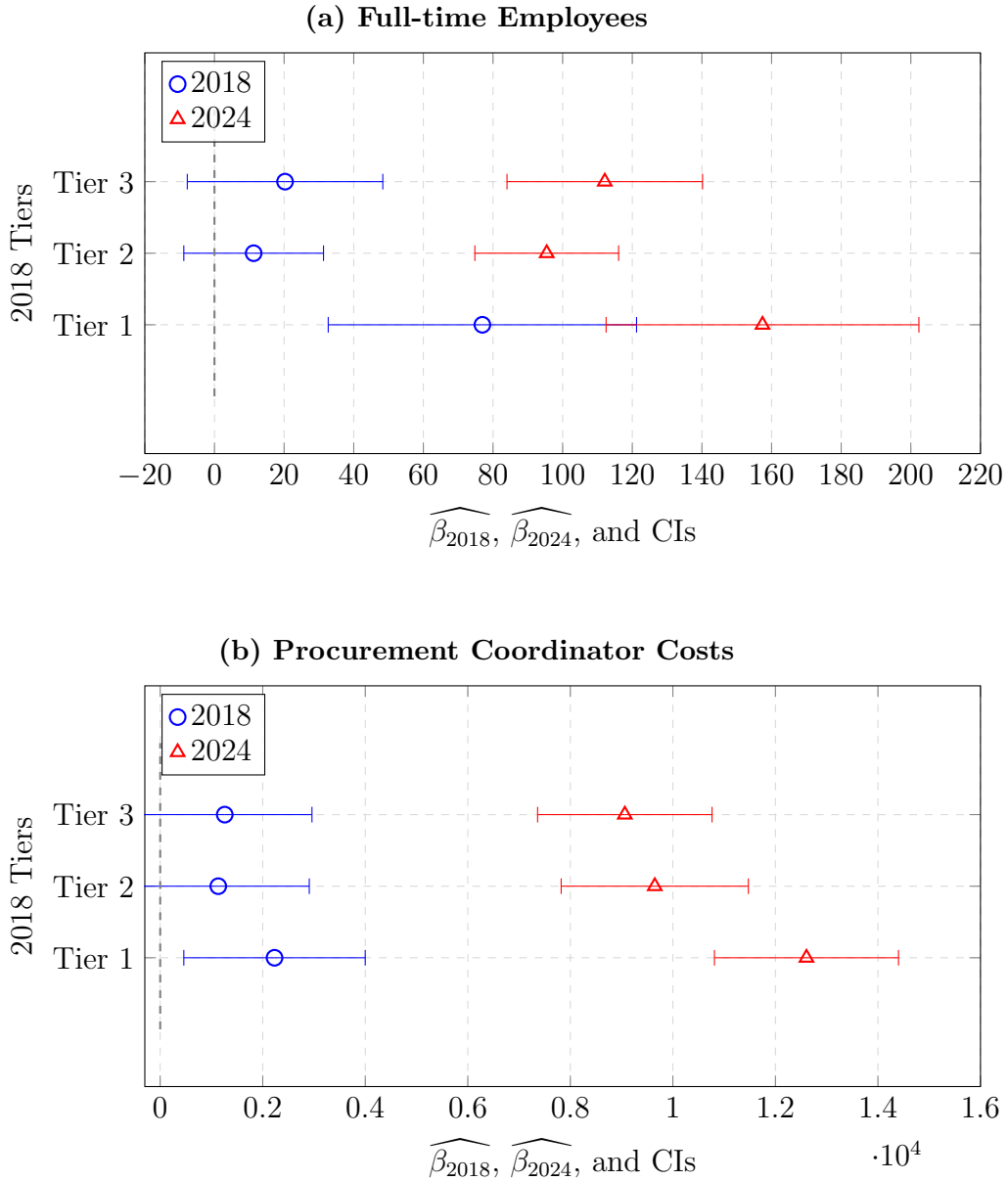
(a) Kidneys



(b) Other organs

Notes: Authors' calculations. Panel (a) displays the series of total monthly kidneys recovered, including its nonparametric trend (solid line). It also shows a trend estimated using pre-reform data and extrapolated for the months following December 2019. Panel (b) presents the same analysis for all other organs, both combined and separately for hearts, livers, lungs, and pancreas.

Figure 5: Increases in Total Personnel and Procurement Coordinator Costs: 2018 versus 2024 (both relative 2015) by Tiers - YES

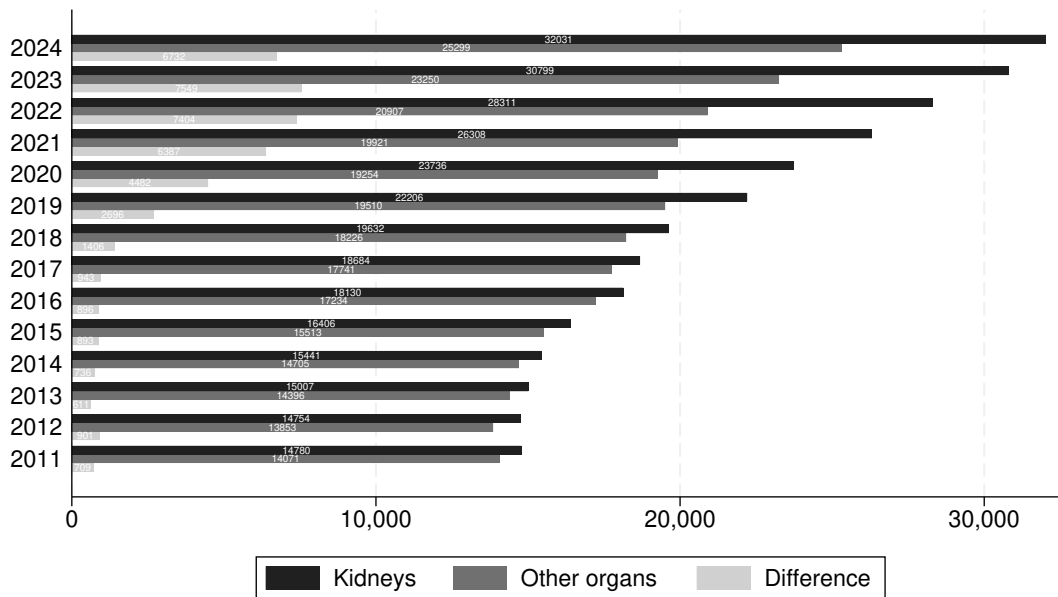


Note: The table reports the estimated values for β_{2018} and β_{2024} and their associated confidence intervals from the regression:

$$y_{jt} = \alpha + \sum_{t=2016}^{2024} \beta_t D_t + \alpha_j + \mu_{jt},$$

where $\{D_t\}_{t=2016}^{2024}$ denotes a set of year indicators, and α_j represents OPO fixed effects. The year 2015 serves as the baseline. Panel (a) presents results for total full-time employees (TFE in Table 2), while panel (b) shows results for procurement coordinators costs (PCC in Table 2).

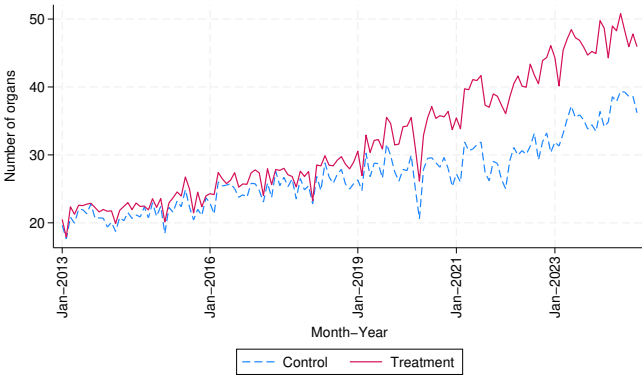
Figure 6: Annual Recovered Organs: Kidneys vs. Other Organs, 2011-2024



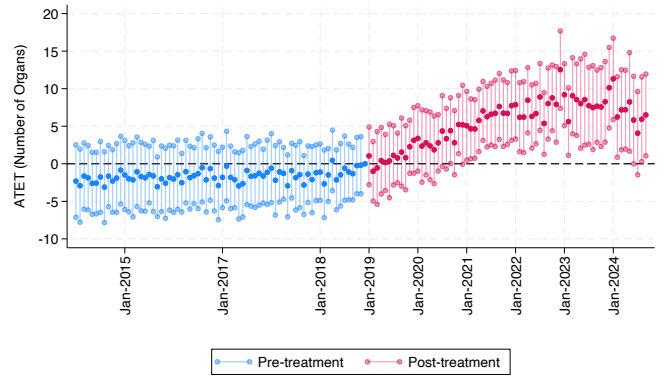
Source: Authors own calculations.

Note: The figure compares the annual number of recovered kidneys and other organs. Under “Difference,” it also reports the gap between the two series. The evolution of this difference illustrates the core logic of our identification strategy. For 2024 we annualize the figures using information available up to September, the most recent month of data.

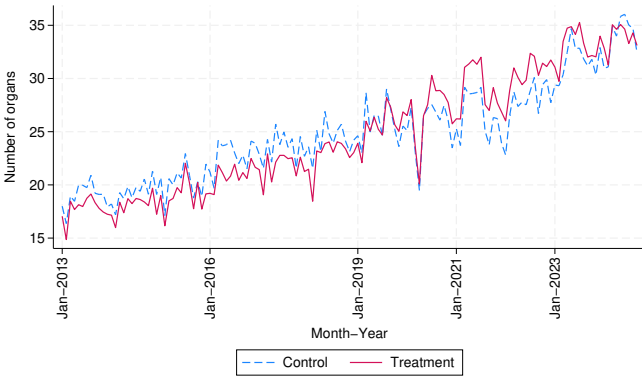
Figure 7: Average Monthly OPO-level Recovered and Transplanted Organs: Kidneys (Treatment) vs. Other Organs (Control)



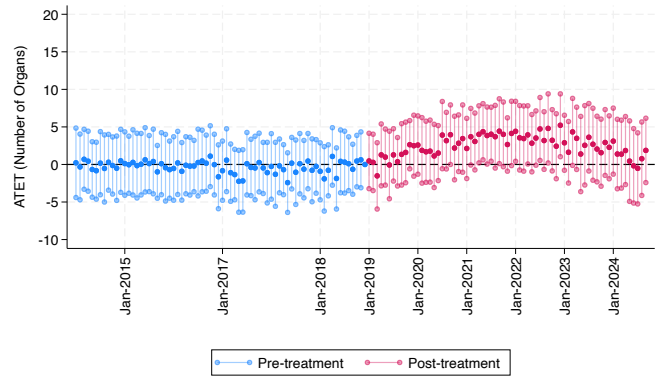
(a) Recovered - Trends



(b) Recovered - ATET



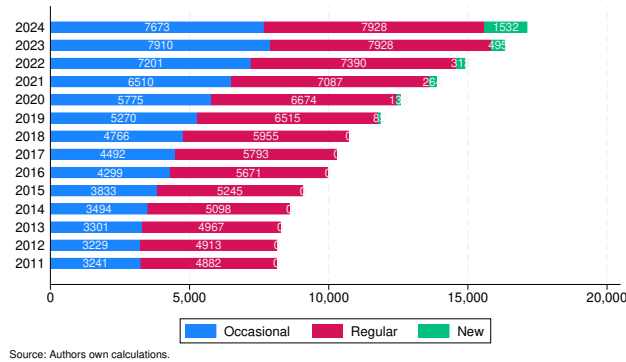
(c) Transplanted - Trends



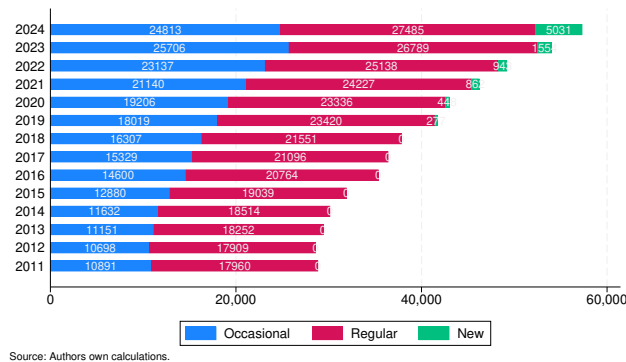
(d) Transplanted - ATET

Note: “Kidneys” represent the treatment group, while “Other Organs” serve as the control group. Panels (a) and (b) display the trends in the number of organs recovered for both groups and the estimated evolution of average treatment effects derived from the event-study plots, respectively. Panels (c) and (d) repeat the analysis for transplanted organs. The bands in panels (b) and (d) represent 95% confidence intervals.

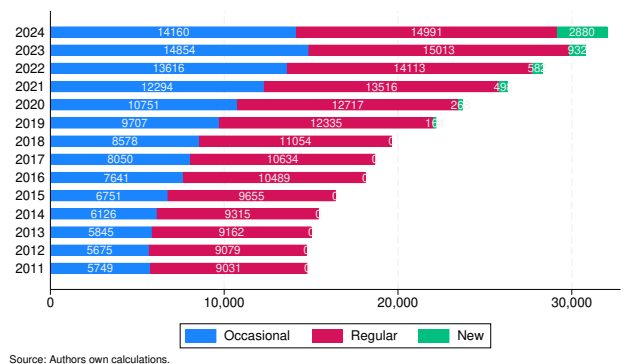
Figure 8: Total Donors, Organ Recoveries, and Kidney Recoveries by Hospital Type (2011-2024)



(a) Donors



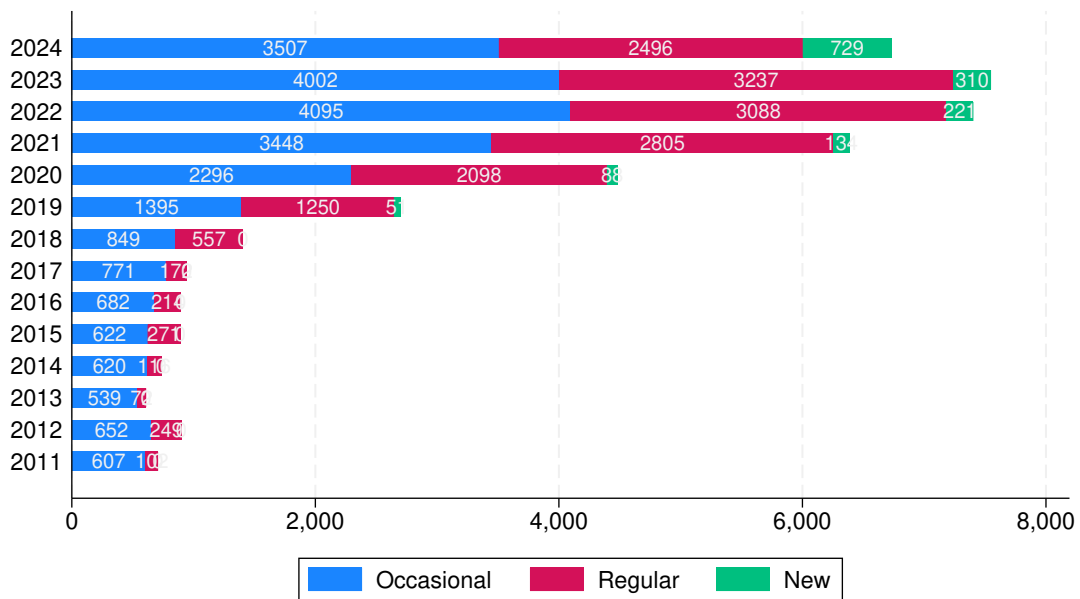
(b) All Organs



(c) Kidneys

Note: Panel (a) decomposes the annual number of donors from 2011 to 2024 across three types of hospitals. *New hospitals* are defined as institutions with which OPOs recorded their first interaction after January 2019. *Regular hospitals* are those that provided donors and organs in more than 50% of the months between January 2011 and December 2018, indicating sustained engagement prior to the reform. *Occasional hospitals* are those that did so in fewer than 50% of the months during the same pre-reform period. Panel (b) repeats the analysis for the annual series of all organs, while panel (c) does so for kidneys. For 2024 we annualize the figures using information available up to September, the most recent month of data.

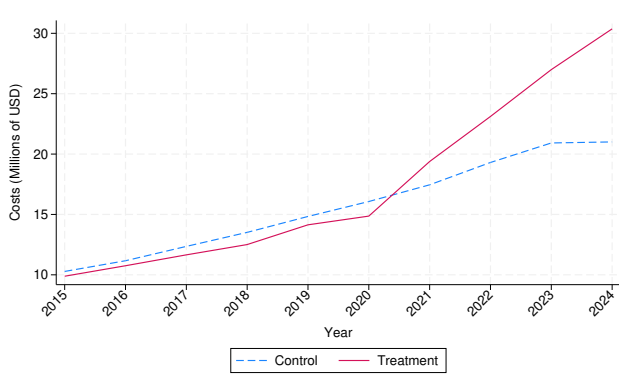
Figure 9: Difference in Kidneys vs. Other Organ Recoveries by Hospital Type, 2011–2024



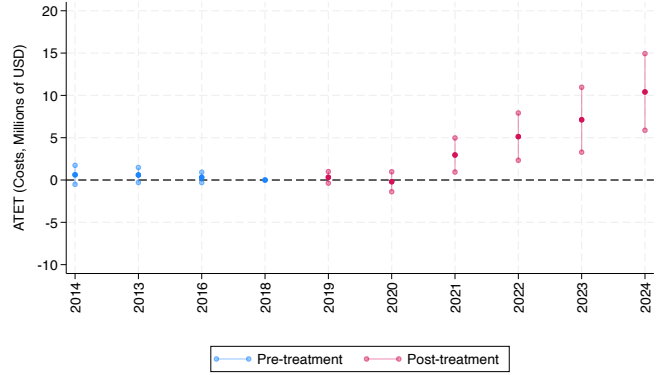
Source: Authors own calculations.

Note: The figure decomposes the difference between kidney recoveries (treatment group) and other organ recoveries (control group) from 2011 to 2024 across three types of hospitals. “Other organs” excludes kidneys. *New hospitals* are defined as institutions with which OPOs recorded their first interaction after January 2019. *Regular hospitals* are those that provided donors and organs in more than 50% of the months between January 2011 and December 2018, indicating sustained engagement prior to the reform. *Occasional hospitals* are those that did so in fewer than 50% of the months during the same pre-reform period. For 2024 we annualize the figures using information available up to September, the most recent month of data.

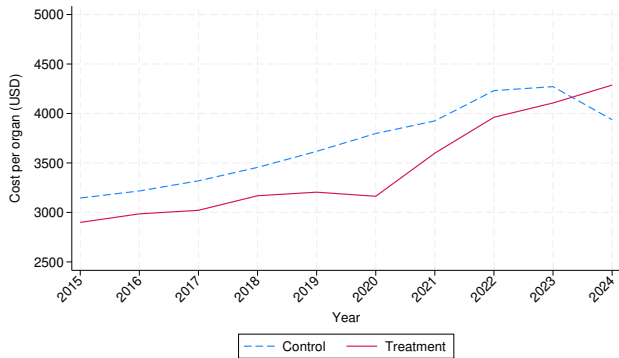
Figure 10: The Impact of the Reform on OPO-level Costs Kidneys (Treatment) vs. Other Organs (Control), 2015-2024



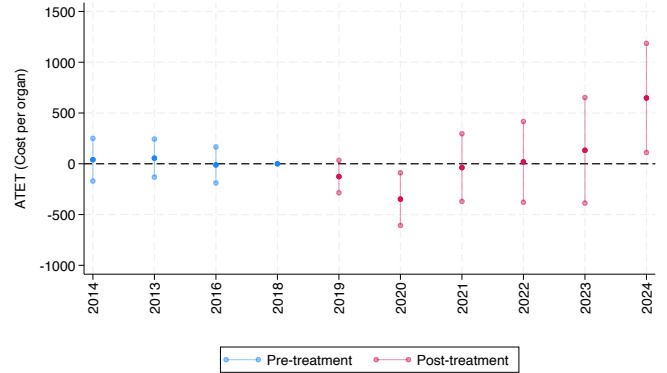
(a) Total - Trends



(b) Total - ATET



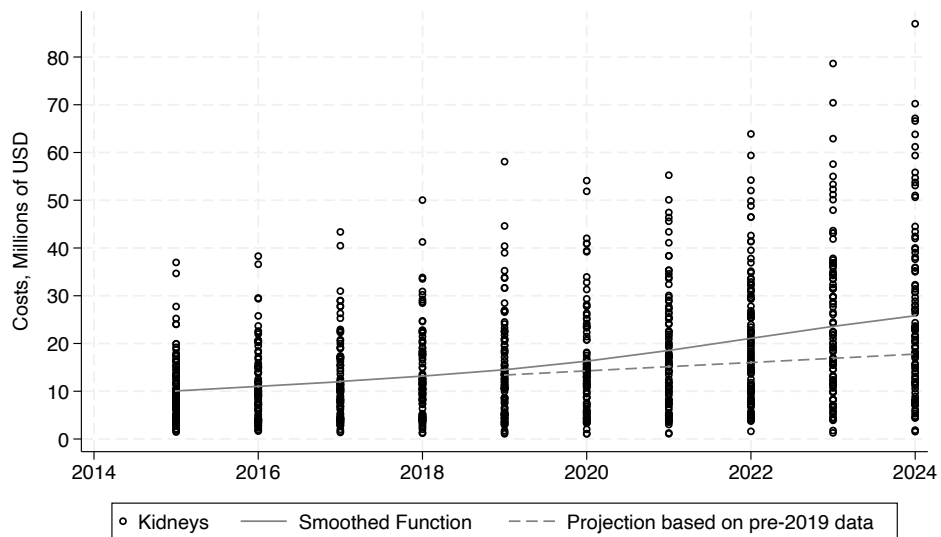
(c) Per organ - Trends



(d) Per organ - ATET

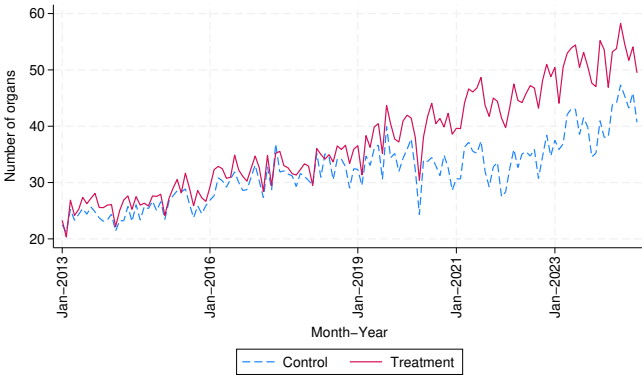
Note: “Kidneys” represent the treatment group, while “Other Organs” serve as the control group. Panel (a) shows the trends in OPO-level costs for both groups, and panel (b) presents the estimated evolution of average treatment effects derived from the event-study analysis. Panels (c) and (d) repeat the analysis for per-organ costs. The shaded bands in panels (b) and (d) represent 95% confidence intervals. “Other Organs” include hearts, lungs, pancreas, and livers. “For panels (c) and (d), we annualize the 2024 number of organs using data available through September, the most recent month reported.

Figure 11: Annual OPO-level costs associated with kidney procurement, 2015-2024

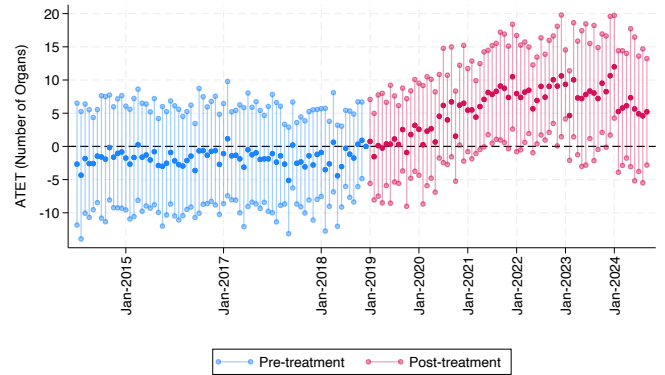


Notes: The figure displays OPO-level costs associated with kidney procurement, including a non-parametric trend (solid line). It also includes a linear trend estimated using pre-reform data and extrapolated into the post-reform period (dashed line). For 2024 we annualize the figures using information available up to September, the most recent month of data.

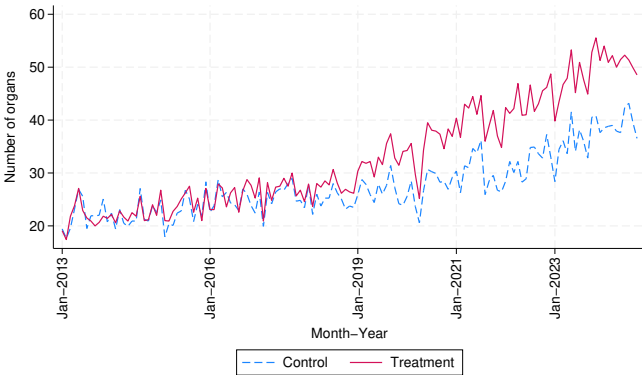
Figure 12: The Impact of the Reform on Monthly OPO-level Recovered Organs: Kidneys (Treatment) vs. Other Organs (Control) by tier (2011-2024)



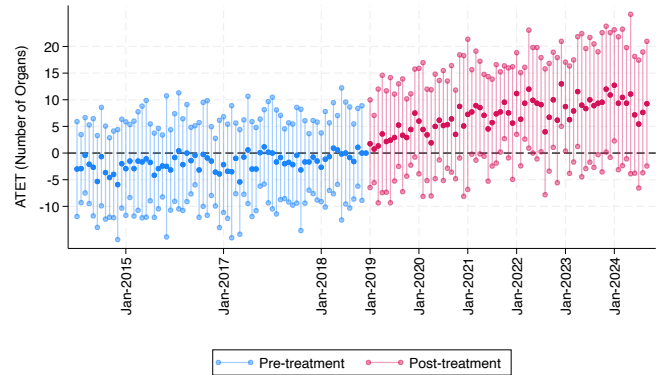
(a) Tier 1 - Trends



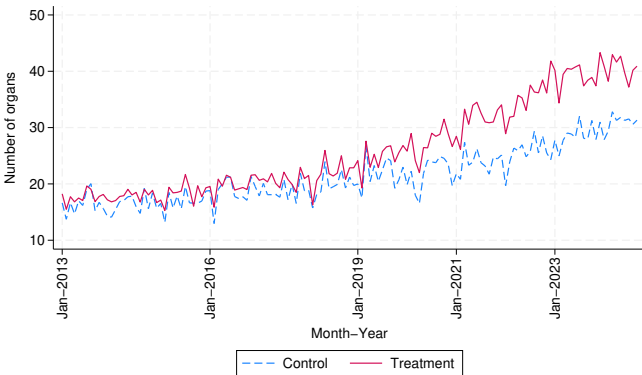
(b) Tier 1 - ATET



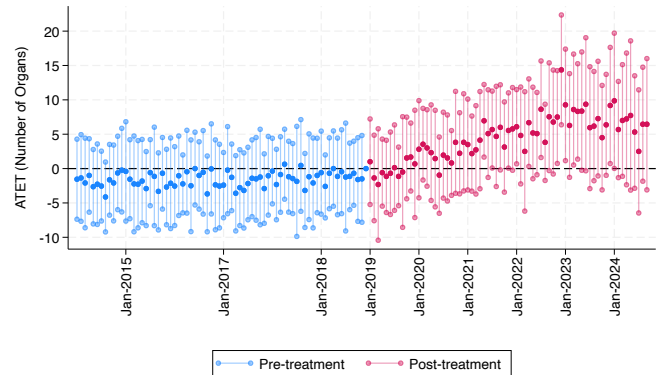
(c) Tier 2 - Trends



(d) Tier 2 - ATET



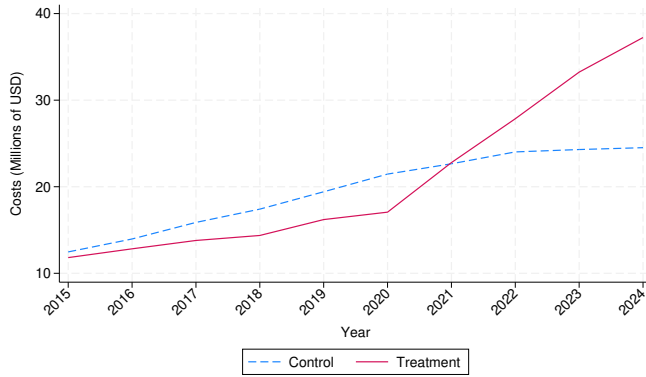
(e) Tier 3 - Trends



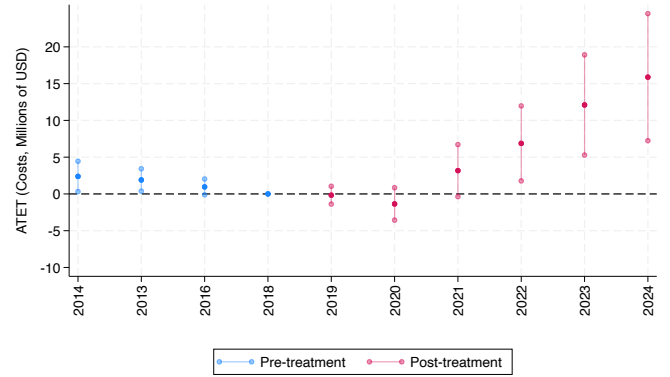
(f) Tier 3 - ATET

Note: “Kidneys” represent the treatment group, while “Other Organs” serve as the control group. For Tier 1 OPOs, panels (a) and (b) display the trends in the number of organs recovered for both groups and the estimated evolution of average treatment effects derived from the event-study analysis, respectively. Panels (c) and (d) and panels (e) and (f) repeat the analysis for Tiers 2 and 3, respectively. The shaded bands in panels (b), (d), and (f) represent 95% confidence intervals.

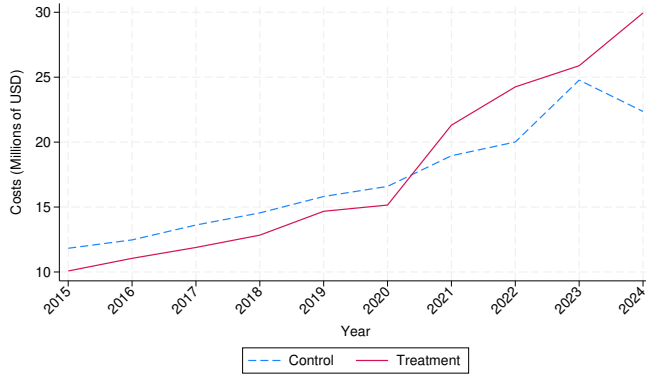
Figure 13: The Impact of the Reform on OPO-level Costs: Kidneys (Treatment) vs. Other Organs (Control) by tier (2015-2024)



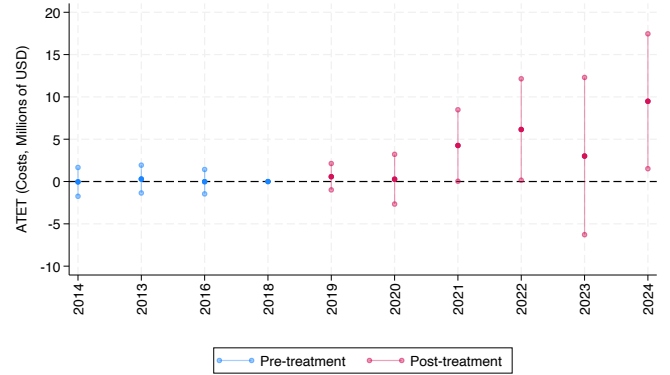
(a) Tier 1 - Trends



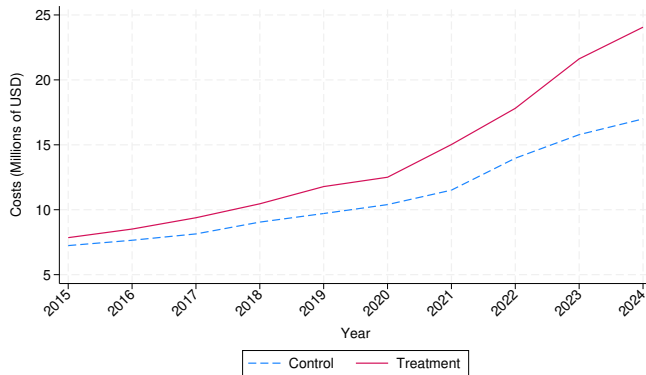
(b) Tier 1 - ATET



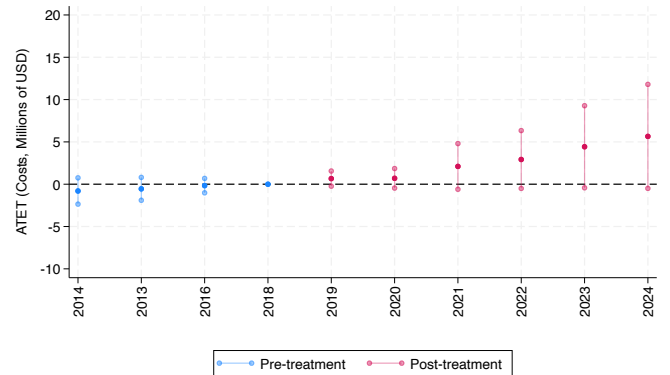
(c) Tier 2 - Trends



(d) Tier 2 - ATET



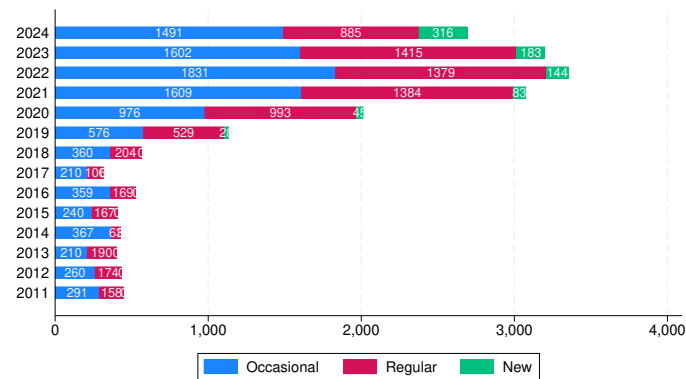
(e) Tier 3 - Trends



(f) Tier 3 - ATET

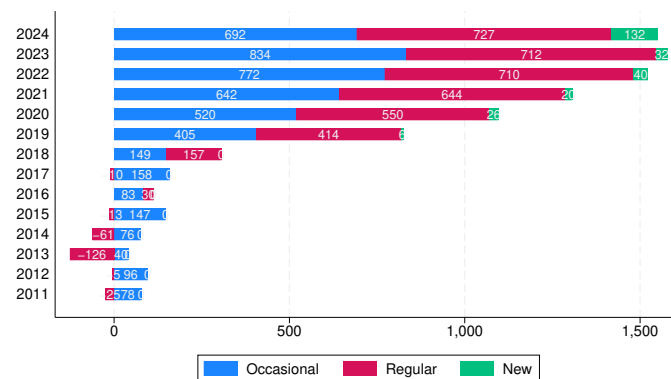
“Kidneys” represent the treatment group, while “Other Organs” serve as the control group. For Tier 1 OPOs, panels (a) and (b) show the trends in OPO-level costs for both groups and the estimated evolution of average treatment effects derived from the event-study analysis, respectively. Panels (c) and (d) repeat the analysis for Tier 2, and panels (e) and (f) for Tier 3. The shaded bands in panels (b), (d), and (f) represent 95% confidence intervals.

Figure 14: Difference in Kidneys vs. Other Organ Recoveries by Hospital Type and Tier (2011-2024)



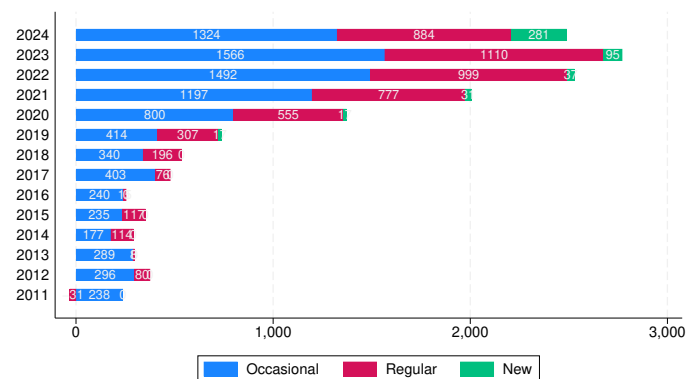
Source: Authors own calculations.

(a) Tier 1



Source: Authors own calculations.

(b) Tier 2



Source: Authors own calculations.

(c) Tier 3

Note: For Tier 1 OPOs, panel (a) decomposes the difference between kidney recoveries (treatment group) and other organ recoveries (control group) from 2011 to 2024 across three types of hospitals. “Other organs” excludes kidneys. Panels (b) and (c) repeat the analysis for Tiers 2 and 3, respectively. *New hospitals* are defined as institutions with which OPOs recorded their first interaction after January 2019. *Regular hospitals* are those that provided donors and organs in more than 50% of the months between January 2011 and December 2018, indicating sustained engagement prior to the reform. *Occasional hospitals* are those that did so in fewer than 50% of the months during the same pre-reform period. For 2024 we annualize the figures using information available up to September, the most recent month of data.

A Other Results

Table A1: The Evolution of Average Monthly Donors: Yearly trend, 2011-2024 (2011 as baseline)

VARIABLES	(1) Tier 1	(2) Tier 2	(3) Tier 3	(4) Overall
2012	-0.017 (0.436)	0.201 (0.537)	-0.061 (0.401)	0.010 (0.262)
2013	0.640 (0.436)	-0.176 (0.539)	-0.108 (0.401)	0.188 (0.262)
2014	1.199*** (0.436)	0.306 (0.537)	0.232 (0.400)	0.649** (0.262)
2015	2.226*** (0.436)	1.153** (0.537)	0.489 (0.400)	1.347*** (0.262)
2016	4.265*** (0.436)	2.125*** (0.537)	1.132*** (0.401)	2.637*** (0.262)
2017	4.581*** (0.436)	2.583*** (0.537)	1.713*** (0.400)	3.082*** (0.262)
2018	5.574*** (0.436)	2.592*** (0.538)	2.285*** (0.400)	3.713*** (0.262)
2019	7.094*** (0.436)	4.956*** (0.538)	3.698*** (0.400)	5.366*** (0.262)
2020	7.768*** (0.436)	6.382*** (0.537)	4.883*** (0.400)	6.389*** (0.262)
2021	9.740*** (0.436)	8.170*** (0.550)	7.057*** (0.400)	8.398*** (0.263)
2022	10.719*** (0.436)	9.836*** (0.550)	9.107*** (0.400)	9.923*** (0.263)
2023	13.284*** (0.441)	12.351*** (0.550)	11.391*** (0.400)	12.371*** (0.264)
2024	14.495*** (0.477)	13.960*** (0.596)	12.352*** (0.432)	13.562*** (0.286)
Observations	3,937	1,929	3,620	9,486
R-squared	0.821	0.814	0.823	0.827
OPO FE	YES	YES	YES	YES
Average Y (t=0)	15.74	13.33	10.30	13.18

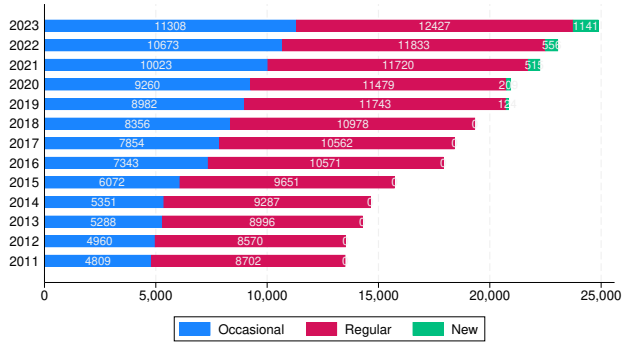
Note: The table displays the evolution of average monthly donors per year using 2011 as the baseline. Columns (1)-(3) report the results by tiers, while column (4) reports the overall estimates. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A2: Heterogeneous Effects by Tier
The impact of the reform on OPO-level costs per organ

Tiers:	Tier 1	Tier 2	Tier 3
	(1)	(2)	(3)
A. Full sample			
DiD	-44.98 (209.5)	123.1 (352.4)	34.94 (171.2)
H_0 : Parallel Trend (p-value)	0.0067	0.325	0.520
Observations	396	212	399
B. Excluding 2019			
DiD	17.48 (239.8)	172.1 (407.6)	35.35 (200.3)
H_0 : Parallel Trend (p-value)	0.0067	0.325	0.520
Observations	356	190	359
C. Excluding 2020			
DiD	85.22 (228.3)	208.4 (363.8)	68.03 (192.9)
H_0 : Parallel Trend (p-value)	0.0067	0.325	0.520
Observations	356	190	359
D. Excluding 2019 and 2020			
DiD	196.9 (275.6)	302.3 (407.6)	76.77 (235.4)
H_0 : Parallel Trend (p-value)	0.0067	0.363	0.520
Observations	316	168	319
\bar{Y} : Control group in pretreatment period	3,362	3,474	3,100
\bar{Y} : Treatment group in pretreatment period	2,787	3,267	3,113

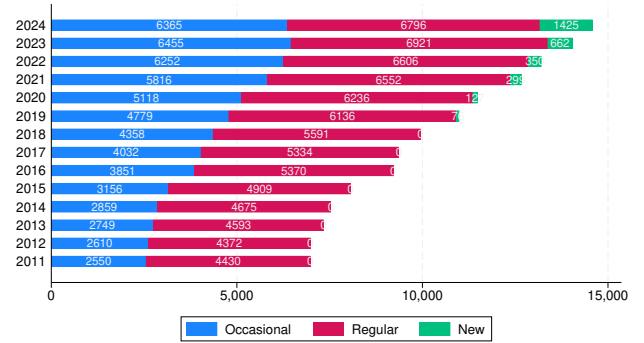
Notes: The table reports the estimated coefficient β from equation (1), using annual information on procurement costs per organ at the OPO level, disaggregated by Tier, across different samples. Panel (a) reports results for the full sample; panel (b) excludes data from 2019, and panel (c) excludes 2018. “Kidneys” constitute the treatment group, while “Other Organs” serve as the control group. The treatment period begins in January 2019. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure A1: All Organs and Kidneys recovered by hospital type and tier, 2011 to 2024



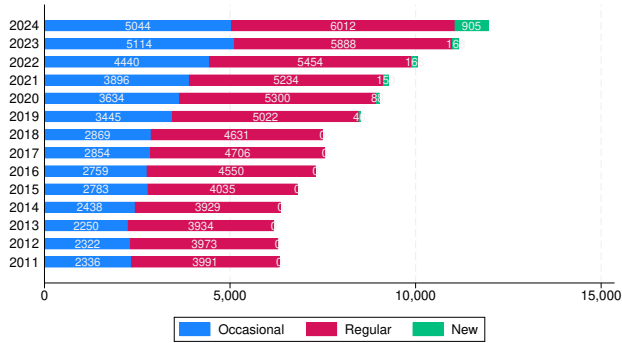
Source: Authors own calculations.

(a) Tier 1: All organs



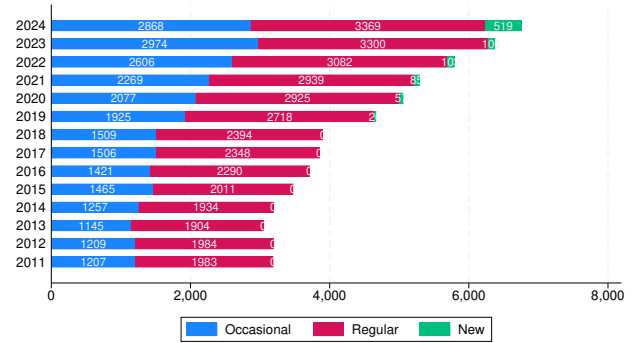
Source: Authors own calculations.

(b) Tier 1: Kidneys



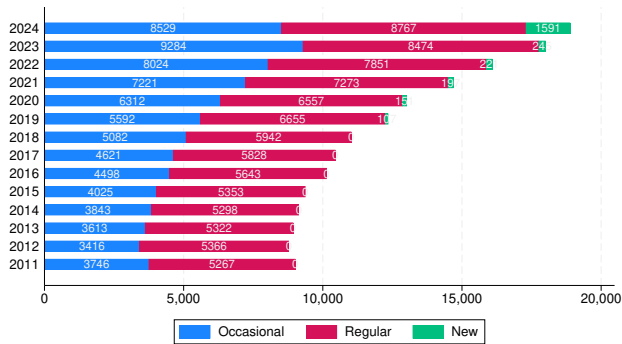
Source: Authors own calculations.

(c) Tier 2: All organs



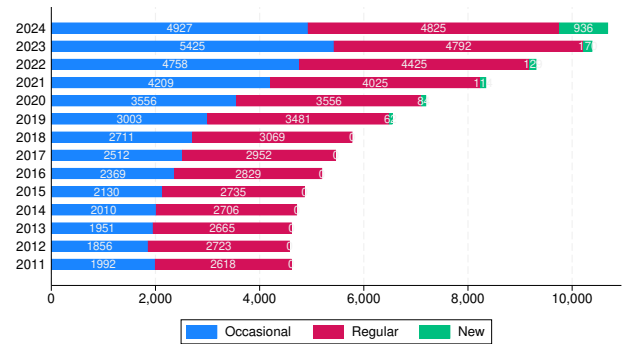
Source: Authors own calculations.

(d) Tier 2: Kidneys



Source: Authors own calculations.

(e) Tier 3: All organs

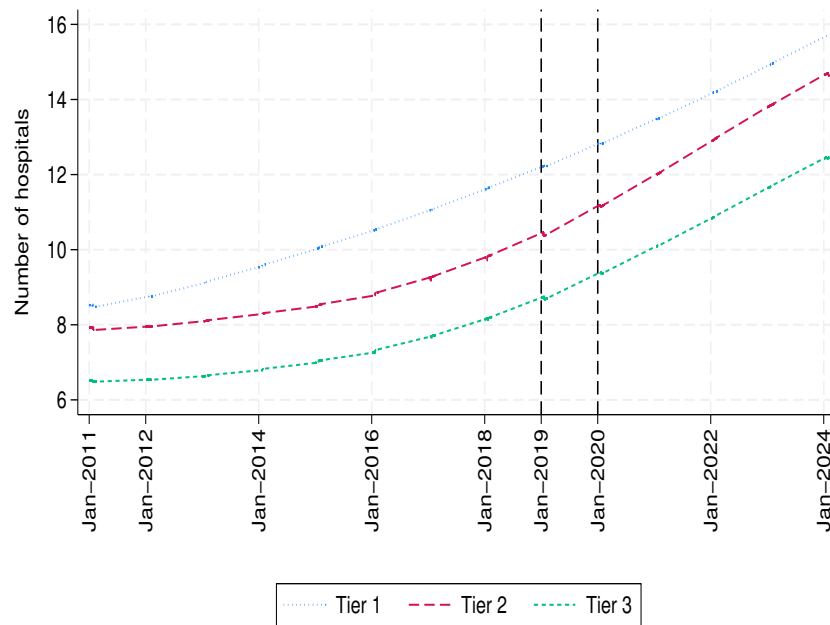


Source: Authors own calculations.

(f) Tier 3: Kidneys

Note: The figures decompose the sources of organs across three types of hospitals. *New hospitals* are defined as institutions with which OPOs recorded their first interaction after January 2019. *Regular hospitals* are those that provided donors and organs in more than 50% of the months between January 2011 and December 2018, indicating sustained engagement prior to the reform. *Occasional hospitals* are those that did so in fewer than 50% of the months during the same pre-reform period. For 2024 we annualize the figures using information available up to September, the most recent month of data.

Figure A2: Number of Hospitals by Tier, 2011-2024



Note: The figure displays the evolution of the average number of hospitals the OPOs had contact with on a monthly basis between January 2011 and January 2024 by tier.