Cost-Shifting in Healthcare:
Insights from Organ Procurement Organization Cost Reports

Erkut Y. Ozbay
Department of Economics
University of Maryland
ozbay@umd.edu

Ariel Rava
Harvard Law school
Harvard University
arava@law.harvard.edu

Emanuel Zur
R.H. Smith School of Business
University of Maryland
ezur@umd.edu

We thank Greg Segal, Philip Held, Jennifer Bragg-Gresham, Jetson Leder-Luis, Bob Kaplan and David Cutler for their helpful comments. Ariel Rava acknowledges the support of the Program on Corporate Governance at Harvard Law School.

Cost-Shifting in Healthcare:
Insights from Organ Procurement Organization Cost Reports

Abstract

This study examines the incentives that influence strategic cost allocation and the resulting outcomes within the nonprofit organ transplantation system in the United States. Using comprehensive data from annual Organ Procurement Organizations' (OPOs) cost reports, we conducted an analysis of the costs associated with organ procurement. We employ a variance decomposition analysis to examine the costs of the four most sought-after organs (kidneys, livers, hearts, and lungs) and find that the cost allocation by OPOs differs between organs with prices set according to a predetermined fee schedule and reimbursed by public and private insurances and kidneys, which are fully reimbursed by Medicare through end-of-year reconciliations. Our research shows the mechanism that enables OPOs to potentially engage in cost-shifting practices from different organs to kidneys. Our paper provides a comprehensive financial analysis of the organ procurement system by demonstrating that different reimbursement policies may result in different cost allocation patterns.

1 Introduction

This study examines the incentives that influence strategic cost allocation and the resulting outcomes within the nonprofit organ transplantation system in the United States. In light of recent congressional investigations into the organ procurement industry's performance, finances, and conflicts of interest by both the House Oversight Committee [1] and the Senate Finance Committee,[2,3] this paper delves into cost allocations among the four most sought-after organs: kidneys, livers, hearts, and lungs. We propose an empirical framework for understanding cost allocation in a setting where profit is not the primary goal, multiple reimbursement methods exist, and when reimbursement is available through commercial insurance and Medicare. Specifically, we examine whether variations in reimbursement mechanisms for different organ types, may lead to distinct patterns of cost allocation. The hypothesis we propose posits that Organ Procurement Organizations' (OPOs) cost allocation differs between organs whose prices are negotiated in real-time with transplant centers versus kidneys, which are fully cost-reimbursed by public insurer (Medicare) with end-of-year reconciliations.

The key players in the U.S. organ transplantation system are 57 OPOs.[4] Of these, 51 are independent, private, nonprofit organizations, and six are hospital-based. OPOs operate under federal contracts and are responsible for providing all deceased donor organs to the nation's 287 transplant centers. Each OPO must be a member of the Organ Procurement Transplantation Network (OPTN), which manages the waiting list for potential recipients and sets and oversees the rules for organ allocation nationwide. Currently, over 107,000 people are on the U.S. organ transplant waitlist. On average, 150 people are added daily, and approximately 7,500 individuals on the waitlist die each year (DeRoos et al. 2021). The organ procurement industry operates under the oversight of the Centers for Medicare & Medicaid Services (CMS) and is governed by the National Organ Transplant Act of 1984. This legislation outlines two primary aspects of OPO operations: firstly, each OPO holds exclusive rights to recover deceased donor organs within its

[1] Oversight Subcommittee Launches Investigation into Poor Performance, Waste, and Mismanagement in Organ Transplant Industry | House Committee on Oversight and Reform

[2] Chairman's News | Newsroom | The United States Senate Committee on Finance

[3] 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.

[4] Prior to Dec 31, 2020, there were 58 OPOs. As of January 1, 2021, two OPOs, LifeChoice Sonor Service and New England Donor Bank, merged, bringing the total number of OPOs to 57.

designated service area; secondly, OPOs predominantly determine their reimbursement rates for transplanted organs. Notably, OPOs receive full reimbursement from the CMS for all costs associated with kidney procurement at the end of each year, while they negotiate with private and public insurers reimbursement rates for other organ procurements in collaboration with transplant centers in real time.

Using comprehensive data from the annual cost reports (Form CMS 216-94) of 51 independent OPOs from 2015 to 2021, which were obtained under the Freedom of Information Act (FOIA) and supplemented with data from other sources such as the CMS and OPTN, we conduct a thorough analysis of the costs tied to organ procurement. We start by detailing both direct and indirect procurement costs, which amounted to $9.25 billion in our sample period. Next, we assess the current industry landscape. Drawing from variance decomposition models used in labor economics and international trade, we explore the significant cost variations across OPOs, organs, and various reimbursement methods and sources (Eaton et al., 2004; Hottman et al., 2016). Additionally, by employing the Oaxaca-Blinder decomposition technique, we delve deeper into our analysis, breaking down organ costs in dollar terms to pinpoint the sources of variation (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973). Our primary objective is to use comprehensive data and advanced statistical tools to explore the factors influencing cost allocation in organ procurement, with the goal of better understanding the possible cost-shifting mechanism in the healthcare market and aiding practitioners and policymakers in enhancing the organ procurement process.

OPOs receive reimbursement for organ procurement costs related to organ retrieval from both Medicare, the country's largest health insurance provider, and transplant centers via private and public (again, Medicare) insurers. Concerning kidney transplant reimbursements, OPOs are guaranteed 100% coverage by the CMS based on their self-reported cost reimbursement reports. Medicare fully covers people of all ages who have End Stage Renal Disease (ESRD), which is permanent kidney failure requiring dialysis or a kidney transplant. Considering the saving that kidney transplants present in contrast to costlier alternative treatments, legislators have sought to ensure that OPOs remain consistently incentivized to recover kidneys (Held et al., 2016; Held et al., 2021). With this understanding, the CMS sets a standard price per kidney for each OPO based on the previous years' costs and the number of kidneys the OPO procured. At the fiscal year's end, if an OPO's expenses for kidney recovery surpass its total kidney reimbursements, Medicare adjusts the set price per kidney and compensates the difference with a one-time payment. Conversely, if the reimbursement is greater than the OPO's kidney recovery expenses, the OPO must repay the excess to Medicare; this repayment occurs even if the OPO has positive margins from other organ procurement activities that could offset these costs. The reimbursement process for other solid organs, namely livers, hearts, and lungs, differs slightly: OPOs charge transplant centers a negotiated price in real time based on the OPO's self-reported procurement expenses.[5]

The cost reimbursement mechanism for OPOs offers substantial incentives and opportunities for shifting costs to kidneys and therefore to the Medicare program, which already faces financial pressures associated with higher healthcare costs, growing enrollment, and an aging population.[6] Firstly, any intention to procure kidneys from deceased donors permits OPOs to allocate direct costs to the kidney acquisition charges, including shared direct costs such as surgeon or lab fees, even for non-viable kidneys. This cost-shifting practice is easy to implement because kidney procurements may occur in conjunction with the procurement of other organs, and the OPOs only need to declare an intent to procure the kidneys, regardless of the likelihood of viable procurement.[7] This is especially important given that multi-organ procurements share the same direct, overhead, operational, and managerial expenses, which may be hard to disentangle between the organs. Secondly, having end-of-year reconciliations for kidneys and timely payments for other organs may allow the OPOs to shift any unassigned costs to the kidneys at the end of each fiscal year as long as the OPO originally declared an intent to procure the kidneys. Finally, the allocation method for administrative and general costs, based on the relative size of each organ's direct and overhead costs and the absent adequate Medicare oversight and accountability, incentivizes OPOs to amplify these costs for kidneys to allocate a larger share of administrative and general costs towards kidney reimbursements.[8]

Prior healthcare and accounting research provides evidence for cost-shifting mainly in the hospital care system in the United States (e.g., Danzon, 1982; Eldenburg and Soderstrom, 1996), with a few international exceptions (Eldenburg et al., 2017). Studies in both California and Washington State indicate that hospitals shifted costs to outpatients, especially via strategic cost

[5] Livers, hearts, and lungs along with kidneys amount to 95% of solid organs procured by OPOs. Organs such as intestines, bowls, and pancreas comprise the remainder.
[6] https://www.kff.org/medicare/issue-brief/what-to-know-about-medicare-spending-and-financing/
[7] CMS-216-94_Chapter_33_cost_guide.
[8] Transforming Organ Donation in America (Appendix A), 2020, Bridgespan Group. Bridgespan-OPO-Report-FINAL-Appendix-A.pdf

allocation by increasing outpatient services, when Medicare began using prospectively defined rates instead of cost-based reimbursement for inpatients (Danzon, 1982; Eldenburg and Kallapur, 1997). At the same time, recent research also provides evidence of cost-shifting from Medicare to private insurance, such as after the passage of the 2010 Patient Protection and Affordable Care Act (Frakt, 2011). This cost-shifting behavior is influenced by various factors, including managerial incentives, normative pressures from stakeholders emphasizing patient-related services, and regulatory oversight, all of which play crucial roles in financial and operational decisions within hospitals (Brickley and Van Horn, 2002; Krishnan and Yetman, 2011).

Our study contributes to the debate on the cost reimbursement model by examining the cost allocations for organ procurement, specifically comparing fully reimbursed kidneys with end-of-year reconciliations to the real-time negotiated price reimbursement mechanism for other organs. Using comprehensive cost reports of the entire independent OPO population, we are able to allocate costs precisely as OPOs do and determine the average cost driver for each procured organ. Through this approach, we investigate whether OPOs are inclined to shift costs between different reimbursement programs and estimate the dollar value of such behavior. We believe this behavior would manifest as follows: firstly, OPOs' overhead costs will account for a higher portion of kidney costs compared to other solid organs. Secondly, OPOs' direct costs will account for a lower portion of kidney costs compared to other solid organs. Finally, OPOs' primary cost drivers will account for a lower portion of kidney costs compared to other solid organs.

To examine the possibility of OPOs engaging in cost-shifting, we employed a variance decomposition analysis to distinguish the primary determinants of organ cost, including direct costs, overhead costs, organ yields, success rates, and other pivotal resources and environmental factors. Ideally, in the absence of cost-shifting, these determinants should consistently explain the cost variance across organs. Our methodology aligns with Hottman et al. (2016) and mirrors the variance decomposition by Eaton et al. (2004) that is used in international trade and labor economics studies.

A notable finding Is the large variation in direct costs between kidneys and other types of organs. Specifically, while direct costs (e.g., surgeon fee, transportation fee, medical supplies, laboratory tests) explain over 70% of the variation in livers, hearts, and lungs, they explain only 30% in kidneys. Furthermore, we also find that the variation in overhead costs (e.g., administrative, coordination expenses, education costs, etc.) associated with kidneys explains more than twice as much as in other organs. Finally, we find that the overall unexplained variance in the main cost drivers for kidneys is at least 50% higher than for other organs. Other cost drivers, such as the total number of organs, the percentage of non-viable organs, revenue from tissue sales, and the number of hospitals and transplant centers the OPO works with, do not seem to play a major role in OPO cost variation, although they are significantly correlated to costs. The above evidence supports the argument that OPOs shift both direct and indirect costs from different solid organs to kidneys during the reimbursement process. Moreover, the unexplained variable raises questions about potential undisclosed financial reallocations between organs or underlying inefficiencies. Taken together, these results may suggest that OPOs are engaging in cost-shifting practices from different organs to the kidney.

We subsequently attempt to quantify the dollar difference between high-cost and low-cost OPOs to understand the potential magnitude of cost-shifting. To achieve this, we employ the Blinder–Oaxaca decomposition, a statistical technique that decomposes the difference in the means of a dependent variable between two groups (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973). Using this methodology, we can determine how much of the observed cost difference in organ procurement arises from variations in the explanatory variables between high and low-cost OPOs and how much might be ascribed to unobserved characteristics or specific practices within these OPO groups. Most importantly, the Blinder–Oaxaca decomposition enables us to assign a dollar value to the differences in each cost driver between high and low-cost OPOs in the context of organ procurement. This quantification provides a concrete measure of the disparities, offering insights into the financial implications of the observed variations.

We find that the cost gap between high-cost and low-cost OPOs is smallest for kidneys at $8,586, followed by the liver at $12,369, the heart at $16,004, and the lung at $20,407. However, the observed difference between high- and low-cost OPOs explains the least variation in kidneys, with more than 50% of the differential not explained by the main cost drivers. When we examine the cost gap more closely, we find that direct costs explain at least twice as much of the cost in other organs when compared to kidneys. Furthermore, we find that overhead costs are a top contributor to the difference in kidney costs, explaining at least three times the gap in costs's variance when compared to other organs. Overall, direct and overhead costs consistently stand out as the primary drivers of costs. However, the distinct dynamics surrounding kidney costs compared to other organs raise compelling questions about potential cost-shifting practices.

Our paper contributes in several ways to the prior healthcare and accounting research. Firstly, we provide an empirical analysis to understand the cost of organ procurement in the United States using a comprehensive dataset. Our unique dataset, which includes manually constructed FOIA-obtained OPO cost reports from 2015–2021, supplemented with data from various restricted and unrestricted sources, provides us with the opportunity to examine the industry in a new light. In August 2023, the office of Inspector General (OIG) released audit report titled "*Medicare Paid Independent Organ Procurement Organizations Over Half a Million Dollars for Professional and Public Education Overhead Costs That Did Not Meet Medicare Requirements*".[9] Using this unique dataset and conducting a thorough analysis of the costs associated with organ procurement, our study may help inform future legislation and industry operations and can ultimately improve organ transplantation in the United States.

Secondly, we contribute to healthcare economics research by providing a comprehensive financial analysis of the organ procurement system as a whole by using advanced statistical tools (Held et al. 2020; 2021). Our methodology borrows from international trade and labor economics, providing a framework to decompose and understand the main cost drivers of different types of organs (Eaton et al., 2004; Hottman et al., 2016). In addition, the use of the Blinder–Oaxaca decomposition allows us to assign a dollar value to quantify the inefficiencies of the organ procurement industry (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973).

Thirdly, the evidence of different cost patterns underscores the importance of greater transparency and a more standardized approach to reimbursement and cost policy within OPOs to ensure equitable organ pricing and efficient operations. In this regard, we demonstrate that different reimbursement policies, such as real-time pricing and end-of-year reconciliation, may result in different cost patterns that may eventually lead to a shift of funds from private insurers covering patients to Medicare programs (Eldenburg et al., 2017). Our findings also raise concerns about possible lack in the CMS's oversight of the organ procurement system in the United States, which can result in abuse of the Medicare program and taxpayer dollars.

Finally, we contribute to healthcare accounting research by explaining the mechanisms and incentives for cost-shifting. Prior research (e.g., Eldenburg and Kallapur, 1997) has indicated that

[9] Office of Inspector General Report No. A-09-21-03020, August 2023 (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 (hhs.gov)).

hospitals have changed the services provided to patients to increase revenue ("real cost management"); for example, hospitals shifted patients from inpatient to outpatient settings and also shifted tests and procedures previously associated with inpatient stays to outpatients. In addition, prior research has also provided indirect evidence for accounting cost-shifting ("accrual cost management") by documenting an increase in overhead allocation to outpatients. We extend prior research by providing direct evidence for accounting cost-shifting. By analyzing the different cost drivers, we explain the mechanism through which OPOs shift costs to kidneys. In addition, delineating the association between cost-shifting and end-of-year reconciliations allows us to better understand the mechanism OPOs use.

The remainder of the paper is structured as follows. We begin by describing the industry and developing hypotheses. Then, we describe the sample and OPOs' main cost drivers. Next, we describe the methodology in detail and provide the results. The last section offers a conclusion.

2 Institutional Background

2.1 Role of OPOs

The 57 organ procurement organizations (OPOs) in the United States are federally designated nonprofit entities. Each is entrusted with a specific geographic domain, granting them exclusive rights and responsibilities. This organ procurement structure is rooted in the National Organ Transplant Act of 1984 (NOTA). This legislation dictates two main aspects of OPO operations. Firstly, every OPO has a monopoly on the recovery of deceased donor organs within its designated service area (DSA). Their key responsibilities encompass evaluating potential organ donors, obtaining consent for organ donation from the deceased's next of kin, surgically extracting and preserving organs for transplantation, and transporting these organs to transplant center hospitals. While OPOs manage procurement, the allocation of organs to specific recipients falls under the jurisdiction of the Organ Procurement Transplantation Network (OPTN) and the United Network for Organ Sharing (UNOS).[10] However, the final decision on whether to accept or decline an organ lies with the transplant centers (Held et al. 2020). Secondly, OPOs largely set their own reimbursement rates for transplanted organs. Notably, they receive full reimbursement

[10] It is worth noting that UNOS holds the federal contract from OPTN.

from the CMS for all costs related to kidney acquisition, while OPOs determine reimbursement for the acquisition of other organs through negotiation with the transplant centers. This reimbursement usually manifests as a payment from the transplant center to the OPO, and it mirrors the expenses tied to the organ. This process and expenses related to it are termed the standard acquisition cost (SAC).

The importance of organ transplants cannot be overstated. They provide a lifesaving intervention for patients with organ failure. However, the demand for organs significantly exceeds the supply, resulting in extended wait times. This disparity leads to around 7,500 patients dying annually while awaiting a transplant (DeRoos et al. 2021). At the heart of this critical process are the OPOs, which are responsible for identifying potential deceased donors, receiving consent for donation, and coordinating the procurement and allocation of organs from deceased donors across the United States.

Despite periodic reviews of OPO costs by the CMS and the United States having the world's most extensive organ transplant program, there is a notable lack of analysis regarding the overall costs of organ procurement. Furthermore, there is a staggering lag in research concerning the cost and quality of procured solid organs such as the kidney, liver, heart, and lung. While research has focused on the procurement of kidneys, other solid organs, which comprise approximately 50% of the market in both quantity and cost, remain underexplored (Held et al., 2020; 2021). This gap is especially surprising as OPOs regularly submit their financial data to the CMS, which covers a significant portion of all OPO expenses (Held et al. 2021). The absence of such research raises concerns, particularly given the monopolistic power of OPOs, allegations of insufficient oversight from U.S. Senate hearings, and OPOs' authority to set costs, which brings the network's cost efficiency into question.

The potential for a comparison of costs across OPOs emerges from the National Organ Transplantation Act. This act requires OPOs to employ a standardized approach in determining the SAC of each organ. These costs are tabulated using Form CMS 216-94, which we have accessed for the years 2015–2021 through a FOIA request. As every U.S. region is overseen by a specific OPO, diverse factors can influence the associated expenses. These can range from local labor rates to variations in the number of potential and actual donors, the density of transplant hospitals within an OPO's designated area, and the fees levied by hospitals for maintaining the viability of donor organs, among other variables (Held et al. 2020; 2021). Armed with this data, our primary objective is to delve into the determinants of organ procurement costs. We aim to furnish practitioners and policymakers with tangible data and analytical tools, paving the way for an enhanced organ procurement system.

2.2 The Organ Reimbursement Mechanism

A discussion of the transplant program must include the costs associated with patients with ESRD. Medicare, the largest health insurance provider in the United States, is a federally funded program primarily serving individuals aged 65 years and older, those with permanent disabilities, and—uniquely—patients with ESRD. For those with ESRD, kidney transplantation is the preferred therapeutic option. When compared to its alternatives, such as maintenance dialysis and associated medications, kidney transplantation stands out not only as a vital intervention but also as a cost-effective solution. Given the substantial costs of maintenance dialysis, kidney transplantation is frequently championed as a cost-saving alternative. Research suggests that kidney transplantation offers an estimated economic benefit of approximately $1.1 million (Held et al. 2021). This underscores the rationale for fully reimbursing OPOs: they operate as nonprofit entities under a federal contract, ensuring that organ procurement remains uncompromised by fiscal challenges. Viewing kidney transplantation as a more cost-effective option than treatments like maintenance dialysis, the legislative intent behind full reimbursement was to encourage and bolster organ transplantation, thereby benefiting both patients and the larger healthcare system. Nevertheless, despite these clear advantages, the majority of ESRD patients in the United States do not receive a kidney transplant, predominantly due to a limited organ supply (Cheng et al. 2021; 2022). Medicare's inclusion of ESRD underscores its acknowledgment of the steep costs of maintenance dialysis, frequent hospital visits, and other related complications. As evidence of its commitment, the ESRD program accounted for 7.2% of Medicare's total fee-for-service expenditures in 2018, highlighting the program's significant investment in addressing the complexities of ESRD and its treatments (Cheng et al. 2021; 2022).

OPO compensation for organ procurement is based on self-reported cost reimbursement, with Medicare and transplant centers (through private and public insurers) covering the costs related to organ procurement. We determined that the total coverage for organ procurement for the four solid organs between 2015 and 2021 was $9.25 billion (Table 2).

Kidneys are reimbursed in a unique way, with OPOs guaranteed 100% coverage of the SAC for viable and non-viable kidneys by the CMS; this is in large part due to the fact that Medicare covers ESRD and the potential cost savings kidney transplants offer compared to costly alternative treatments, where CMS tries to ensure that OPOs are never financially demotivated from recovering kidneys. Initially, CMS determines a set price per kidney based on previous years' SAC and the quantity of kidneys procured in each OPO. At the end of each fiscal year, if an OPO's kidney-recovery expenses exceed its total kidney reimbursements from transplant centers, Medicare will pay the difference through end-of-year reconciliation payments. This happens even if the OPO generates positive margins in other organ procurement activities that could cover these costs. If the reimbursement exceeds the OPO's kidney-recovery expenses, the OPO is required to repay Medicare the excess amount. We calculated that total kidney SAC between 2015 and 2021 was $4.7 billion and that the average SAC of a single kidney was $31,381 (Tables 2 & 3).

Other solid organs, including the three major ones of liver, heart, and lung—which, along with kidneys, comprise approximately 95% of the solid organs procured—are reimbursed a bit differently. OPOs charge transplant centers a real-time SAC for each organ type, which is calculated based on OPO costs and the number of organs procured in previous years. We find that the average cost per organ between 2015 and 2021 was $33,910 for the liver, $36,384 for the heart, and $36,616 for the lung, with a total SAC of $4.5 billion (Tables 2 & 3).

A major concern of this reimbursement practice is that kidney procurements occur in conjunction with the procurement of other organs. This creates a scenario where the full reimbursement for kidneys creates incentives for cost-shifting because OPOs have a financial interest in showing Medicare that their kidney procurement costs exceed their reimbursements as they otherwise have to repay Medicare any positive difference. This is especially important when considering that multi-organ procurement shares the same direct, overhead, operational and managerial expenses, which may be hard to disentangle between the organs.[11]

[11] A report by Bridgespan claims that this cost-shifting "…may impact the actual clinical practices of organ procurement, as some costs can be allocated to kidneys prior to recovery so long as there is an initial intent to procure one (even if those kidneys are not in fact suitable for donation)."

Another important revenue source many OPOs rely on is human tissue procurement. While SAC and Medicare reimbursement represent the whole revenue from solid organ recovery, OPOs also recover and sell human tissues such as cornea, bone, and skin as part of their organ recovery activity. Unlike in solid organ procurement, the tissue is then sold to both non- and for-profit organizations at market prices, which are not governed or overseen by the CMS.[12] On the one hand, such activity may increase OPO revenue with minimal resources and a minimal marginal cost since OPOs already recover organs, and this allows the OPO to invest more in organ recovery activity. One the other hand, tissue procurement may provide OPOs with greater incentives to focus more on tissue recovery rather than solid organ procurement and to attempt to shift indirect and overhead costs to kidneys, which are fully reimbursed. Tissue procurement is a significant revenue source for most OPOs, with significant revenues of over $9 billion dollars between 2015–2021.

Another concern arises around the determination of SAC for organs besides the kidneys. While negotiation of reimbursement with OPOs is possible, transplant centers are at a disadvantage. OPOs are geographic monopolies and subject to limited financial disclosure requirements, leaving the transplant center with limited information about OPO costs, which most likely results in reduced negotiating power. Furthermore, transplant centers do not have other legal ways to acquire organs, which further reduces their negotiating power, and any import fees from imports from other OPOs are subject to fee coverage as well. This monopolistic cost reimbursement system has the potential to pass on costs and expenses with no accountability, resulting in large variation in costs with little regard for efficiency. Hence, this paper aims to understand the variation in the costs of OPOs' SAC based on the organ procurement system as a whole.

2.3 Conceptual Framework – Cost Allocation

Using the CMS cost reimbursement framework, we hypothesize that OPO incentives, constraints, and the regulatory environment encourage and facilitate the process of cost-shifting from other solid organs to kidneys. The cost reimbursement mechanism for OPOs presents several significant opportunities for cost-shifting to kidneys. Firstly, any intent to procure kidneys from a

[12] Tissue donations are governed by regulations within the Food and Drug Administration, although such oversight is confined to clinical regulation only.

deceased donor allows OPOs to allocate direct costs to the kidney SAC. In such cases, OPOs can allocate shared direct costs to kidneys (e.g., surgeon fee, transportation fee, medical supplies, laboratory tests) even if the kidney is non-viable.[13] Consequently, OPOs are incentivized to declare intent in as many cases as possible, even when clinical evidence for procurement is highly unlikely. Secondly, the allocation of overhead costs is based on the relative number of total organs the OPO has procured by the end of the year (both viable and non-viable). This allocation mechanism further incentivizes OPOs to declare the intent to procure kidneys in as many cases as possible. Finally, the allocation of administrative and general costs is based on the relative amount of both direct and overhead costs for each organ. This mechanism provides a dual incentive to inflate both direct and overhead costs for kidneys as OPOs can allocate a larger portion of administrative and general costs towards kidney reimbursements.

In healthcare accounting research, evidence on cost-shifting is mainly documented in hospital care in the United States (e.g., Danzon, 1982; Eldenburg and Soderstrom, 1996), with a few international exceptions (Eldenburg et al., 2017). Research indicates that hospitals in California and Washington State have been observed to shift costs to maximize hospital net cash flows (Danzon, 1982; Eldenburg and Kallapur, 1997). Eldenburg and Kallapur (1997) show that cost-shiftings are especially evident with overhead costs, which are traditionally conditional on volume (Garrison et al. 2015; Horngren et al. 2005). They argue that hospitals shift overhead costs because these costs are allocated to departments rather than directly to patients, though the allocation between departments remains discretionary. Further studies demonstrate that under deregulation, both nonprofit and for-profit hospitals leverage accounting standards to shift costs between payers while attempting to stay within regulatory constraints (Dranove, 1988; Eldenburg and Soderstrom, 1996). Given this prior research, we hypothesize the following:

HYPOTHESIS 1A (H1A): *OPOs' direct costs will differ based on reimbursement mechanisms.*

HYPOTHESIS 1B (H1B): *OPOs' overhead costs will differ based on reimbursement mechanisms.*

Prior research has examined the relationship between cost drivers and cost and the explanatory power of various activity cost drivers (e.g., Miller and Vollman, 1985; Foster and

[13] CMS-216-94_Chapter_33_cost_guide.

Gupta, 1990; Banker, Potter, and Schroeder 1995, and many others). For example, managerial incentives play a key role in hospital financial and operational decisions. In nonprofit hospitals, both CEO turnover and compensation have been found to be related to financial performance, suggesting similar pressures to for-profit firms (Brickley and Van Horn, 2002). Furthermore, cost-shifting behavior by nonprofit hospitals may be influenced by both normative pressures from stakeholders, emphasizing patient-related program services over revenue maximization, and by regulative factors such as oversight (Krishnan and Yetman, 2011). Specifically, hospitals facing greater normative pressure to appear efficient tend to shift costs more, whereas those under stricter regulatory oversight shift costs less.[14] Based on the evidence in healthcare accounting literature, and considering the OPOs' unique reimbursement regime for kidneys and their monopolistic control over their designated service area, our final hypothesis is as follows.

HYPOTHESIS 2 (H2): *OPOs' total cost drivers will differ based on reimbursement mechanisms.*

3 Sample Selection and Data Descriptive

Our sample is comprised of 51 independent OPOs from 2015 to 2021. Data from six hospital-based OPOs was not available under a FOIA request. We manually collected all financial and operational information related to procurement activities from federally mandated reports (Form CMS 216-94) obtained via a FOIA request. The federally mandated reports include information about the OPOs' revenue, expenses, operations, and total organs procured. For each OPO, we further supplement this data with specific geographic data on population and OPO coverage area (Scientific Registry of Transplant Recipients); information on the number of hospitals, donation centers, and donor-specific data (Organ Procurement and Transplantation Network); wage index data (Centers for Medicare & Medicaid Services); and CEO salary data from IRS Form 990 where it is missing from FOIA-obtained forms (Return of Organization Exempt from Income Tax). A total of 356 OPO-year observations are included in the final sample.

[14] In the defense industry, however, the evidence regarding cost-shifting presents a mixed picture. While some studies reveal cost-shifting to pension cost reimbursement programs, others find no evidence of cost-shifting when analyzing the profitability of defense contractor cost reimbursement programs (Thomas and Tung, 1992; McGowan and Vendrzyk, 2002).

3.1 Main Variables

We begin by constructing our main variable of interest, the SAC per organ for each OPO, which takes the total cost reported for the organ divided by the number of total organs procured (viable and non-viable), extracted from Form CMS 216-94. Worksheet B (Cost Allocation – General Service Cost) provides information on the total cost for each organ and encompasses both the direct cost (e.g., surgeon fee, transportation fee, medical supplies, laboratory tests) and the overhead costs each OPO allocates to each organ acquisition (procurement coordination, public and professional education, etc.). In the first stage, overhead costs are allocated based on the relative number of total organs acquired, and this ratio of allocation is calculated in Worksheet B-1 (Cost Allocation – Statistical Basis). In the second stage, admin and general costs are allocated based on the relative size of the subtotal cost, which includes the direct and relative overhead charges calculated in stage one. Hence, in the construction of the SAC variable, we use the total number of organs that the OPO used to allocate costs.[15]

To understand the fundamentals of SAC, we rely on prior healthcare research in constructing the probable drivers of costs (Held et al. 2020;2021). We begin with the direct cost per organ from Worksheet A-2 (Organ Acquisition Cost). Worksheet A-2 describes all costs directly associated with each organ acquisition, including surgeon fee, transportation fee, medical supplies, laboratory tests, preservation, import, and so on. We then include the various overhead costs per organ, provided in Worksheet A (Reclassification and Adjustment of Trial Balance of Expenses). Overhead costs include procurement coordination, public and professional education, and administrative support personnel. We also include the executive director's pay per organ, taken either from Worksheet A-1 (Admin and General) or supplemented from IRS Form 990. All the above-mentioned costs are divided by the total number of organs, similarly to SAC, and allocated based on the ratio used in Worksheet B-1.

We then examine additional variables that may influence cost using the FOIA-obtained forms. We add the total number of organs, the percent of non-viable organs, the number of full-time

[15] The OPO reports the number of organs in worksheet S1 but registers the basis for cost calculation in worksheet B1. In all but a few cases, this number is equal to the total organs acquired (viable and non-viable). Nevertheless, for consistency with OPO calculations, where the basis for cost calculation takes only the viable organs, we remain consistent with the OPO calculation and use the number reported in worksheet B1 for that OPO-year.

employees, and total assets.[16] These variables provide information on the resources the OPO has and the volume and success rates of the OPO, which may help provide information about the costs.

Furthermore, special attention should be given to the inclusion of tissue revenue from the FOIA-obtained files. In addition to the procurement of solid organs, many OPOs also procure human tissues, such as bone and skin, to be sold separately in procedures that are not covered by Medicare. Many of these activities are large in scale and provide major revenue sources for the OPOs. As this activity may not be life-saving and provides a major source of revenue for the OPOs, the resources and cost allocations may come in place of the core activity the legislator gave the OPOs, which may influence the OPOs' costs and efficiency.

Finally, we add information on the specific geographic area the OPO operates in. Specifically, the population in the designated service area (Scientific Registry of Transplant Recipients), the number of hospitals the OPO acquired organs from and the transplant centers they were delivered to (Organ Procurement and Transplantation Network), and the hospital worker wage index (Centers for Medicare & Medicaid Services). A full list of variable definitions and sources is available in Appendix A.

3.2 Descriptive Statistics

Table 1 lists the 51 independent OPOs' data regarding the procurement of the four major solid organs, drawn from the FOIA-obtained cost reports (Form CMS 216-94). OPOs procured over 50,000 organs in 2021 and over 280,000 across our sample years of 2015–2021, constituting 95% of solid organ procurement in the United States. Across the board, kidneys constitute the largest number of organs procured (55%), followed by the liver (26%), heart (10%), and lung (9%). We also learned that the operations of OPOs may differ significantly, with the smallest OPO procuring only 5% as many kidneys as the largest OPO. The procurement of organs has been steadily increasing, with a slight jump in 2021 for kidneys, livers, and hearts and a decline for lungs.

[16] Very few OPO-years do not report assets. Where data exists for some years, we supplement with the closest year. Where there is missing data for all OPO-years, we supplement with the median assets of kidneys acquired by the OPOs within the same quartiles. While not a perfect substitute, since kidneys are a major driver of OPO operations, we believe such measure should describe well the operation needs of the OPO for organ acquisition volume. Furthermore, the results remain consistent when dropping those missing assets for OPO-years.

Table 2 describes the organ SAC, focusing on the major channels of OPO expenses. The total industry size for the four solid organs between 2015–2021 was $9.25 billion, with the 2021 cost approximated at $1.8 billion. Kidneys have the largest SAC, amounting to 51% of the industry, followed by the liver (26%), heart (12%), and lung (11%).

Table 3 provides information about the average SAC for each organ. Kidneys, the most sought-after organ, have an average SAC of $31,281. The SAC for kidneys varies between $20,097 and $47,748. Similarly, we observe such variation in other organs: the average cost for a liver is $33,910 (ranging from $14,195 to $56,027), the average cost for a heart is $36,384 (ranging from $12,893 to $63,397), and the average cost for a lung is $36,616 (ranging from $11,902 to $99,859). Thus, for all organs, we observe significant cost variation. In kidneys, there is an approximate difference of 130% between the lowest and highest costs. For other organs, the disparity is even more pronounced, with the lung seeing a difference of 650% between the lowest and highest costs.

Figure 1 plots the average and per-organ SAC for each OPO, sorted by the average SAC for all solid organs for each OPO. We note that OPOs do not cluster around a specific cost, but rather costs vary significantly among the OPOs and across all organs.

Figure 1 – OPO SAC / Organ

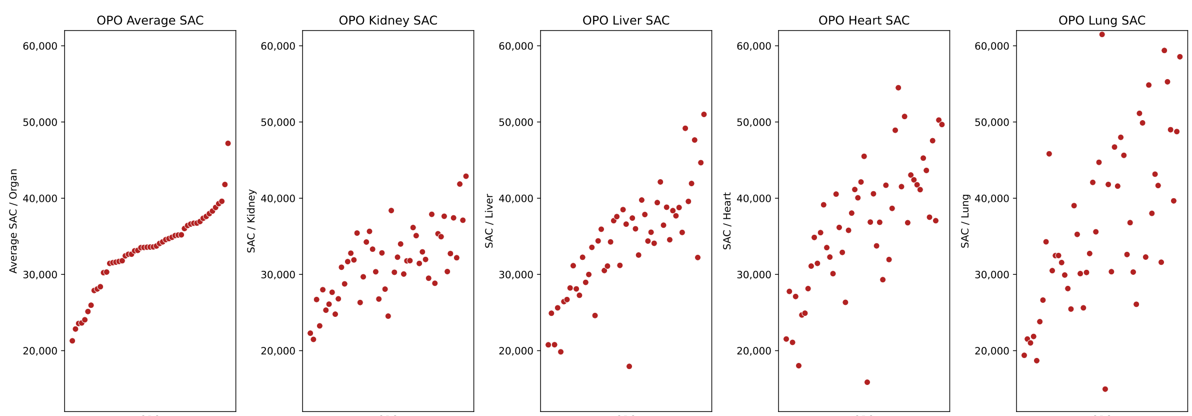

Figure 2 plots the average organs procured for each OPO, where OPOs are sorted by the average SAC for organ (as in Figure 1). We note that there seems to be no clear relationship between costs and quantities of organs. The most expensive OPOs in terms of SAC per organ seem to be procuring similar quantities as the cheapest ones.

Figure 2 – OPO Organ Procurement

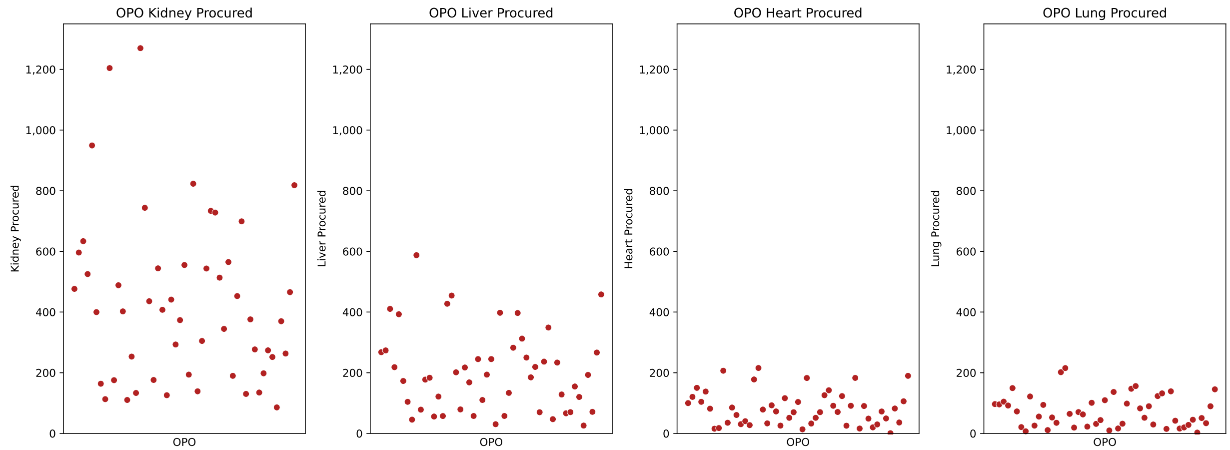

Figure 3 directly plots the average SAC for each organ against the average number of organs an OPO has procured. We observe that the variation in costs remains substantial, even when graphed in relation to the number of organs. For instance, for an OPO that procures 600 kidneys, SAC can range from $20,000 to $35,000—a 75% cost difference for the same number of kidneys procured.

Figure 3 – Organ SAC to Quantity

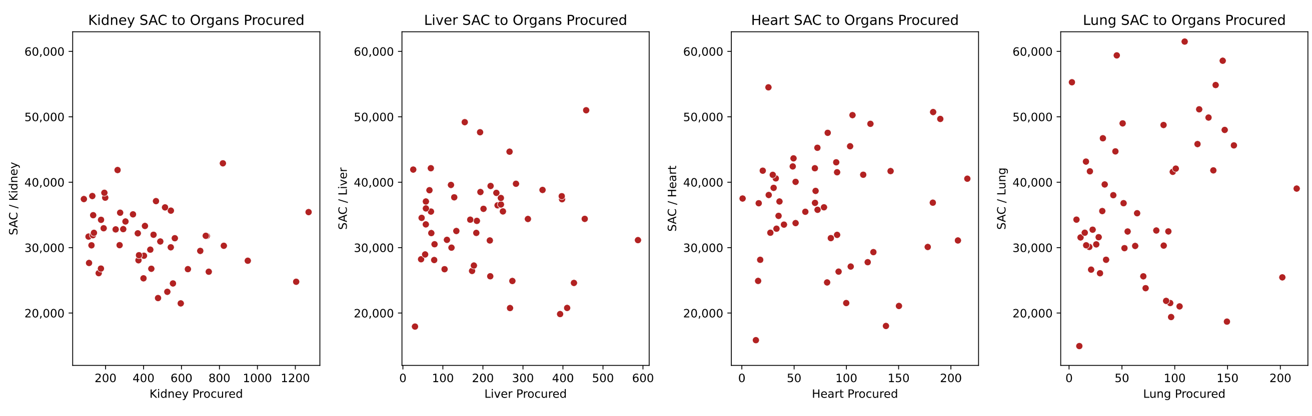

Table 4 outlines the direct and overhead costs for each organ. Direct costs encompass factors such as surgeon fees, various tests, import fees, supplies, medications, and more. These direct costs are linearly added to the SAC of each organ. We note that, similar to the total cost, direct costs also vary. Overhead costs account for the expenses OPOs allocate to their various organ transplant-related activities and the personnel responsible for them, which includes coordination, professional training, and public education about the organ procurement process. Support personnel costs represent the administrative expenses associated with organ procurement. Unlike direct costs, overhead costs are distributed proportionally to each organ based on the total number of organs procured by the end of the year.

Table 5 details the operating environment and the resources the OPOs employ. The median OPO possesses assets worth $30.5 million, generates approximately $4.5 million in tissue revenue, employs 120 individuals, collaborates with 27 hospitals, and covers a DSA serving roughly five million people. The median pay for a CEO is $468,837, with a range spanning from $84,762 to $11.3 million.

Based on the presented data, it is evident that OPOs exhibit variability across numerous factors, including cost structure, procurement strategies, and operational environments. Beyond offering this comprehensive overview, the primary objective of this study is to scrutinize the underlying factors contributing to the variations in OPOs' costs and to ascertain if these cost determinants align coherently with their primary mission of organ procurement.

4 Methodology and Results

4.1 Accounting for Cost Drivers of the SAC

Next, we examine the factors that underlie the vast variations in the SAC of each organ across OPOs. To test our hypotheses that OPOs' costs differ based on reimbursement mechanisms, we conducted a variance decomposition analysis to study the primary determinants of SAC for each organ. These determinants encompass direct costs, overhead costs, organ yields, and success rates, as well as resources and environmental factors crucial to organ procurement activities. In a scenario without cost-shifting, these drivers should account for a consistent amount of SAC variance for each organ. If the variance decomposition for a particular organ or category deviates from the norm, it might indicate that OPOs are engaging in cost-shifting practices.

We begin our accounting exercise by estimating the following regression for each organ separately:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon \tag{1}$$

In this regression, Y is SAC in time t, and $X_1 \dots X_n$ are the various cost drivers. In these regressions, SAC represents the total expenses that the OPO has determined and allocated for each of the four primary solid organ types: kidney, liver, heart, and lung. The covariates included in the regressions are various cost drivers, explained in detail in Appendix A.

The coefficients estimate $\hat{\beta}_1 \dots \hat{\beta}_n$ in Table 6 provide insight into how various covariates are correlated with the SAC of each organ separately. However, these coefficients do not directly indicate how much each factor contributes to the variation in the costs. To understand the relative importance of each factor, we need to consider the share of the variation in the costs that each explains. To assess the relative contribution of each predictor variable to the overall variability in the outcome, we performed a variance decomposition analysis based on the regression covariate results. This analysis allows us to quantify how much each covariate accounts for the variation in the dependent variable. We follow the approach of Hottman et al., (2016), a procedure analogous to Eaton et al., (2004) variance decomposition commonly used in the international trade and labor literature to decompose the variance into the effects of different covariates. This variance decomposition method of breaking down the variance, measures how much each covariate explains the variation in the outcome by itself and in combination with other covariates. It does this by adding the direct effect of each covariate to the shared effect with each of the other covariates, as follows.

$$
\begin{aligned}
\hat{\beta}_1 X_1 &= \alpha_1 + \delta_1 Y + \omega_1 \\
\hat{\beta}_2 X_2 &= \alpha_2 + \delta_2 Y + \omega_2 \\
&\cdots \\
\hat{\beta}_n X_n &= \alpha_n + \delta_n Y + \omega_n \\
\hat{\varepsilon} &= \alpha_{n+1} + \delta_{n+1} Y + \omega_{n+1}
\end{aligned} \tag{2}
$$

This method is designed to produce a decomposition where the terms $(\widehat{\delta_1} \dots \hat{\delta}_n, \hat{\delta}_{n+1})$, which evaluate the impact of cost drivers on SAC, as well as the residual, add up to one.[17] Appendix B proves the validity of this decomposition method and demonstrates that the sum of the terms $(\widehat{\delta_1} \dots \hat{\delta}_n, \hat{\delta}_{n+1})$ indeed equals one, ensuring the accuracy and reliability of our approach.

[17] The variance decomposition may yield negative coefficients due to the presence of negative covariates. However, this does not impact the interpretation of other positive coefficients. As the sum of all coefficients is one, combining negative and positive coefficients is feasible for analyzing the overall effect of the cost drivers on SAC.

Table 7 provides the results of this decomposition for the model shown in Table 6. The table provides the variance decomposition of costs and the factors associated with SAC across OPOs and among different organs. Our findings indicate that direct costs account for the largest portion of SAC: kidneys with 30%, livers with 70%, hearts with 73%, and lungs with 76%. Support personnel costs—reflecting the administrative expenses incurred by OPOs—followed second, ranging from 15% for kidneys to 7% for lungs. It is noteworthy that tissue revenue contributes only minimally to explaining the costs; this is puzzling because tissue operations should, in theory, aid OPOs in reducing costs and enhancing efficiency. Additionally, geographical factors such as wages, prices, hospital cooperation, and DSA population densities have minimal impact on the cost variance. Lastly, CEO compensation does not appear to explain much of the organ costs.

While the rankings of contributors are similar across organs, the percentage of the variance accounted for in kidneys stands out from other organs. The largest contributor, direct costs, accounts for 31% of the variance, but it accounts for more than 70% of all the other organs. Furthermore, overhead costs—which include coordination; support; and personal, public, and professional education—stand out, explaining 37% of the variation for kidneys. Overhead costs for other organs, however, explain much less—only 19% and 18% for the liver and heart, respectively. Moreover, the unexplained variance (residual) for kidneys is notably high at 21%, while for other organs, it ranges from 7%–14%.

The variance decomposition highlights several pivotal insights regarding OPOs' financial strategies and cost structures. A notable discovery is the variation in direct costs, especially between kidneys and other types of organs. Moreover, the elevated administrative and coordination expenses associated with kidneys could suggest cost-shifting practices. In addition, the substantial unexplained variance, including a pronounced 21% residual in certain instances, raises questions about potential undisclosed financial reallocations or underlying inefficiencies. Taken together, the evidence supports H1–H3, suggesting OPOs' costs differ based on reimbursement mechanisms. It is thus plausible that OPOs are redistributing costs from other operations to kidney procurement and distribution either to offset inefficiencies or to strategically manage their fiscal metrics. This evidence underscores the importance of greater transparency, a more standardized approach to costing within OPOs to ensure equitable organ pricing and efficient operations, and perhaps changing the cost reimbursement policy.

4.2 Determinants of OPOs' (High and Low) Costs

We now turn to the differences in the variations in the cost of organs across OPOs. For each organ, we split the OPOs into two groups: high- and low-cost OPOs, based on whether their cost is above or below the median cost for each specific organ.

To investigate the impact of cost drivers on total expenses, we implement Blinder-Oaxaca decomposition for each organ separately. The Blinder–Oaxaca decomposition is a statistical method that explains the difference in the means of a dependent variable between two groups by decomposing the gap into two components: one that is due to group differences in the mean values of the independent variables, and one that is due to group differences in the effects of the independent variables (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973). A major advantage of the Blinder–Oaxaca decomposition is that it allows us to assign a dollar value for the differences explained.

The basic objective of the method is to estimate separate linear regression models for each group and then compare the predicted outcomes for each group using a counterfactual scenario. In particular, to decompose the cost gap between high- and low-cost OPOs, we first estimate the following models:

$$\begin{gathered} Y_{high} = \beta_{high} X_{high} + \varepsilon_{high} \\ Y_{low} = \beta_{low} X_{low} + \varepsilon_{low} \end{gathered} \tag{3}$$

where Y is the cost of the organ, X is a vector of explanatory variables, β is a vector of coefficients, and ε is an error term. The subscripts high and low denote above and below the median cost of OPOs, respectively (or any other groups one wishes to examine). Then, we compute the mean predicted cost for each group as

$$\begin{gathered} Mean(Y_{high}) = Mean(X_{high}) * \beta_{high} \\ Mean(Y_{low}) = Mean(X_{low}) * \beta_{low} \end{gathered} \tag{4}$$

The difference between these two means is the observed cost gap:

$$\begin{aligned} & Mean(Y_{high}) - Mean(Y_{low}) \\ & \quad = \underbrace{[Mean(X_{high}) - Mean(X_{low})] * \beta_{high}}_{a} + \underbrace{[\beta_{high} - \beta_{low}] * Mean(X_{low})}_{b} \end{aligned} \tag{5}$$

Part *a* of Equation (5) is the impact of between-group differences on the explanatory variables X, evaluated using the coefficients for the group *high*. Part *b* of Equation (5) is the differential not explained by these differences in observed characteristics X. Part *a* on the left side is the part of the cost gap explained by group differences in the mean values of the explanatory variables, evaluated using the coefficients for high-cost OPOs. Part *b* is the part of the cost gap that is unexplained by these differences and may reflect group differences in unobserved characteristics.

Panels A through D of Table 8 provide the Blinder–Oaxaca decomposition for OPOs with costs above and below the median to assess the cost centers for the most and least affordably priced organs. Column (1) of each panel provides the means of high-cost OPOs, while Column (2) provides the means of low-cost OPOs. Columns (3) and (4) of each panel provide the results of the linear regression described in Equation (3) for the high- and low-cost OPOs, respectively. Our main column of interest is Column (5), which provides an estimate of the explained part of the gap in dollar terms between high- and low-cost OPOs. Column (6) describes the unexplained part of the gap, while Column (7) sums parts *a* and *b* of Equation 5.

First, we observe that the differences between high- and low-cost OPOs vary significantly depending on the organs, ranging from approximately $8,586 for kidneys to $20,407 for lungs. However, the observed differences in high- and low-cost OPOs account for 61% in livers cost-differences, approximately 70% in hearts and lungs, but only 49% for kidneys. In other words, for kidneys, more than 50% of the differential is not explained by the observed characteristics.

Across OPOs, we find that direct cost explains the largest portion of the gap, ranging from $1,701 for kidneys to $14,179 for lungs. As in the variance decomposition analysis, support personnel costs—reflecting the administrative expenses incurred by OPOs—follow second.

Delving deeper into the cost gap, we find that direct costs explain approximately 20% of the gap in kidney costs between the groups, while explaining much more for other organs, with the liver being next (50%) and the lungs being the highest (with almost 70% of the gap explained by direct costs). Again, we find overhead costs to be a top contributor to the difference in kidney costs, explaining 28% of the gap, while explaining 9% in hearts and close to zero in lungs.

Overall, direct and overhead costs stand out consistently as the primary drivers of SAC. However, the distinct dynamics surrounding kidney overhead costs compared to other organs raise compelling questions about potential cost-shifting practices.

In an unablated analysis, we examine OPOs' SAC structure and changes over time. With regard to OPOs' SAC structure, we observe that ten OPOs' SAC is consistently below the median for all organs, whereas eight OPOs' SAC is consistently above. Interestingly, six OPOs' SAC is above the median specifically for kidneys but below the median for other organs. In contrast, four

OPOs adopted the inverse strategy. The remaining OPOs employed a mix of SAC structures, with some having SAC above and some below the median for different organs. With regards to OPOs SAC changes over time we examine whether OPOs' SAC changes from one year to the next. We find that eight OPOs SAC remained consistently above the median for all organs, while five OPOs' SAC is persistently below the median across all organs. The rest of the OPOs fluctuated around the median SAC at least once during our sample period. This data suggests that while some OPOs maintain relatively consistent cost structures (either consistently above or below the median), others exhibit more variability in SAC in comparison to their peers. This variability, paired with the unique financial behavior observed for kidneys, indicates that cost-shifting might be a strategic choice for some OPOs. As regulatory environments evolve and scrutiny intensifies, deciphering these cost structures and understanding their implications become crucial, not just for transparency but also for ensuring equitable organ pricing and fostering trust in organ procurement processes.

5 Conclusions

Following the August 2023 OIG's audit report that states that "there is an incentive for OPOs to maximize their Medicare reimbursement by shifting the costs of procuring nonkidney organs to kidneys"[18], we study the incentives that influence strategic cost allocation and the resulting outcomes within the nonprofit organ transplantation system in the United States. Using comprehensive data from the annual cost reports of 51 independent OPOs from 2015 to 2021, which were obtained under the FOIA, and supplemented with data from other sources such as the CMS and OPTN, we conducted a thorough analysis of the costs tied to organ procurement.

Using variance decomposition analysis, we identified large variation in direct costs between kidneys and the other organs. In addition, we noted the cost drivers that play a major role in OPO cost variation (e.g., administrative costs, coordination expenses, education costs). Overall, these results indicate that OPOs engage in cost-shifting practices and provide the mechanism through which OPOs may shift costs to kidney. Finally, our paper also traced the association between cost-shifting and end-of-year reconciliations reimbursement mechanisms, thereby allowing us to better understand the mechanism OPOs use.

[18] Office of Inspector General Report No. A-09-21-03020, August 2023 (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 (hhs.gov)).

Our study adds to the existing healthcare accounting and economics literature on cost allocation in several ways. Our methodology borrows from international trade and labor economics, allows us to decompose and understand the main cost drivers for cost allocation (both direct and indirect costs), and permits us to assign a dollar value to quantify the inefficiencies of the organ procurement industry (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973; Eaton et al., 2004; Hottman et al., 2016). Moreover, prior research has provided direct evidence for cost-shifting through real activities (i.e., shifting patients from the inpatient to outpatient settings), and our research provides direct evidence for cost-shifting through accounting activities (e.g., Eldenburg and Kallapur, 1997). Overall, our research has the potential to influence future legislation and industry operations and can ultimately improve organ transplantation in the United States.

References

Banker, R. D., Potter, G., and Schroeder, R. G. (1995). An empirical analysis of manufacturing overhead cost drivers. Journal of Accounting and Economics, 19(1), 115-137.

Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. Journal of Human resources, 436-455.

Brickley, J. A., and Van Horn, R. L. (2002). Managerial incentives in nonprofit organizations: Evidence from hospitals. The Journal of Law and Economics, 45(1), 227-249.

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), pp.e221847-e221847.

Cheng, X. S., Held, P. J., Dor, A., Bragg-Gresham, J. L., Tan, J. C., Scandling, J. D., ... 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.

Danzon, P. M. (1982). Hospital 'profits': the effects of reimbursement policies. Journal of Health Economics, 1(1), 29-52.

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), pp.173-180.

Dranove, D. 1988. Pricing by non-profit institutions: The case of hospital cost-shifting. Journal of Health Economics 7 (1): 47–57. doi:10.1016/0167-6296(88)90004-5

Eaton, J., Kortum, S., and Kramarz, F. (2004). Dissecting trade: Firms, industries, and export destinations. American Economic Review, 94(2), 150-154.

Eldenburg, L., and Kallapur, S. (1997). Changes in hospital service mix and cost allocations in response to changes in Medicare reimbursement schemes. Journal of Accounting and Economics, 23(1), 31-51.

Eldenburg, L. G., Krishnan, H. A., and Krishnan, R. (2017). Management accounting and control in the hospital industry: A review. Journal of Governmental & Nonprofit Accounting, 6(1), 52-91.

Eldenburg, L., and N. Soderstrom. 1996. Accounting system management by hospitals operating in a changing regulatory environment. The Accounting Review 71 (1): 23–42.

Foster, G., and Gupta, M. (1990). Manufacturing overhead cost driver analysis. Journal of Accounting and Economics, 12(1-3), 309-337.

Frakt, A. B. (2011). How much do hospitals cost shift? A review of the evidence. The Milbank Quarterly, 89(1), 90-130.

Garrison, R. H., Noreen E. W., and Brewer P.C. (2015). Managerial Accounting (15th ed.). New York: McGraw-Hill Education.

Held, P.J., Bragg-Gresham, J.L., Peters, T.G., 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), pp.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), pp.2612-2619.

Held, P. J., McCormick, F., Ojo, A., and Roberts, J. P. (2016). A cost-benefit analysis of government compensation of kidney donors. American Journal of Transplantation, 16(3), 877-885.

Horngren, C.T., Sundem G.L., Burgsthahler, D., and Schatzberg, J, (2005). Intoductoin to Management Accounting (6th ed.) Edinbur: Pearson Education Limited.

Hottman, C. J., Redding, S. J., and Weinstein, D. E. (2016). Quantifying the sources of firm heterogeneity. The Quarterly Journal of Economics, 131(3), 1291-1364.

Kitagawa, E. M. (1955). Components of a difference between two rates. Journal of the american statistical association, 50(272), 1168-1194.

Krishnan, R., and Yetman, M. H. (2011). Institutional drivers of reporting decisions in nonprofit hospitals. Journal of Accounting Research, 49(4), 1001-1039.

McGowan, A. S., & Vendrzyk, V. P. (2002). The relation between cost shifting and segment profitability in the defense-contracting industry. The Accounting Review, 77(4), 949-969.

Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. International economic review, 693-709.

Thomas, J. K., & Tung, S. (1992). Cost manipulation incentives under cost reimbursement: Pension costs for defense contracts. Accounting Review, 691-711.

Appendix A – Variable Definition

Variable	Definition
SAC - Standard Acquisition Charge	This variable represents the total expenses that the OPO has determined and allocated for each of the four primary solid organ types: kidney, liver, heart, and lung. This data is sourced from Form CMS 216-94, which was obtained through the Freedom of Information Act. Specifically, the information is derived from Worksheet B, titled "Cost Allocation," under the "General Services Costs" section, from Column 11 labeled "Total Expenses."
SAC / Organ	This variable represents the SAC divided by the total number of organs used for cost allocation. The count of organs used for this purpose is derived from Form CMS 216-94, Worksheet B1, titled "Cost Allocation Statistical Basis," found in Column 8, labeled "Organ Acquisition Costs (Number Organs)."
Direct Cost / Organ	This variable represents the organ-specific direct cost, sourced from Form CMS 216-94, Worksheet A2 titled "Organ Acquisition Costs," in Column 3 labeled "Total," Row 23 titled "Total Organ Acquisition Cost." This cost is then divided by the total number of organs designated for cost allocation, which is derived from Form CMS 216-94, Worksheet B1, titled "Cost Allocation Statistical Basis," in Column 8 labeled "Organ Acquisition Costs (Number Organs)." The direct cost encompasses expenses such as operating room charges, screening, surgeon fees, import fees, laboratory costs, and more.
Support personnel/ Organ	This variable represents the cost associated with organ-specific support personnel, which is then divided by the total number of organs. This includes expenses related to administration, accounting, medical director, office salaries, and office professional education. The calculation is performed by first determining the ratio of the aforementioned costs to the total administrative and general expenses, as sourced from Form CMS 216-94, Worksheet A1 titled "Admin and General Expenses," in Column 3 labeled "Total." This ratio is then multiplied by the administrative and general costs allocated for each organ, as indicated in Form CMS 216-94, Worksheet B titled "Cost Allocation," in Column 10 labeled "Admin & General." The resulting value is then divided by the total number of organs designated for cost allocation, which is derived from Form CMS 216-94, Worksheet B1, titled "Cost Allocation Statistical Basis," in Column 8 labeled "Organ Acquisition Costs (Number Organs)."
Coordinator Cost / Organ	This variable represents the cost associated with organ-specific overhead procurement coordination, which is then divided by the total number of organs. The calculation is performed by first determining the ratio of procurement coordination expenses, as sourced from Form CMS 216-94, Worksheet A, in Column 7 labeled "Net Cost For Cost Allocation," Row 9 titled "Procurement Coordinators," to the total overhead cost. This total overhead cost is derived from Form CMS 216-94, Worksheet B titled "Cost Allocation," in Column 2 labeled "Net Cost For Alloc.," Row 2 titled "Organ Acquisitions." This ratio is then multiplied by the overhead cost allocated for each specific organ type, as indicated in Form CMS 216-94, Worksheet B, in Column 8 labeled "Organ Acquisition Costs." The resulting value is then divided by the total number of organs designated for cost allocation.
Public Education Cost / Organ	The variable represents the cost associated with organ-specific overhead public education, which is then divided by the total number of organs. The calculation is performed by first determining the ratio of public education expenses, as sourced from Form CMS 216-94, Worksheet A, in Column 7 labeled "Net Cost For Cost Allocation," Row 11 titled "Public Education," to the total overhead cost. This total overhead cost is derived from Form CMS 216-94, Worksheet B titled "Cost Allocation," in Column 2 labeled "Net Cost For Alloc.," Row 2 titled "Organ Acquisitions." This ratio is then

	multiplied by the overhead cost allocated for each specific organ type, as indicated in Form CMS 216-94, Worksheet B, in Column 8 labeled "Organ Acquisition Costs." The resulting value is then divided by the total number of organs designated for cost allocation.
Year	Categorical variable describing the year of operation (2015–2021).
Total Organs Procured	This variable represents the total count of each organ type procured, encompassing both viable and non-viable organs. This data is sourced from Form CMS 216-94, Worksheet S1, Part 1 titled "OPO Statistics."
Healthcare Wage Index	Yearly CMS Wage Index by the headquarter state reported in Form CMS 216-94 https://www.cms.gov/medicare/payment/prospective-payment-systems/skilled-nursing-facility-snf/wage-index
Total Assets	This variable represents the total assets as reported on the OPO's balance sheet, sourced from Form CMS 216-94, Worksheet E titled "Balance Sheet." If data is missing for specific years, we supplement it using information from the closest available year. In cases where data is absent across all years for a particular OPO, we utilize the median assets of OPOs within the same quartile of acquired kidneys as a supplementary measure.
Professional Education / Organ	This variable represents the cost associated with organ-specific overhead professional education, which is then divided by the total number of organs. The calculation is performed by first determining the ratio of professional education expenses, as sourced from Form CMS 216-94, Worksheet A, in Column 7 labeled "Net Cost For Cost Allocation," Row 10 titled "Professional Education," to the total overhead cost. This total overhead cost is derived from Form CMS 216-94, Worksheet B titled "Cost Allocation," in Column 2 labeled "Net Cost For Alloc.," Row 2 titled "Organ Acquisitions." This ratio is then multiplied by the overhead cost allocated for each specific organ type, as indicated in Form CMS 216-94, Worksheet B, in Column 8 labeled "Organ Acquisition Costs." The resulting value is then divided by the total number of organs designated for cost allocation.
Transplant Centers	The number of transplant centers to which the OPO provided organs in a year, as provided by a data request from the United Network for Organ Sharing https://optn.transplant.hrsa.gov/data/view-data-reports/request-data/.
Percent Non-Viable Organs	The ratio of non-viable organs procured to the total organs procured is determined for each specific organ type. Both values are derived from Form CMS 216-94, Worksheet S1, Part 1 titled "OPO Statistics."
Executive Director Pay / Organ	This variable represents the total CEO compensation, which is then divided by the total number of organs. The calculation is performed by first determining the ratio of CEO pay expenses to the total administrative and general expenses, as sourced from Form CMS 216-94, worksheet A1 titled "Admin and General Expenses," in Column 3 labeled "Total." This ratio is then multiplied by the administrative and general costs allocated for each specific organ type, as indicated in Form CMS 216-94, Worksheet B titled "Cost Allocation," in Column 10 labeled "Admin & General." The resulting value is then divided by the total number of organs designated for cost allocation, which is derived from Form CMS 216-94, Worksheet B1, titled "Cost Allocation Statistical Basis," in Column 8 labeled "Organ Acquisition Costs (Number Organs)." In instances where CEO pay is not provided in Form CMS 216-94, the information is supplemented from the IRS form 990.
Tissue Revenue	This variable represents the OPO's tissue revenue. This data is sourced from Form CMS 216-94, either from Worksheet E1 or E2 if tissue revenue is reported there. If not available in the worksheets, tissue revenue is calculated by manually summing the revenues for cornea, bone, and skin from Worksheet S1.

Procurement Hospitals	The number of hospitals from which the OPO procured organs in a year, as provided by a data request from the United Network for Organ Sharing.
DSA Population	The population within the OPO's Designated Service Area, as sourced from the Annual Reports of the Scientific Registry of Transplant Recipients https://www.srtr.org/.
Total Employees	This variable represents the total number of OPO employees. This data is sourced from Form CMS 216-94, Worksheet S1, Part 3 titled "Full Time Employees," in Row 2 labeled "Total FTEs."

Appendix B: Theoretical Foundation for the Variance Decomposition Methodology

The contribution of variance X_k to variance of Y is defined as

$$V_k = var(\widehat{\beta_k} X_k) + \sum_{l:\, l=1, l\neq k}^{n} cov(\widehat{\beta_k} X_k, \widehat{\beta_l} X_l)$$

We have to theoretically show that $\frac{V_k}{var(Y)} = \widehat{\delta_k}$, with $\widehat{\delta_k}$ as defined in equation 2 of Section 4.1. First, note that $var(\widehat{\beta_k} X_k) = cov(\widehat{\beta_k} X_k, \widehat{\beta_k} X_k)$ so V_k can be simplified to

$$V_k = \sum_{l:\, l=1}^{n} cov(\widehat{\beta_k} X_k, \widehat{\beta_l} X_l)$$

The proof consists of three steps.

<u>Step 1:</u> We will try to simplify V_k first. Replacing $\widehat{\beta_k} X_k = \alpha_k + \widehat{\delta_k} Y + \widehat{\epsilon_k}$ and $\widehat{\beta_l} X_l = \alpha_l + \widehat{\delta_l} Y + \widehat{\epsilon_l}$ for all value of l in V_k, we have

$$V_k = \sum_{l:\, l=1}^{n} cov(\alpha_k + \widehat{\delta_k} Y + \widehat{\epsilon_k}, \alpha_l + \widehat{\delta_l} Y + \widehat{\epsilon_l})$$

Note that we have $cov(\alpha_k + \widehat{\delta_k} Y + \widehat{\epsilon_k}, \alpha_l + \widehat{\delta_l} Y + \widehat{\epsilon_l}) = cov(\widehat{\delta_k} Y, \widehat{\delta_l} Y) + cov(\widehat{\epsilon_k}, \widehat{\epsilon_l})$ because

- α_k, α_l are constants and;
- Y and $\widehat{\epsilon_k}$ are independent and;
- Y and $\widehat{\epsilon_l}$ are independent.

Also, we can write $cov(\widehat{\delta_k} Y, \widehat{\delta_l} Y) = \widehat{\delta_k}\widehat{\delta_l} cov(Y, Y) = \widehat{\delta_k}\widehat{\delta_l} var(Y)$ because

- $\widehat{\delta_k}$, $\widehat{\delta_l}$ are constants and;
- $cov(Y, Y) = var(Y)$.

Therefore, we can simplify V_k as

$$V_k = \sum_{l:\, l=1}^{n} \left[\widehat{\delta_k}\widehat{\delta_l} var(Y) + cov(\widehat{\epsilon_k}, \widehat{\epsilon_l})\right] = \widehat{\delta_k} var(Y) \sum_{l:\, l=1}^{n} \widehat{\delta_l} + cov\left(\widehat{\epsilon_k}, \sum_{l=1}^{n} \widehat{\epsilon_l}\right)$$

where the second equation uses

$$\sum_{l:\, l=1}^{n} cov(\widehat{\epsilon_k}, \widehat{\epsilon_l}) = cov\left(\widehat{\epsilon_k}, \sum_{l=1}^{n} \widehat{\epsilon_l}\right)$$

<u>Step 2:</u> We use regression equations to further simplify V_k. Note that

$$Y = \alpha + \sum_{k=1}^{n} \widehat{\beta_k} X_k \ + \ \hat{u}$$

Replacing $\widehat{\beta_k} X_k$ with $\alpha_k + \widehat{\delta_k} Y \ + \ \widehat{\epsilon_k}$ for all k in the equation above, we have

$$Y = \alpha + \sum_{k=1}^{n} \left[\alpha_k + \widehat{\delta_k} Y \ + \ \widehat{\epsilon_k}\right] \ + \ \hat{u}$$

The above equation is equivalent to

$$\left(1 - \sum_{l=1}^{n} \widehat{\delta_l}\right) Y - \hat{u} = \sum_{l=1}^{n} \widehat{\epsilon_l} \ + \alpha + \sum_{l=1}^{n} \alpha_l$$

Hence,

$$cov\left(\widehat{\epsilon_k}, \sum_{l=1}^{n} \widehat{\epsilon_l}\right) = cov\left(\widehat{\epsilon_k}, \sum_{l=1}^{n} \widehat{\epsilon_l} + \alpha + \sum_{l=1}^{n} \alpha_l\right) = cov\left(\widehat{\epsilon_k}, \left(1 - \sum_{l=1}^{n} \widehat{\delta_l}\right) Y - \hat{u}\right)$$
$$= -cov(\widehat{\epsilon_k}, \hat{u})$$

The first equation holds because $\alpha + \sum_{l=1}^{n} \alpha_l$ is a constant. In the second equation, we replace $\sum_{k=1}^{n} \widehat{\epsilon_k} \ + \alpha + \sum_{k=1}^{n} \alpha_k$ by $\left(1 - \sum_{l=1}^{n} \widehat{\delta_l}\right) Y - \hat{u}$. The last equation comes from the fact that $cov(\widehat{\epsilon_k}, Y) = 0$ since Y and $\widehat{\epsilon_k}$ are independent.

We have $\widehat{\beta_k} X_k = \alpha_k + \widehat{\delta_k} Y \ + \ \widehat{\epsilon_k}$ and $cov\left(\widehat{\beta_k} X_k, \hat{u}\right) = 0$ because $\hat{u}$ is the residuals in the OLS regression of Y on $X_1, X_2, \ldots, X_n$. It follows $cov\left(\alpha_k + \widehat{\delta_k} Y \ + \ \widehat{\epsilon_k}, \hat{u}\right) = 0$. Equivalently,

$$cov(\alpha_k, \hat{u}) + cov\left(\widehat{\delta_k} Y, \hat{u}\right) + cov(\widehat{\epsilon_k}, \hat{u}) = 0$$

or $-cov(\widehat{\epsilon_k}, \hat{u}) = \widehat{\delta_k} cov(Y, \hat{u})$ because $cov(\alpha_k, \hat{u}) = 0$ since α_k is a constant. Note that

$$-cov(\widehat{\epsilon_k}, \hat{u}) = \widehat{\delta_k} cov(Y, \hat{u}) = \widehat{\delta_k} cov\left(Y, \alpha_u + \widehat{\delta_u} Y \ + \ \widehat{\epsilon_u}\right) = \widehat{\delta_k}\widehat{\delta_u} var(Y)$$

where the second equation uses $\hat{u} = \alpha_u + \widehat{\delta_u}Y \ + \ \widehat{\epsilon_u}$ and the last equation uses $cov(Y, Y) = var(Y)$. Therefore, using the formula of V_k in step 1:

$$V_k = \widehat{\delta_k} var(Y) \sum_{l=1}^{n} \widehat{\delta_l} + cov\left(\widehat{\epsilon_k}, \sum_{l=1}^{n} \widehat{\epsilon_l}\right) = \widehat{\delta_k} var(Y) \sum_{l=1}^{n} \widehat{\delta_l} + \widehat{\delta_k}\widehat{\delta_u} var(Y)$$
$$= \widehat{\delta_k}\left(\widehat{\delta_u} + \sum_{l=1}^{n} \widehat{\delta_l}\right) var(Y)$$

<u>Step 3:</u> We will show that

$$\widehat{\delta_u} + \sum_{l=1}^{n} \widehat{\delta_l} = 1$$

so it follows that $V_k = \widehat{\delta_k} var(Y)$, which is what we want to show. From step 2, note that we have

$$\left(1 - \sum_{l=1}^{n} \widehat{\delta_k}\right) Y - \hat{u} = \sum_{l=1}^{n} \widehat{\epsilon_k} \ + \sum_{l=1}^{n} \alpha_k$$

Using $\hat{u} = \alpha_u + \widehat{\delta_u}Y \ + \ \widehat{\epsilon_u}$, we get

$$\left(1 - \widehat{\delta_u} - \sum_{l=1}^{n} \widehat{\delta_l}\right) Y = \widehat{\epsilon_u} + \sum_{l=1}^{n} \widehat{\epsilon_l} \ + \alpha + \alpha_u + \sum_{l=1}^{n} \alpha_l$$

Therefore,

$$cov\left(Y, \left(1 - \widehat{\delta_u} - \sum_{l=1}^{n} \widehat{\delta_l}\right) Y\right) = cov\left(Y, \widehat{\epsilon_u} + \sum_{l=1}^{n} \widehat{\epsilon_l} \ + \alpha + \alpha_u + \sum_{l=1}^{n} \alpha_l\right)$$

Note that that RHS of the equation above is 0 because

- $\alpha, \alpha_u, \alpha_k$ are constants and;
- Y and $\widehat{\epsilon_u}$ are independent and;
- Y and $\widehat{\epsilon_k}$ are independent.

The LHS of the equation above is equal to

$$var(Y)\left(1 - \widehat{\delta_u} - \sum_{l=1}^{n} \widehat{\delta_l}\right)$$

Since $var(Y) > 0$, it is equal to 0 if and only if $1 - \widehat{\delta_u} - \sum_{l=1}^{n} \widehat{\delta_l} = 0$, which is what we need.

Table 1 - OPO Organ Procurement Operations 2015-2021

Note: Panel A details the total count of both viable and non-viable organs procured for the four major solid organs: kidney, liver, heart, and lung. Panel B illustrates the yearly distribution of the number of the four major solid organs: kidney, liver, heart, and lung, procured by OPOs from 2015 to 2021. The information is derived from Form CMS 216-94, Worksheet S1, Part 1 titled "OPO Statistics," obtained through a Freedom of Information Act request.

Panel A - OPO Total				
Year	**Kidneys Procured**	**Livers Procured**	**Hearts Procured**	**Lungs Procured**
2015	17,453	8,550	3,284	3,019
2016	18,773	9,218	3,506	3,095
2017	19,735	9,884	3,780	3,732
2018	20,527	9,977	4,026	3,932
2019	23,123	10,497	4,707	4,255
2020	24,143	11,551	4,855	3,896
2021	29,160	12,366	5,164	3,993
Total	***152,914***	***72,043***	***29,322***	***25,922***
Panel B - OPO Year				
N	356	356	356	356
Mean	430	202	82	73
STD	287	137	59	57
Min	70	22	-	-
25%	199	83	35	26
50%	378	179	70	60
75%	591	275	116	105
MAX	1,537	726	279	364

Table 2 - OPO Total SAC 2015-2021

Note: The table presents the total Standard Acquisition Charge (SAC) for the years 2015-2021. The SAC is defined as the total expenses that the OPO has calculated and allocated for each of the four primary solid organ types: kidney, liver, heart, and lung. See Appendix A for full variable definition.

Year	Kidney SAC	Liver SAC	Heart SAC	Lung SAC
2015	504,141,364	272,836,125	108,418,905	98,885,291
2016	548,370,164	293,894,655	116,753,866	112,092,463
2017	594,314,184	324,996,262	127,368,454	129,791,996
2018	637,807,557	338,580,967	143,425,017	158,159,946
2019	721,242,358	350,529,466	184,203,369	168,132,511
2020	758,028,102	419,602,816	194,364,039	159,470,572
2021	969,167,018	451,601,456	208,136,661	157,236,929
Total	***4,733,070,747***	***2,452,041,747***	***1,082,670,311***	***983,769,708***

Table 3 - OPO SAC/Organ

Note: The table describes the distribution of the Standard Acquisition Charge for a single organ (SAC / Organ) across all OPOs from 2015 to 2021. See Appendix A for a full variable definition.

	SAC / Kidney	SAC / Liver	SAC / Heart	SAC / Lung
N	356	356	351	354
Mean	31,381	33,910	36,384	36,616
STD	5,339	7,883	10,001	13,213
Min	20,097	14,195	12,893	11,902
25%	27,648	28,757	29,458	27,287
50%	31,390	34,284	36,481	34,885
75%	34,608	38,755	42,559	43,928
MAX	47,748	56,027	63,497	99,859

Table 4 – OPO - Year Direct and Overhead Costs

Note: The table describes the distribution of direct and various overhead costs for a single organ across all OPOs between 2015 and 2021. See Appendix A for a full variable definition.

	N	Mean	Std	Min	25%	50%	75%	Max
Direct Cost / Organ ($)								
Kidney	349	13,446	4,039	5,284	10,568	13,019	16,199	26,104
Liver	349	15,345	7,506	4,045	8,963	13,956	20,797	39,159
Heart	344	17,474	9,350	1,806	9,872	15,916	24,142	43,997
Lung	347	17,485	12,374	970	7,502	12,982	25,670	74,193

Overhead Costs

	N	Mean	Std	Min	25%	50%	75%	Max
Support Personal Cost / Organ ($)								
Kidney	349	2,859	1,479	0	1,752	2,801	3,846	8,027
Liver	349	3,070	1,597	0	1,960	3,038	4,125	9,235
Heart	344	3,309	1,814	0	1,948	3,137	4,731	8,861
Lung	347	3,218	1,949	0	1,901	2,890	4,290	10,836
Professional Education Cost / Organ ($)								
Kidney	349	1,513	1,220	0	759	1,421	2,051	8,153
Liver	349	1,534	1,270	0	759	1,427	2,064	8,153
Heart	344	1,534	1,290	0	734	1,395	2,064	8,153
Lung	347	1,481	1,267	0	711	1,318	2,034	8,153
Coordinator Cost / Organ ($)								
Kidney	349	6,852	2,835	1,177	4,919	6,520	8,377	17,708
Liver	349	6,908	2,883	1,177	4,922	6,520	8,402	17,708
Heart	344	6,829	2,930	1,012	4,873	6,520	8,348	22,718
Lung	347	6,784	2,946	129	4,926	6,457	8,403	17,708
Public Education Cost / Organ ($)								
Kidney	349	1,185	1,201	0	368	808	1,656	6,247
Liver	349	1,200	1,218	0	364	821	1,726	6,247
Heart	344	1,173	1,206	0	338	799	1,636	6,465
Lung	347	1,172	1,216	0	304	804	1,675	6,247

Table 5 - OPO Operational Environment

Note: The table describes various OPO operational environment statistics used in the empirical analysis. See Appendix A for a full variable definition.

	N	Mean	STD	Min	25%	50%	75%	max
HealthCare Wage Index	349	86%	16%	40%	78%	83%	89%	133%
Total Assets ($mill)	349	51.7	63.8	4.7	17.2	30.5	66.7	502.8
Tissue Revenue ($mill)	349	13.5	50.5	0.0	2.0	4.5	8.9	425.6
Total Full Time Employees	349	157	173	20	71	120	170	1,148
Procurement Hospitals	349	32.0	20.3	5.0	16.0	27.0	40.0	95.0
Transplant Hospitals DSA	349	4.5	3.3	1.0	2.0	3.0	5.0	15.0
DSA Population	349	6,100,514	3,987,783	1,415,872	2,764,902	5,109,861	7,444,344	20,058,137
CEO Pay ($)	349	603,555	747,571	84,762	285,018	468,837	595,506	11,363,097

Table 6 - Regression of SAC / Organ on Cost Drivers

Note: The table presents the first stage of the variance decomposition analysis, estimating the linear regression for the major cost drivers in relation to the SAC of the four major solid organs (equation 1). The estimated coefficients provide insight into how various covariates correlate with the SAC of each organ individually. Regression results remain robust when including OPO and year fixed effects, as well as when clustering standard errors by OPO. See Appendix A for a full variable definition. P-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Dependant Variable - SAC / Organ	**Kidney**	**Liver**	**Heart**	**Lung**
Direct Cost / Organ	0.816***	0.920***	0.935***	0.935***
	(0.000)	(0.000)	(0.000)	(0.000)
Support Personal / Organ	1.204***	1.134***	1.133***	0.842***
	(0.000)	(0.000)	(0.000)	(0.000)
Coordinator Cost / Organ	0.767***	0.914***	1.164***	0.795***
	(0.000)	(0.000)	(0.000)	(0.000)
Public Education Cost / Organ	0.698***	0.565***	0.623***	-0.021
	(0.000)	(0.000)	(0.000)	(0.936)
Year	439.951***	290.849***	285.485***	415.223***
	(0.000)	(0.000)	(0.001)	(0.006)
Total Organs Procured	-5.354***	-10.240***	-11.754*	-27.301***
	(0.001)	(0.000)	(0.077)	(0.003)
Healthcare Wage Index	2,543.915**	1,042.203	2,044.708*	-5,541.857**
	(0.025)	(0.355)	(0.091)	(0.012)
Total Assets	-667.568**	-460.059*	-684.799**	-2,655.161***
	(0.013)	(0.089)	(0.023)	(0.000)
Professional Education / Organ	0.774***	0.978***	1.171***	0.595**
	(0.000)	(0.000)	(0.000)	(0.012)
Transplant Centers	-170.934**	-1.497	49.763	-146.676
	(0.026)	(0.985)	(0.570)	(0.362)
Percent Non-Viable Organs	-5,353.143*	-4,043.537*	-4,952.266	-9,202.936***
	(0.062)	(0.079)	(0.124)	(0.000)
Executive Director Pay / Organ	1.468***	1.488***	1.218***	-0.443
	(0.000)	(0.000)	(0.000)	(0.432)
Tissue Revenue	-42.981	-34.633	-71.380**	120.160**
	(0.149)	(0.227)	(0.023)	(0.030)
Procurement Hospitals	14.127	-19.838	-48.385**	-14.150
	(0.570)	(0.400)	(0.034)	(0.722)
DSA Population	1,072.777*	1,178.909**	4.922	2,807.467**
	(0.067)	(0.042)	(0.994)	(0.013)
Total Employees	3.662***	2.443**	2.453*	3.318
	(0.002)	(0.038)	(0.058)	(0.151)
Constant	-882,627.981***	-587,994.164***	-558,102.796***	-816,302.536***
	(0.000)	(0.000)	(0.002)	(0.008)
Observations	349	349	344	347
Adjusted R-squared	0.776	0.893	0.920	0.853

Table 7 – SAC / Organ Variance Decomposition of Main Cost Drivers

Note: The table presents our main results for the variance decomposition of costs and the factors associated with SAC across OPOs and different organs. It assesses the relative contribution of each predictor variable from table 6 to the overall variability in SAC (Hottman et al. 2016; Eaton, Kortum, and Kramarz 2004). This method measures the individual and combined impact of each covariate on the variation in the outcome. Designed to evaluate the impact of cost drivers on SAC, the decomposition results, including the residual, sum to one. While the variance decomposition may produce negative coefficients due to negative covariates, it does not affect the interpretation of positive coefficients. Given that the sum of all coefficients equals one, combining negative and positive coefficients provides a comprehensive analysis of the cost drivers' effect on SAC. See Appendix A for a full variable definition.

	(1)	(2)	(3)	(4)
SAC / Organ	**Kidney**	**Liver**	**Heart**	**Lung**
Direct Cost / Organ	30.69%	69.85%	73.09%	76.45%
Support Personal / Organ	15.53%	10.55%	10.50%	6.69%
Coordinator Cost /Organ	16.06%	4.30%	3.22%	2.42%
Public Education Cost / Organ	4.25%	1.61%	1.21%	-0.03%
Year	3.91%	1.17%	1.04%	0.51%
Total Organs Procured	3.44%	-0.52%	-0.57%	-1.40%
Healthcare Wage Index	2.87%	0.41%	0.37%	-1.06%
Total Assets	2.31%	0.32%	-0.16%	-1.28%
Professional Education / Organ	1.67%	2.49%	3.10%	-0.27%
Transplant Centers	1.41%	0.00%	0.08%	-0.59%
Percent Non-Viable Organs	1.16%	0.88%	0.47%	3.77%
Executive Director Pay / Organ	0.24%	-0.50%	-0.16%	-0.18%
Tissue Revenue	-0.45%	-0.33%	-0.37%	0.49%
Procurement Hospitals	-0.60%	0.52%	1.00%	-0.07%
DSA Population	-1.82%	-0.09%	0.00%	1.02%
Total Employees	-2.02%	-0.82%	-0.45%	-0.46%
Residual	21.34%	10.17%	7.63%	13.98%

Table 8 - Blinder–Oaxaca Decomposition of Cost Drivers:

Note: Panels A-E detail the Blinder–Oaxaca decomposition, which explains the difference in the means of SAC / Organ between high and low-cost OPOs (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973). This categorization is based on whether an OPO's cost is above or below the median cost for each specific organ. Columns 1 and 2 display the means for each group. Columns 3 and 4 estimate the linear regression for the primary cost drivers of each group in relation to the SAC of the four major solid organs. Column 5 showcases the Blinder–Oaxaca decomposition, assigning a dollar value to the explained differences. The "Difference In Means" in Column 5 represents the explained variation in dollar amount, $[Mean(X_{high}) - Mean(X_{low})] * \beta_{high}$ while the "Difference In Coefficients" in Column 6 represents the unexplained portion of the variation $[\beta_{high} - \beta_{lo}] * Mean(X_{low})$. The "Total Difference" in Column 7 is the sum of the explained and unexplained variations. See Appendix A for a full variable definition. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A - Kidney							
	OPO Averages		Regression Coefficents		Blinder–Oaxaca Decomposition		
	High Cost OPOs	Low Cost OPOs	High Cost OPOs	Lower Cost OPOs	**Difference In Means ($)**	Difference in Coefficients	Total Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant Variable - SAC	35,659	27,073					8,586
Direct Cost / Organ	14,824	12,076	0.62***	0.69***	**1,701**	-891	810
Support Personal / Organ	3,426	2,295	1.00***	0.64***	**1,132**	836	1,968
Coordinator Cost / Organ	7,901	5,809	0.43***	0.83***	**891**	-2,332	-1,441
Total Organs Procured	407.33	459.97	-6.35***	-3.70***	**334**	-1,219	-885
Year	4.40	3.59	383***	313***	**309**	248	557
Transplant Centers	4.09	4.86	-307**	84.08	**239**	-1,902	-1,664
Total Assets	17.18	17.40	-1,004**	-443**	**214**	-9,752	-9,538
Public Education Cost / Organ	1,487	884	0.12	1.23***	**71**	-986	-914
Professional Education / Organ	1,581	1,444	0.44***	0.99***	**60**	-794	-735
Percent Non-Viable Organs	0.18	0.19	-2,328	-4,733**	**35**	465	500
Healthcare Wage Index	0.91	0.81	348	878	**33**	-429	-396
Executive Director Pay / Organ	638	630	1.35**	0.76***	**10**	374	384
Tissue Revenue	13.61	12.36	-99.22**	-30.67	**-124**	-847	-972
Procurement Hospitals	30.02	33.86	43.80	-0.52	**-168**	1,501	1,332
DSA Population	15.35	15.49	1,297	-389	**-178**	26,120	25,942
Total Employees	137	176	8.31***	0.44	**-327**	1,389	1,062
Const	1	1	16,450	23,873***	0	-7,424	-7,424
Adjusted R2			0.55	0.81			
Observations			174	175			
Total Explained ($)					**$4,231**		
% of Total Difference					**49%**		

Panel B - Liver	OPO Averages		Regression Coefficents		Blinder–Oaxaca Decomposition		
	High Cost OPOs	Low Cost OPOs	High Cost OPOs	Lower Cost OPOs	**Difference In Means ($)**	Difference in Coefficients	Total Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant Variable - SAC	40,088	27,719					12,369
Direct Cost / Organ	20,116	10,601	0.66***	0.87***	**6,279**	-2,275	4,004
Support Personal / Organ	3,630	2,513	0.85***	0.93***	**945**	-214	730
Coordinator Cost / Organ	7,114	6,703	0.51***	0.94***	**209**	-2,890	-2,681
Total Organs Procured	211.39	198.24	-12.18***	-11.58***	**-160**	-119	-279
Year	4.30	3.69	478***	249***	**294**	848	1,141
Transplant Centers	4.45	4.50	-288***	281**	**16**	-2,564	-2,548
Total Assets	17.28	17.30	-286	-713*	**5**	7,391	7,396
Public Education Cost / Organ	1,488	914	0.49***	0.26	**282**	209	491
Professional Education / Organ	1,669	1,400	0.63***	0.80***	**168**	-251	-83
Percent Non-Viable Organs	0.10	0.13	4,912	-6,368**	**-136**	1,453	1,316
Healthcare Wage Index	0.87	0.85	4,857***	1,875	**125**	2,520	2,645
Executive Director Pay / Organ	647	703	0.79	1.57***	**-45**	-547	-592
Tissue Revenue	13.18	12.79	36.38	-47.68	**14**	1,075	1,089
Procurement Hospitals	30.24	33.64	12.77	-44.52*	**-43**	1,927	1,884
DSA Population	15.39	15.46	1,770*	1,682**	**-120**	1,359	1,239
Total Employees	135	178	4.79*	2.34*	**-207**	437	230
Const	1	1	-8,893	-5,279	0	-3,614	-3,614
Adjusted R2			0.80	0.81			
Observations			174	175			
Total Explained ($)					**$7,625**		
% of Total Difference					**61%**		

Panel C - Heart							
	OPO Averages		Regression Coefficents		Blinder–Oaxaca Decomposition		
	High Cost OPOs	Low Cost OPOs	High Cost OPOs	Lower Cost OPOs	**Difference In Means ($)**	Difference in Coefficients	Total Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant Variable - SAC	44,328	28,324					16,004
Direct Cost / Organ	23,731	11,216	0.68***	1.01***	**8,549**	-3,626	4,923
Support Personal / Organ	3,931	2,686	1.02***	0.94***	**1,273**	219	1,492
Coordinator Cost / Organ	6,979	6,679	0.94***	1.05***	**283**	-688	-404
Total Organs Procured	84.52	84.33	9.76	-21.63**	**2**	2,647	2,649
Year	4.34	3.65	262**	272**	**181**	-36	145
Transplant Centers	4.37	4.69	90.88	15.46	**-29**	353	324
Total Assets	17.35	17.29	-181	-1,368***	**-11**	20,536	20,525
Public Education Cost / Organ	1,411	936	0.40**	0.62**	**189**	-207	-18
Professional Education / Organ	1,704	1,365	1.04***	1.06***	**352**	-28	324
Percent Non-Viable Organs	0.03	0.05	4,927	-6,820*	**-89**	566	477
Healthcare Wage Index	0.86	0.85	2,070	1,678	**14**	333	347
Executive Director Pay / Organ	694	714	1.49***	0.69*	**-29**	568	539
Tissue Revenue	13.41	12.53	-38.57	-95.21**	**-34**	710	676
Procurement Hospitals	29.31	35.23	-68.02*	-14.67	**403**	-1,880	-1,477
DSA Population	15.38	15.50	-1,207	748	**144**	-30,310	-30,166
Total Employees	153	165	0.61	4.31***	**-8**	-610	-618
Const	1	1	33,984**	17,719	0	16,264	16,264
Adjusted R2			0.84	0.84			
Observations			172	172			
Total Explained ($)					**$11,192**		
% of Total Difference					**70%**		

Panel D - Lung							
	OPO Averages		Regression Coefficents		Blinder–Oaxaca Decomposition		
	High Cost OPOs	Low Cost OPOs	High Cost OPOs	Lower Cost OPOs	**Difference In Means ($)**	Difference in Coefficients	Total Difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant Variable - SAC	47,255	26,847					20,407
Direct Cost / Organ	25,981	9,038	0.84***	0.82***	**14,179**	159	14,338
Support Personal / Organ	4,005	2,436	0.44*	0.94***	**686**	-1,231	-545
Coordinator Cost / Organ	6,948	6,622	0.50***	0.82***	**163**	-2,140	-1,977
Total Organs Procured	85.15	63.50	-31.28**	-15.11	**-677**	-1,027	-1,704
Year	4.17	3.79	568**	234**	**216**	1,266	1,482
Transplant Centers	5.17	3.81	-185.77	291	**-253**	-1,816	-2,069
Total Assets	17.41	17.18	-3498***	-1,506***	**-825**	-34,219	-35,044
Public Education Cost / Organ	1,306	1,039	-0.63	0.22	**-168**	-879	-1,046
Professional Education / Organ	1,420	1,542	0.29	0.92***	**-35**	-970	-1,005
Percent Non-Viable Organs	0.11	0.20	-11,353**	-3,026	**1,068**	-1,681	-613
Healthcare Wage Index	0.87	0.85	1,112	-636	**26**	1,478	1,504
Executive Director Pay / Organ	712	695	-2.25*	0.62	**-39**	-1,990	-2,029
Tissue Revenue	13.42	12.53	233***	-47.81	**209**	3,521	3,730
Procurement Hospitals	33.68	30.41	11.23	-50.18	**37**	1,868	1,904
DSA Population	15.50	15.36	1,103	1,040	**159**	974	1,132
Total Employees	146	169	-0.55	3.67**	**13**	-715	-702
Const	1	1	63,987**	20,798	0	43,190	43,190
Adjusted R2			0.74	0.77			
Observations			173	174			
Total Explained ($)					**$14,757**		
% of Total Difference					**72%**		