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# How Lagging Financial Metrics Affect Next Year Hospital Patient Metrics

## Abstract

This paper analyzes a dataset of 231 California general acute hospitals from 2013-2018 to determine whether there are differences between how financial metrics affect following year patient metrics in non-profit versus investor-owned hospitals. The primary patient metric used in this paper is the average length of stay, excluding long-term care. The primary financial metrics used in this paper are lagged gross patient revenue. Secondary outcomes measured include how c-section births, inpatient operating room minutes, and total discharges are affected by financial metrics from non-profit and investor-owned hospitals. The main finding of this paper is that investor-owned hospitals decrease the average length of stay while non-profit hospitals increase the average length of stay as the previous year's net income increases.

## Keywords

hospital finance, healthcare management, hospital decision-making, cross-subsidization

## Disciplines

Health and Medical Administration | Nonprofit Administration and Management

HOW LAGGING FINANCIAL METRICS AFFECT NEXT YEAR HOSPITAL PATIENT  
METRICS

By

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An Undergraduate Thesis submitted in partial fulfillment of the requirements for the  
WHARTON RESEARCH SCHOLARS

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## **ABSTRACT**

This paper analyzes a dataset of 231 California general acute hospitals from 2013-2018 to determine whether there are differences between how financial metrics affect following year patient metrics in non-profit versus investor-owned hospitals. The primary patient metric used in this paper is the average length of stay, excluding long-term care. The primary financial metrics used in this paper are lagged gross patient revenue. Secondary outcomes measured include how c-section births, inpatient operating room minutes, and total discharges are affected by financial metrics from non-profit and investor-owned hospitals. The main finding of this paper is that investor-owned hospitals decrease the average length of stay while non-profit hospitals increase the average length of stay as the previous year's net income increases.

## INTRODUCTION

The COVID-19 pandemic has emphasized the importance of financial stability for hospitals. During the height of the pandemic, hospitals around the U.S. suspended elective surgeries - a critical source of revenue. Hospitals were overrun by patients fighting the virus and experienced significant operating losses - smaller hospitals faced potential closure. In 2020, more than three dozen hospitals filed for bankruptcy (Coleman-Lochner, 2020). According to the American Hospital Association, 2020 operating losses for hospitals around the U.S. were expected to be at least \$323.1 billion (American Hospital Association, 2020).

Not-for-profit (NFP) hospitals are exempt from taxes. NFP hospitals are intended to provide more value to their communities than they would if they were taxed. However, the power of the U.S. healthcare system lies with payers and providers rather than patients. Patients rarely have the information to comparison shop hospitals and are often left to the whims of insurance companies and healthcare providers. Research into how hospitals make decisions is critical in ensuring that hospitals choose patients over profits. This research is especially vital for examining whether not-for-profit hospitals deserve their tax break by providing value to their communities. It is essential to understand how providers make decisions that could affect patient treatments, like the length of stay, type of birth, or operating room minutes.

Financial metrics play a large role in hospital decision making. It is plausible to assume that hospital managers could push for specific initiatives that would lead to more favorable financial metrics like c-sections or surgery or cost cuts like decreasing the amount of time a patient is in the hospital. There is some evidence that NFP hospitals are incentivized to manipulate their reported earnings to be closer to zero to receive donation benefits. (Leone and Van Horn, 2005). Unprofitable services are particularly affected by finances throughout the hospital. Hospitals use

cross-subsidization, the practice of using money from profitable divisions to supplement unprofitable divisions, to continue providing necessary treatments. However, if the hospital becomes less profitable then services in unprofitable divisions could decrease while services in profitable divisions simultaneously increase. A 2018 study by David, Lindrooth, Helmchen, and Burns found that when NFP hospitals had a cardio specialty hospital, a historically profitable type of specialty hospital, open near them, causing profitable patients to leave, the NFP hospitals reduced services for their unprofitable divisions like psychiatry, substance-abuse, and trauma care and expanded their services for profitable divisions like neurosurgery (David et al., 2018).

The 2010s had a significant expansion of Medicare and Medicaid with the passage of the Affordable Care Act in 2010. The legislation significantly altered the two platforms and changed the landscape for patients, providers, and payers. In turn, this could have led to providers changing the relationship they have between patients and financial metrics. This paper examines if differences in patient metrics between years are caused by the previous years' financial metrics or the fixed effects from that calendar year.

## **METHODOLOGY**

This paper uses the Hospital Annual Financial Data dataset provided by the California Office of Statewide Health Planning & Development. The data was cleaned to include only general acute non-profit and investor-owned hospitals with data available for all six selected years, reported financial metrics greater than zero, and an audit length of 365 (or 366 days in a leap year). Lagging variables were created for net income, income from operations, and gross patient revenue to study how financial metrics influence following year patient metrics. Dummy variables were created for each year for any time fixed effects. The data was segmented into non-profit hospitals and investor-owned hospitals. Finally, linear regressions were run on each dataset and compared.

The final dataset included 231 hospitals in total, with 71 investor-owned hospitals and 160 non-profit hospitals.

The primary dependent variable was the average length of stay excluding long-term care (ALOS). ALOS was selected because it was a patient metric available in the data that every hospital reported and contributes directly to financial metrics through revenue and costs from services provided during a patient's stay. Secondary dependent variables were inpatient operating room minutes, the number of cesarean births, and total discharges. These variables were selected to understand how lagged financial metrics affect other patient outcomes. Surgery generates a large percentage of hospitals' revenue, c-sections are more expensive than natural births, and total patient volume affects revenue and costs. All three of these variables could be affected by the previous year's financial metrics and are included as secondary outcomes. Hospitals that reported a zero for any year in the data for the dependent variable were excluded from all regressions.

Gross patient revenue was the primary lagged financial metric used as an independent variable. Patient revenues are easily comparable every year and represents growth for hospitals. Because of their tax incentives, non-profit hospitals cannot grow their net income, or profit, as aggressively as investor-owned hospitals. Therefore, it is more appropriate to use gross patient revenue when comparing the two types of hospitals because it is equally relevant to both types of hospitals.

### **Regression equations**

$$ALOS = \beta_0 + \beta_1 \text{Lagged Gross Patient Revenue} + \text{Time Fixed Effects}$$

$$\text{Operating Room Minutes} = \beta_0 + \beta_1 \text{Lagged Gross Patient Revenue} + \text{Time Fixed Effects}$$

$$C \text{ Sections} = \beta_0 + \beta_1 \text{Lagged Gross Patient Revenue} + \text{Time Fixed Effects}$$

$$\text{Total Discharges} = \beta_0 + \beta_1 \text{Lagged Gross Patient Revenue} + \text{Time Fixed Effects}$$

## **RESULTS**

### **Primary Outcome: Average Length of Stay**

Lagged gross patient revenue was significant in predicting the average length of stay for non-profit and investor-owned hospitals with p-values of  $<0.001$ . The effect sizes were small, 0.0001337 for non-profit hospitals and -0.003838 for investor-owned hospitals. Gross patient revenue did affect the average length of stay of patients in the following year, increasing it for non-profit hospitals for every million dollars increase and the opposite for investor-owned, but the effect sizes too small to discern a significant difference. None of the time-fixed effects were significant with p-values  $> 0.05$ , meaning that the results were not caused by any particular year.

### **Secondary Outcome #1: C-sections**

Lagged gross patient revenue was again predictive of the number of c-sections in the following year for non-profit and investor-owned hospitals with p-values of  $< 0.001$ . The effect size for every million-dollar increase in lagged gross patient revenue increased 0.13 c-sections for non-profit hospitals and 0.30 for investor-owned hospitals. However, some of these results could be due to the circumstances of particular years. For non-profit hospitals, c-sections were partially predicted by dummy variables for 2013, 2014, and 2015. For both types of hospitals, the number of c-sections as predicted by each year decreased.

### **Secondary Outcome #2: Inpatient operating room minutes**

Lagged gross patient revenue predicted next year operating room minutes with p-values of  $<0.0001$  for both non-profit and investor-owned hospitals with effect sizes of 313.86 and 208.74, respectively. However, some of the effects of changes in operating room minutes can be explained by year effects in 2013, 2014, 2015, and 2016 for non-profit hospitals and 2013, 2014, and 2016 for investor-owned hospitals with p-values of  $< 0.05$ .

### **Secondary Outcome #3: Total discharges**



Total discharges were predicted by lagged gross patient revenue for non-profit and investor-owned hospitals with p-values < 0.0001. Fixed effects for 2013 were significant for non-profit hospitals, and fixed effects for investor-owned hospitals were significant for 2013, 2014, and 2015. Lagged gross patient revenue had an effect size of 3.85 for every million dollar increase for non-profit hospitals and 5.61 for investor-owned hospitals. However, the time-fixed effects could be significant in explaining that the individual years could explain any variance in discharges.

## **DISCUSSION**

Gross patient revenue was significant in predicting all patient metrics in the following year for both non-profit and investor-owned hospitals. This finding contributes to the evidence that previous year financial metrics determine patient metrics and decisions in non-profit and investor-owned hospitals. However, there are some caveats to that claim.

The effect sizes of lagged gross patient revenue were relatively small for all the patient metrics, and the differences between the effect sizes of non-profit and investor-owned hospitals are too small to pass judgement on their decisions. One implication of gross patient revenue being predictive of patient metrics is that both non-profit and investor-owned hospitals react to their previous year's financial metrics and, usually, they react in the same way. However, because the effect sizes are tiny, it can be determined that if hospitals do make decisions that affect their patient metrics based on their previous year financial metrics, the size of the difference is small. For example, yearly total discharges increased by 3.85 and 5.61 per million dollar increase in lagged gross patient revenue for NFP and investor-owned hospitals, respectively. The mean gross patient revenue for non-profits is 1,459,000,000 for non-profit hospitals and 809,000,000 for investor-owned hospitals. The mean total discharges are 11,269.83 and 6,996.60, respectively. While

fluctuations in lagged gross patient revenue predict total discharges, the effect size is small enough relative to the mean that it would not be an enormous difference. Further, the difference between how non-profit and investor-owned hospitals react is only 1.76 total discharges per million dollar increase which is evidence that the two types of hospitals act similarly.

Some of the variances in inpatient metrics could also have been explained by individual years. Especially with the roll-out of the expansion of Medicaid and Medicare, individual years have significant effects on patient metrics, perhaps for both types of hospitals, perhaps more than financial metrics. However, there were linear dependencies in the dummy variables for each year which could make cause errors in determining the fixed effects of each year on patient metrics.

### **IMPLICATIONS**

Understanding how hospitals make decisions is vital to the regulation of our healthcare industry. Hospitals are pillars of society that are expected to act in the best interests of the patients. Financial metrics should play a part in hospitals' decisions, but it is crucial to understand how much. There needs to be research that aims to understand how not-for-profit hospitals make decisions differently than investor-owned hospitals.

The answers to these questions are essential for hospital managers, regulators and government, and community members. Regulators and community members should know whether the tax benefits that not-for-profit hospitals receive are deserved and if not-for-profit hospitals are more mission-driven than for-profit hospitals than they do. If not-for-profit hospitals and investor-owned hospitals make the same decisions, then there is an implication that, at least under this condition, not-for-profit and for-profit hospitals deliver the same quality of care. This implication would raise the question of whether not-for-profit hospitals deserve their tax break. Non-profit status for hospitals means that millions of dollars are not being paid to the government. This tax

break is justified if the benefits of not-for-profit hospitals are larger than the revenue that the government could be collecting. With this in mind, communities hope that the not-for-profit hospitals are more altruistic in their mission than investor-owned hospitals. Since they deliver a community service that shields them from taxes, their decisions should be less influenced by financial metrics than investor-owned hospitals that seek to return value to shareholders.

Consumer healthcare costs have been rising astronomically compared to increases in wages and inflation metrics. Our current healthcare system has power-asymmetry with all the information coalescing on the side of the providers, payers, and drug companies. Healthcare consumers are left in the dark about their treatments and the options available to them. Patients receive a bill after their treatment with little ability to comparison shop or find a better deal. The power imbalance between providers and consumers of healthcare is one of the most prominent reasons why research examining how hospitals make decisions is important. Because patients have little choice and knowledge about their healthcare, hospitals must be accountable for their decisions to ensure that they are making decisions, especially regarding patient metrics like length of stay, operating room minutes, and c-section births, in the patient's best interest and not due to financial metrics.

Hospital managers will benefit from these findings by understanding which divisions typically suffer from budget cuts. As such, managers could proactively plan ways to support these divisions even during years of financial downturn. That way, necessary services are not denied when hospitals experience down financial years. Further, by being aware of potential blind spots that managers could have to prioritize profits over patients, hospitals can better focus their decisions on the right metrics.

## **FURTHER RESEARCH**

Further research would help determine how generalizable differences are between non-profit and investor-owned hospitals. This study was limited to a small number of general acute hospitals in California over a short period of years. A more comprehensive study on a national dataset would help determine the differences between the two types of hospitals. This study cannot be generalized to the entire country or other states. Because of the small sample size, the results are not necessarily indicative of all California hospitals. A larger study could potentially use CMS Form 2552 to examine at how financial metrics affect patient metrics on a national scale.

The use of different patient metrics could also explore other relationships between patient metrics and previous year financial metrics. The average length of stay, c-sections, total discharges, and operating room minutes variables in this study were selected because they were available for all hospitals in the dataset. However, it would be beneficial for follow-up studies to examine other patient metrics to see how they are affected by financial metrics.

More research should be done on whether previous year financial metrics affect cross-subsidization in hospitals. David et al. found that services in low-profit divisions can be left to the mercy of the revenue in high-profit divisions. A new study could determine how low-profit divisions are affected when revenue decreases for hospitals.

## **CONCLUSION**

This paper finds that both non-profit and investor-owned hospitals react to their financial metrics by altering patient metrics. In particular, the previous year's financial metrics predict positive predictive relationships with patient volume (total discharges), c-section births, operating room minutes, and the average length of stay. The regressions determined that for every million-dollar increase in lagged gross patient revenue, total discharges, c-section births, operating room minutes, and average length of stay increased in the following year. One exception is the average

length of stay for investor-owned hospitals, which decreases with every million dollar increase in lagged gross patient revenue.

The effect sizes were small and the differences between non-profit and investor-owned hospitals were negligible. Therefore, determining any differences between their actions is futile. Further, while both types of hospitals reacted to their previous year financial metrics, the reaction was extremely small and patient metrics generally stayed the same in the following year.

Further research could expand upon the theme of how non-profit and investor-owned hospitals react to their financial metrics. A nationwide study that examines various patient metrics would have more generalizable results about policy discussions around the country. Other studies that do not have linear dependencies amongst the time fixed effects could explain if individual years affect patient metrics better than this study. Additionally, it would be valuable for future research to study how cross-subsidization in hospitals is affected by financial metrics.

Understanding the differences between non-profit and investor-owned hospitals is an important topic. Non-profit hospitals should act differently from investor-owned hospitals because they are exempt from taxes. If they benefit their communities, they should be providing more altruistic care and be less reactive to their financial metrics by altering patient metrics, even though patient metrics affect financial metrics. Investor-owned hospitals seek to maximize shareholder value and can alter patient metrics in the pursuit of more money. While this paper did not lead to significant enough results to draw conclusions on this topic, further research could accomplish this aim and shape hospital decision-making and regulation.

### Non-Profit Hospitals Variable Distributions

Variable	Mean	Std. Dev
Average Length of Stay	4.48	1.78
Lagged Gross Patient Revenue (millions)	1,458.73	1817.24
Operating Room Minutes	49,3970.8	641,411.14
C Sections	527.11	576.26
Total Discharges	11,269.83	8,956.93

*Figure 1. Summary statistics of variables for non-profit hospitals*

### Investor-Owned Hospitals Variable Distributions

Variable	Mean	Std. Dev
Average Length of Stay	9.44	11.153
Lagged Gross Patient Revenue (millions)	809.11	899.19
Operating Room Minutes	203,353.51	224,979.05
C Sections	311.74	407.90
Total Discharges	6,996.60	5,848.72

*Figure 2. Summary statistics of variables for investor-owned hospitals*

Dataset: 160 non-profit hospitals

Dependent Variable: Average length of stay excluding long-term care

Method: Least squares

Observations: 906

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	0.0001337	3.253e-5	4.11	<.0001
2013	0.1496174	0.102532	1.46	0.1449
2014	0.0461741	0.101677	0.45	0.6498
2015	0.0630375	0.102558	0.61	0.5389
2016	0.0378736	0.102482	0.37	0.7118
2017	0.0385689	0.102434	0.38	0.7066
2018*	0	0	-	-

\*zeroed

*Figure 3. Regression table of lagged gross patient revenue and time fixed effects predicting average length of stay excluding long-term care for non-profit hospitals*



Dataset: 70 investor-owned hospitals

Dependent Variable: Average length of stay excluding long-term care

Method: Least squares

Observations: 401

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	-0.003838	0.000598	-6.41	<.0001
2013	1.3117343	0.920579	1.42	0.1550
2014	1.2054572	0.944883	1.28	0.2028
2015	0.936503	0.917488	1.02	0.3080
2016	0.6393267	0.916583	0.70	0.4859
2017	0.2809181	0.916029	0.31	0.7593
2018*	0	0	-	-

\*zeroed

*Figure 4. Regression table of lagged gross patient revenue and time fixed effects predicting average length of stay excluding long-term care for investor-owned hospitals*

Dataset: 160 non-profit hospitals

Dependent Variable: C-sections

Method: Least squares

Observations: 906

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	0.1336938	0.009619	13.90	<.0001
2013	-73.57919	30.31532	-2.43	0.0154
2014	-79.41869	30.06246	-2.64	0.0084
2015	-59.86115	30.32291	-1.97	0.0487
2016	-41.80398	30.30033	-1.38	0.1680
2017	-20.87769	30.28626	-0.69	0.4908
2018*	0	0	-	-

\*zeroed

*Figure 5. Regression table of lagged gross patient revenue and time fixed effects predicting the number of c-sections for non-profit hospitals*

Dataset: 70 investor-owned hospitals

Dependent Variable: C-sections

Method: Least squares

Observations: 401

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	0.2995257	0.017336	17.28	<.0001
2013	-78.53994	26.67588	-2.94	0.0034
2014	-60.8017	27.38014	-2.22	0.0269
2015	-63.71719	26.58632	-2.40	0.0170
2016	-40.39347	26.56008	-1.52	0.1291
2017	-28.43159	26.54403	-1.07	0.2848
2018*	0	0	-	-

\*zeroed

*Figure 6. Regression table of lagged gross patient revenue and time fixed effects predicting the number of c-sections for investor-owned hospitals*

Dataset: 160 non-profit hospitals

Dependent Variable: Inpatient operating room minutes

Method: Least squares

Observations: 906

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	313.86271	5.491704	57.15	<.0001
2013	-86509.06	17307.31	-5.00	<.0001
2014	-68702.69	17162.95	-4.00	<.0001
2015	-57514.64	17311.65	-3.32	0.0009
2016	-40771.74	17298.76	-2.36	0.0186
2017	-14768.81	17290.72	-0.85	0.3933
2018*	0	0	-	-

\*zeroed

*Figure 7. Regression table of lagged gross patient revenue and time fixed effects predicting the number of inpatient operating room minutes for non-profit hospitals*

Dataset: 70 investor-owned hospitals

Dependent Variable: Inpatient operating room minutes

Method: Least squares

Observations: 401

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	208.73547	7.074412	29.51	<.0001
2013	-24917.32	10885.69	-2.29	0.0226
2014	-24277.2	11173.08	-2.17	0.0304
2015	-18359.33	10849.15	-1.69	0.0914
2016	-25360.45	10838.44	-2.34	0.0198
2017	-14050.34	10831.89	-1.30	0.1953
2018*	0	0	-	-

\*zeroed

*Figure 8. Regression table of lagged gross patient revenue and time fixed effects predicting the number of inpatient operating room minutes for investor-owned hospitals*

Dataset: 160 non-profit hospitals

Dependent Variable: Total discharges

Method: Least squares

Observations: 906

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	3.8530112	0.10362	37.18	<.0001
2013	-831.3709	326.5638	-2.55	0.0111
2014	-628.5061	323.8399	-1.94	0.0526
2015	-571.6487	326.6456	-1.75	0.0804
2016	-349.7399	326.4023	-1.07	0.2842
2017	-164.2682	326.2507	-0.50	0.6147
2018*	0	0	-	-

\*zeroed

*Figure 9. Regression table of lagged gross patient revenue and time fixed effects predicting total discharges for non-profit hospitals*

Dataset: 70 investor-owned hospitals

Dependent Variable: Total discharges

Method: Least squares

Observations: 401

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Lagged Gross Patient Revenue (millions)	5.6087249	0.170367	32.92	<.0001
2013	-744.455	262.1502	-2.84	0.0047
2014	-637.5552	269.0711	-2.37	0.0183
2015	-628.6089	261.27	-2.41	0.0166
2016	-401.8427	261.0122	-1.54	0.1245
2017	-214.2208	260.8544	-0.82	0.4120
2018*	0	0	-	-

\*zeroed

*Figure 10. Regression table of lagged gross patient revenue and time fixed effects predicting total discharges for investor-owned hospitals*

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