

COVID-19 Implications on the Financial Health and Quality of Skilled Nursing Facilities: A Regression Discontinuity Approach

Ai Ren^{1δ*}, Svetlana Doronkina^δ, Pavlo Mysak^δ, Alexandra Kassian^δ

¹ rena@newpaltz.edu
^δ School of Business, State University of New York at New Paltz
* Corresponding author

Abstract:

The COVID-19 pandemic placed unprecedented financial and operational strain on skilled nursing facilities (SNFs) in the United States, exacerbating long-standing challenges in healthcare funding and quality of care. This study examines the relationship between financial health and care quality in SNFs, with a particular focus on the impact of COVID-19. Using a Regression Discontinuity Design (RDD), we analyze financial and quality metrics from over 12,000 SNFs between 2015 and 2021, leveraging public data from the Centers for Medicare and Medicaid Services (CMS), the CDC’s National Healthcare Safety Network (NHSN), and the Federal Reserve’s Economic Data (FRED). Our findings reveal that better financial health correlates with higher quality ratings, while increased reliance on Medicaid funding is associated with lower operating margins. For-profit facilities demonstrate higher profitability, often at the expense of staffing levels. Additionally, we find that COVID-19 generally had a negative impact on SNFs’ financial performance, with conditions worsening over time. However, facilities with a higher number of COVID-19 cases experienced increased operating margins, likely due to COVID-relief funding. These insights highlight the fragile balance between financial stability and care quality in the SNF sector and underscore the need for policy interventions to ensure equitable and sustainable long-term care.

Keywords: skilled nursing facilities, COVID-19 impact, regression discontinuity design

1. Introduction

The COVID-19 pandemic disrupted healthcare systems worldwide with a notable impact on skilled nursing facilities (SNFs). As the central providers of care for vulnerable populations, SNFs experienced both operational and financial strain during this time. Challenges included external factors such as competition and evolving reimbursement models, as well as internal issues such as staffing requirements and increased regulatory demands (Lord, 2020). Skilled nursing facilities have limited capacity to address these challenges, as their efforts are ultimately constrained by available funding. The majority of funding for nursing home services comes from three main sources: the federal Medicare program, the federal-state Medicaid program, and private payers (National Academies Press, 2022). While Medicaid provides the largest share of nursing facility funding, it is also the most constrained, as regulations differ across states. These limitations can strain

the financial health of facilities, reducing their ability to invest in quality improvements. Recent trends highlight the need for nursing homes to strike a balance between quality of care and financial performance, as profitability is essential for their sustainability (Weech-Maldonado, Robert, et al., 2019). Research indicates that facilities with stronger financial performance tend to provide higher quality care and have the flexibility to reduce costs (Weech-Maldonado, 2003). Despite the importance of profitability, there is a significant gap in research examining how different nursing facility metrics and qualities relate to a facility's financial health, particularly in the context of the pandemic. This study aims to address this gap, and further analyze how these factors vary across different thresholds of care quality during a time of unprecedented strain on healthcare resources.

It is evident that insufficient financial resources threaten the improvement of care quality, regardless of advancements in quality metrics (Burke-Werner, 2019). This underscores the critical relationship between financial stability and the ability to maintain high-quality care. Limited resources may compel skilled nursing facilities to make decisions that could adversely affect the quality of care delivered (Weech, 2019). Understanding the financial health of these facilities is crucial, as it directly impacts their capacity to provide quality care. To assess the financial health of skilled nursing facilities, various financial metrics can be utilized, including net income, operating margin, and working capital ratio. The operating margin of skilled nursing facilities serves as an indicator of profitability from core operations, and reflects effective cost management and operational efficiency.

2. Literature Review

U.S. nursing home care has been the subject of much debate in policy regulation and evaluation over the last few decades, with many of the reforms aimed at improving the quality of facilities. Despite this positive intent, compliance with new regulations and meeting elevated care standards requires significant restructuring and capital, which has proved to be challenging or altogether impossible for many facilities. Given that quality cannot be sustained without adequate financial resources to support it, financial health is a critical indicator of nursing home performance (Gapenski, 2007).

The Nursing Home Act of 1987, enacted under the Omnibus Budget Reconciliation Act (OBRA), was a landmark piece of legislation that set the stage for modern nursing home regulation. This policy aimed to establish higher standards of care by mandating that nursing homes maintain a sufficient and qualified staff, comply with resident rights to protect dignity and autonomy, and update facility standards of care and practices to focus on ensuring positive outcomes. Profitable nursing homes were able to comply with the financial burdens imposed by OBRA and improve their quality of care; less profitable facilities were negatively impacted by these reforms, and their quality of care worsened (Kumar et. al., 2006). Despite this disparity, the long-term impact of the Nursing Home Reform Act was largely positive, as it led to significant reductions in deficiencies related to patient care and helped establish a benchmark for quality that subsequent policies would build on (Kaiser Family Foundation, 2007).

The Affordable Care Act (ACA) of 2010 introduced further transparency and accountability measures to nursing home facility regulation, including penalties for excessive hospital readmissions. These reforms incentivized better care coordination, but they also imposed financial penalties that disproportionately impacted facilities reliant on Medicaid funding (Kaiser Family Foundation, 2024). The introduction of the Patient-Driven Payment Model (PDPM) in 2019 further disrupted the financial dynamics of nursing home facilities, shifting the reimbursement model from a volume-based system to one focused on patient characteristics. PDPM was designed to incentivize individualized care instead of maximizing therapy minutes, thereby reducing emphasis on therapy services and causing a drop in therapy-related revenues (National Academies of Sciences, Engineering, and Medicine, 2022). This had a major impact on the cash flow and operating margins of facilities that were highly invested in therapy care services;

these financial burdens were further magnified by the additional administrative resources that PDPM compliance would require (CMS, 2018).

The COVID-19 pandemic brought unprecedented challenges to nursing home facilities and greatly emphasized the existing vulnerabilities in the system. CMS waivers and flexibilities during the Public Health Emergency (PHE) provided temporary relief from certain regulatory requirements, however, this could not diminish the extreme financial and operational impacts of the crisis (CMS, 2021). Facilities faced skyrocketing costs for personal protective equipment (PPE), testing, and staffing, while simultaneously dealing with reduced occupancy rates (and thereby federal funding) due to the pandemic death toll (AHCA, 2021). The PHE waivers introduced some positive long-term changes regarding tele-health and infection control practices; however, many facilities simply went under. Those that emerged from the crisis did so with weakened financial health and struggled to restore their cash flow and occupancy rates (AHCA, 2021).

The Medicaid Fiscal Accountability Regulation (MFAR) was proposed in 2019 and eventually redacted in 2021 due to the crises caused by the COVID-19 pandemic. This regulation highlighted the concerning financial position of nursing home facilities that were heavily reliant on Medicaid funding and raised alarm bells about potential reductions in Medicaid payments (Federal Register, 2021). This policy would have further destabilized facilities that were operating on low margins and while it did not come into effect, pushed facilities to reassess their financial strategies to safeguard against future funding cuts (NASHP, 2023).

3. Method

Hypothesis: Financial metrics are the most significant influential factors that impact U.S. nursing home performance, with disproportionate influence across different facility types and qualities; this issue was further exacerbated during the COVID-19 crisis.

Data

In order to assess the impact of COVID-19 on nursing home facilities across the United States, we obtained public use data from the Centers for Medicare and Medicaid Services (CMS) outlining skilled nursing facility (SNF) annual cost reports maintained in the Healthcare Provider Cost Reporting Information System (HCRIS) as well as COVID-19 data reported by nursing facilities to the CDC's National Healthcare Safety Network (NHSN) COVID-19 Long Term Care Facility Module. The data for one of our control variables, annual median household income, was obtained from FRED, specifically series MEHOINUSA646N.

The SNF Cost data (HCRIS) is self-reported annually by skilled nursing facilities using the CMS-2540-2010 form and submitted to a Medicare Administrative Contractor (MAC). This data, aggregated by SNF (CMS Certification Number) and by year, involves facility characteristics, utilization data, cost and charges by cost center (in total and for Medicare), Medicare settlement data and financial statement data. For the purposes of our study, we utilize data covering the years 2015 to 2021. This timeframe is crucial to gain an understanding of COVID-19's impact on nursing home health.

Because the SNF Cost data covers a wide range of facilities, not all entities report financial records according to congruent fiscal year lengths or end-point dates. To adjust for this circumstance, we employed a prorata transformation on financial figures. The prorata transformation converts our data into a standardized and comparable form, allowing us to adequately perform analysis across all SNFs and years.

Further cleaning was conducted to eliminate improbable or impossible values from our data. We excluded operating margin values below -100 and above 40, resulting in the removal of 668 observations (less than 1% of the total dataset). An operating margin of -100 indicates that a facility's operating expenses are double its total revenues. We

determined that any values below this threshold are either impossible or inadequate for inclusion in our analysis. Conversely, an operating margin exceeding 40 is abnormally high and may raise concerns regarding a facility's sustainability and quality of care.

Additionally, we excluded observations for facilities with a certified bed count (BEDCERT) exceeding 450, which accounted for 537 records (also less than 1% of the total dataset). Facilities with more than 450 beds are often too large to be generalizable to all skilled nursing facilities (SNFs). Furthermore, if such a facility is part of a hospital, the reported bed count may reflect the total number of beds in the entire hospital rather than just those dedicated to skilled nursing.

Our dataset had 76,662 observations across 132 variables and covered 12,171 unique nursing home facilities. The majority of the observations (76%) were made up of non-profit facility data. 97% of observations studied had not had an ownership change in the last 12 months and 71% were located in urban settings.

Table 1: Description of Variables

Panel A. Dependent & Control Variables

Variable:	Description:
operating_margin	Percentage of gross revenue that is derived from net income from service to patients.
median_household_inc	Median income of U.S. households.
asset_to_liability_ratio	Ratio of total assets to total liabilities.
Working_capital_ratio	Ratio of current assets to current liabilities.
Average_length_stay	SNF total average length of stay by component.
Average_receivable_days	Net Accounts Receivable over Net Patient Revenue per Day.
Accounts_receivable_turnover	Net Credit Sales over Accounts Receivable

Panel B. Staffing Variables

RNHRD	Reported RN Staffing Hours per Resident per Day
VOCHRD	Reported LPN Staffing Hours per Resident per Day.
AIDHRD	Reported Nurse Aide Staffing Hours per Resident per Day.
CM_RN	Case-Mix RN Staffing Hours per Resident per Day.

Panel C. Quality Rating Variables

QUALITY_RATING2	Facilities with a QM rating of 2.
QUALITY_RATING3	Facilities with a QM rating of 3.
QUALITY_RATING4	Facilities with a QM rating of 4.
QUALITY_RATING5	Facilities with a QM rating of 5.

Panel D. Payer Mix & Ownership Variables

payer_mix_medicare	Total Medicare discharges (Title XVIII) over total discharges.
payer_mix_medicaid	Total Medicaid discharges (Title XIX) over total discharges.
OWNERSHIPGovernment	Facilities that are government-owned.
OWNERSHIPNon profit	Facilities that are non-profit.

Panel E. Facility & COVID Variables

BEDCERT	Number of Federally Certified Beds.
covid_case_ratio	Number of COVID Cases per Total Residents
covid_death_ratio	Number of COVID Deaths per Total Residents

Panel F. RDD Variables

rdd_year_index	Year Time Index
binary_cutoff_covid	Cutoff value is 6 (Year 2020)
rdd_year_index:binary_cutoff_covid	Interaction term between Year Index and Cutoff

The standard operating margin formula is typically calculated as $(\text{Operating Income} / \text{Operating Revenue})$, however the nature of CMS data does not allow for a direct application of this formula. As a result, we adapted a modified version also used by Pradhan et al. (2023) and Weech-Maldonado et al. (2019).

$$\text{Operating Margin} = \frac{\text{Net Income from Service to Patients}}{\text{Gross Revenue}}$$

This ratio serves as a strong proxy for financial performance, capturing the proportion of patient-generated revenue that remains after subtracting the direct costs associated with providing care. *Net income from Service to Patients* excludes non-operating income and expenses, such as investment returns or donations, allowing us to isolate profitability from core patient operations. *Gross Revenue* represents the total patient service revenue before deductions, such as contractual allowances and bad debt. By focusing solely on revenues and expenses tied directly to core operating activities, this modified ratio aligns closely with the intent of the traditional operating margin metric, offering a reliable measure of how efficiently facilities convert revenue into operating profit.

Average Length of Stay, a measure of patient turnover, is calculated as the ratio of Total Patient Days to the Total Number of Admissions. We calculated this as follows:

$$\text{Average Length of Stay} = \frac{\text{Total Patient Days}}{\text{SNF Admissions} + \text{NF Admissions}}$$

This metric captures the average number of days a resident remains in care per admission, offering insight into the acuity and complexity of the patient population served by each facility.

To quantify staffing levels across facilities, the suffix HRD (hours per resident day) reflects the average amount of direct care time a resident receives from each category of nursing staff. A higher HRD indicates more labor hours spent per resident per day. This standardization allows us to compare staffing intensity across facilities of varying sizes and occupancy rates.

CM_RN represents the case-mix adjusted registered nurse hours per resident day. It is designed to capture the intensity of skilled nursing care provided while accounting for the clinical complexity of the resident population. By adjusting for case mix, this variable allows us to evaluate how efficiently facilities deploy registered nursing resources relative to the needs of their residents. A higher case mix of registered nurse staffing hours per resident day indicates that a facility is delivering more RN hours per resident than would be expected given its level of acuity, potentially reflecting higher staffing investments, more proactive care, or even inefficiencies in staffing allocation.

The five-star quality rating system is a standardized performance measure developed by the CMS to help consumers, families, and healthcare providers compare the quality of care across skilled nursing facilities. Each facility is assigned an overall rating between 1 and 5 stars, with 5 indicating the highest quality. The overall rating is a composite measure that incorporates three main components: Health Inspection Rating, Staffing Rating, Quality Measures (QM) Rating. In the current study, we focus exclusively on Quality Measures (QM) Rating, which isolates performance based on resident health outcomes and care quality independent of inspection results or staffing volume.

The Medicare and Medicaid Payer Mixes reflect the composition of a facility's discharged residents by primary source of payment, capturing the proportion of residents covered under distinct government programs. The Medicare Payer Mix is defined as the number of Medicare discharges (Title XVIII) divided by the total discharges, while Medicaid Payer Mix is defined as the number of Medicaid discharges (Title XIX) divided by the total discharges. Varying proportions of Medicare or Medicaid Payer Mixes reflect differences in patient populations and care strategies across facilities. A higher Medicare payer mix typically indicates a focus on short-term, post-acute care, which is reimbursed at higher rates for shorter periods of time. In contrast, a higher Medicaid payer mix suggests a greater emphasis on long-term custodial care for lower-income residents, which tends to be reimbursed at lower rates.

Table 2: Summary Statistics on Variables of Interest

Numeric Variables	Count	Mean	Median	St. Dev	Min	Max	Kurtosis
RNHRD	76662	0.68	0.62	0.33	0.00	7.51	12.41
VOCHRD	76662	0.86	0.85	0.32	0.00	5.29	5.05
AIDHRD	76662	2.33	2.26	0.54	0.00	7.79	2.43
CM_RN	76662	0.68	0.46	0.38	0.21	2.25	-1.18
Payer Mix: Medicare	76662	0.36	0.34	0.17	0.00	1.00	-0.08
Payer Mix: Medicaid	76662	0.26	0.23	0.18	0.00	0.99	0.52
Quality Rating	76662	3.67	4.00	1.29	1.00	5.00	-0.85
Operating Margin	76662	-3.61	-1.44	12.51	-99.67	39.33	11.78
Average Length of Stay	76662	183.46	137.10	327.89	0.19	65029.20	20472.59
# of Certified Beds	76662	112.70	106.00	50.96	7.00	450.00	3.44
COVID Case Ratio	76662	0.12	0.00	0.24	0.00	2.32	4.21
COVID Death Ratio	76662	0.02	0.00	0.06	0.00	1.13	37.43
Non-Numeric Variables	Count	Unique	Top	Freq			
Ownership	76662	3	For Profit	58169			
SHOW_LAST_12MOS	76662	2	N	74709			
Rural v. Urban	76662	2	U	54361			

Model

In the current study, we utilize a fixed effect model with a regression discontinuity design component to examine the impact of various factors, including staffing metrics, facility measurements and COVID-19 response on the financial performance of nursing homes across the United States. The model, estimated via Ordinary Least Squares (OLS), allows for individual-specific intercepts and controls for unobserved time-invariant characteristics through within-group variation. We designed our model to include control variables in addition to our selected independent variables to reduce variable bias and further isolate the effects of the independent variables more accurately. These control variables are time-varying, which enables us to account for external environmental factors over time. Within this control group, we included *Asset to Liability Ratio*, *Working Capital Ratio*, *Average Receivable Days*, *Average Receivable Turnover*, *Median Household Income per State* and *Average Length of Stay*.

Asset to Liability Ratio and Working Capital Ratio serve as measures of a facility's financial liquidity, capturing the extent to which SNF's can meet their short- and long-term obligations. These variables help control for financial stability, ensuring our results

are not confounded by underlying solvency issues that may independently influence operating margins. Average Receivable Days and Accounts Receivable Turnover reflect a facility's revenue cycle efficiency. They account for how quickly nursing homes collect payments from payers, controlling for differences in financial management practices and cash flow stability.

Median Household Income per State provides a proxy for broader economic conditions, capturing variations in regional wealth that may impact patient mix, reimbursement rates, and demand for nursing home services. This variable helps account for external market forces that could influence financial performance independent of internal operational factors.

Average Length of Stay controls for patient turnover and acuity level, as facilities with short stays may rely more on higher-reimbursement short-term rehabilitation patients, while those with longer stays may cater more to lower-reimbursement long-term care residents. This ensures that differences in financial outcomes and variable coefficients are not driven by variations in patient composition.

The regression discontinuity design component was integrated to estimate the effect of COVID-19, using 2020 as the cutoff point, c . A binary variable, D , was set to the value 1 for observations after the cutoff point, c , and 0 for those before, allowing us to capture the differential impact of the pandemic period. Furthermore, the interaction term between our binary variable, D , and $t - c$, was included to account for any changes in the slope of the effect over time following the onset of the pandemic. The term allows the model to capture whether and how the impact of COVID-19 evolved beyond the initial shock, providing insights into whether the effects intensified, diminished, or remained constant as time progressed. This design enables a detailed analysis of both the immediate and long-term impacts of COVID-19 on SNF financial performance, isolating the direct effects attributable to the pandemic while controlling for other covariates.

The regression is expressed as follows:

$$\begin{aligned} \text{Operating Margin}_{it} &= \beta_0 + \left(\beta_1 \right) (\text{Control Variables}_{it}) + \left(\beta_7 \right) (\text{Independent Variables}_{it}) \\ &+ \beta_{18}(t - c) + \beta_{19}(D) + \beta_{20}D(t - c) + \alpha_i + \varepsilon_{it} \end{aligned}$$

Where:

- β_{1-6} is a vector of coefficients for control variables.
- β_{7-17} is a vector of coefficients for independent variables.
- β_{18-20} is a vector of coefficients for regression discontinuity design variables.
- *Control Variables* include factors that help isolate the effects of the independent variables on the outcome.
- *Independent Variables* are the key predictors that influence the dependent variable.
- t is time.
- c is the treatment cutoff (COVID-19).
- D is a binary variable equal to one when $t \geq c$.
- α_i captures individual fixed effects.
- ε_{it} is the error term.

To assess the robustness of our findings, we re-estimated the model under different specifications. We removed all control variables, only retaining the independent variables of interest. The resulting coefficients remained largely unchanged, suggesting that our main findings are not driven by the inclusion of control variables and that the estimated effects of the independent variables on nursing home financial performance are not highly sensitive to omitted variable bias, reinforcing the reliability of our results.

4. Results

The coefficients obtained from our primary model, described above, are displayed in Table 3. The results indicate a significant relationship between all staffing metrics and our financial performance measure, operating margin. Registered nurse hours per resident day (RNHRD) exhibit a negative coefficient (-4.37), suggesting that increased RN staffing is associated with lower operating margins. A similar trend is observed for vocational nurses (-3.82) and nurse aides (-1.37), with RN hours exhibiting the largest negative impact. This is an intuitive mechanism, as it's inherently costly to employ staff and any costly endeavor will diminish the operating margin. Additionally, it is natural to have this progression of coefficients among nursing levels, as registered nurses are the most skilled and highest paid among this group, followed by vocational nurses and nurse aides respectively (Griffiths P. et al., 2023).

The case mix of registered nurses, however, return a positive coefficient (2.24), indicating that higher case mix indices of registered nurse hours per patient per resident day improve the operating margin. However, this effect is significantly moderated by the share of Medicare payer mix. This interaction term between the case mix of registered nurses and the Medicare payer mix is -2.84, suggesting that while an increased case mix of registered nurses generally increases profitability, this benefit is significantly reduced in facilities with a higher proportion of Medicare-funded residents.

A key reason for this could be attributed to the fact that Medicare primarily funds short-term care rather than long-term stays (MACPAC, 2023), meaning that while facilities with a higher case mix of registered nurses may initially receive higher reimbursements for more complex patients, this funding is not sustained. Moreover, facilities that treat more complex patients likely incur higher costs due to greater staffing [and other...] needs, yet Medicare payments may not fully compensate for this, particularly if patients transition to lower-reimbursing payers after their Medicare coverage ends.

The main effect of Medicare Payer Mix (9.80) suggests that nursing homes with a larger share of Medicare residents tend to have higher operating margins, likely due to the shorter bursts of higher reimbursement rates in comparison to Medicaid.

Conversely, the main effect of Medicaid Payer Mix exhibited a negative coefficient (-1.99), reinforcing the well-documented financial strain associated with a higher reliance on Medicaid reimbursements (Weech-Maldonado, R. et al., 2019). Medicaid generally reimburses at lower, fixed rates that may not adequately cover the costs of caring for high-acuity patients.

Taken together, a higher case mix of registered nurses is generally associated with better financial performance, yet the stability and duration of reimbursement sources play an important role in determining the extent of this benefit. Facilities with a higher Medicare payer mix may experience temporary financial gains from treating more complex patient cases, but these gains may erode as Medicare funding expires and patients transition to less favorable resources.

Quality ratings demonstrate a fairly linear positive effect on operating margin where, as quality rating increases, so does the operating margin. This effect becomes more significant at higher rating levels, with our coefficient of rating 2 being insignificant and rating 3 being only significant at the 99% confidence level while the coefficients for ratings 4 and 5 are both fully statistically significant. This indicates that higher rated nursing homes experience greater financial benefits, especially at the upper end of the quality rating spread. These higher rated facilities may operate more efficiently, both reducing costs and improving care quality concurrently (Weech-Maldonado, R. et al., 2003). The insignificance of the coefficient for rating 2 and the weaker significance of rating 3 suggest that modest improvements in quality may not directly translate to financial gains, implying that SNF's may need to cross a certain quality threshold before realizing meaningful financial advantages (Park, J. et al., 2010).

Ownership type plays a role in financial performance. For-profit facilities demonstrate higher operating margins compared to non-profit facilities, likely due to stronger cost control measures, revenue-driven strategies, and potentially a greater focus on higher-reimbursing payer mixes (Weech-Maldonado, R. et al., 2012). In contrast, non-profit facilities may prioritize patient care quality and reinvestment over profitability, which could contribute to their lower margins.

Government-owned facilities exhibit a positive but statistically insignificant effect on operating margin. This may be due to their reliance on public funding and subsidies, as well as their propensity to serve Medicaid-dependent residence, constraining and limiting their financial performance.

The ratio of COVID cases produces a positive coefficient (3.97), suggesting that an increase in COVID cases is associated with higher operating margins. This may be driven by a combination of increased government funding, emergency relief programs such as the CARES Act Provider Relief Fund (PRF), Paycheck Protection Program (PPP) or higher reimbursement rates provided to facilities that treated COVID-19 patients (Ulyte, A. et al., 2023).

In contrast, the ratio of COVID deaths yields a substantially lower coefficient (-11.84), suggesting that facilities experiencing higher mortality rates suffered financially. This negative impact could be driven by the higher costs associated with infection control and liability risks, potential reputation damage and decreased patient admissions as well as increased regulatory scrutiny. A higher COVID death rate may also reflect severe outbreaks, leading to disruptions in operations, and strains in financial performance.

Finally, our regression discontinuity coefficients reveal that the initial shock of COVID (-3.40) harmed the operating margins of facilities, with financial conditions worsening as time went on (-1.62). This suggests that the immediate onset of the pandemic strained margins due to initial operational costs associated with infection control measures (e.g. Specialized Protective Equipment) and staffing uncertainties. As time progressed, SNF's faced continued pressures from lower occupancy rates, sustained increases in labor costs, and ongoing regulatory compliance expenses. Additionally, while early pandemic relief efforts may have offset some financial losses, the diminishing support combined with shifts in patient admissions and payer mix further contributed to the declines in profitability (Brunt, C. S. et al., 2024). Even as the crisis subsided, facilities continued to struggle with structural financial challenges.

Table 3: Findings from Model

	Coefficient Estimate	95% Confidence Interval
median_household_inc	0.0001***	[0.00, 0.00]
asset_to_liability_ratio	0.05***	[0.03, 0.06]
working_capital_ratio	0.15***	[0.13, 0.17]
average_length_stay	-0.002***	[0.00, 0.00]
average_receivable_days	-0.0004***	[0.00, 0.00]
accounts_receivable_turnover	0.13***	[0.04, 0.22]
RNHRD	-4.37***	[-4.69, -4.04]
VOCHRD	-3.82***	[-4.12, -3.53]
AIDHRD	-1.37***	[-1.55, -1.19]
CM_RN	2.24***	[1.78, 2.69]
CM_RN:payer_mix_medicare	-2.84***	[-3.71, -1.97]
payer_mix_medicare	9.80***	[8.89, 10.71]
payer_mix_medicaid	-1.99***	[-2.63, -1.35]
OWNERSHIPGovernment	0.06	[-0.45, 0.56]
OWNERSHIPNon profit	-2.17***	[-2.56, -1.78]
QUALITY_RATING2	0.23	[-0.04, 0.49]

QUALITY_RATING3	0.33**	[0.06, 0.59]
QUALITY_RATING4	0.66***	[0.39, 0.92]
QUALITY_RATING5	1.06***	[0.79, 1.33]
BEDCERT	0.002	[-0.01, 0.01]
covid_case_ratio	3.97***	[3.49, 4.45]
covid_death_ratio	-11.84***	[-13.43, -10.25]
rdd_year_index	-0.30***	[-0.38, -0.21]
binary_cutoff_covid	-3.42***	[-3.78, -3.06]
rdd_year_index: binary_cutoff_covid	-1.65***	[-2.04, -1.26]
Note: *** p-value < 0.001, ** p-value < 0.01, *p-value < 0.05		

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There is significant variation in the confidence intervals of some our coefficients, which depending on the variable, may reflect underlying variations in the data or more uncertainty in the estimate. The COVID death ratio has the largest confidence interval range, reflecting the extreme variability across SNF's in COVID outbreaks and mortality. This variability could stem from a wide variety of sources, such as facility differences in reporting accuracy and completeness, resident vulnerability and staffing shortages, and local policy regarding pandemic responses (Ochieng et al., 2021).

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Medicare Payer Mix also has a large confidence interval range, likely because proportions of Medicare patients in facilities vary greatly by state policies and SNF specialization (short vs. long-term care) (Medicare Payment Advisory Commission, 2017). The lower end of the confidence interval may be explained by shorter stays and higher acuity that is typically associated with Medicare-heavy SNF's; operating margin still improves due to the higher reimbursement rates, but this impact is somewhat negated by higher costs of care (Taylor et al., 2024). The interaction effect between the case mix of RN's and Medicare Payer Mix supports this assertion – more RN staffing hours are less beneficial, i.e. more costly, in Medicare-heavy facilities, suggesting diminishing returns. The variation in the estimate reflects operational differences in Medicare SNF's and the high-acuity, short-stay nature of patients; RN input is necessary but not always efficient due to documentation burdens or fragmented care (Medicare Payment Advisory Commission, 2019).

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The Medicaid Payer Mix reveals a comparatively large range in the confidence interval, likely due to wide variation in state-set Medicaid reimbursement rates, which often don't cover the full cost of care. SNF's with high proportions of Medicaid residents typically serve long-stay and low acuity residents, resulting in lower turnover rates and a higher dependence on daily care aides (Medicaid and CHIP Payment and Access Commission, 2023). The government ownership variable displays a relatively wide confidence interval, likely reflecting the small number of government-owned SNFs nationwide and their direct tie to public funding cycles. These facilities are often subject to staffing constraints due to fixed budgets and civil service employment rules (United States Government Accountability Office, 2023). Additionally, government-owned SNFs may vary widely in mission and performance - some facilities prioritize access for long-stay, vulnerable populations, while others are more clinically specialized (Harrington et al., 2018).

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5. Robustness Check

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To ensure robustness of results, we estimated two alternative models. One with a reduced set of variables (Coefficients found in Table 4), and one with a subsample of the full dataset (Coefficients found in Table 5). In the former, we omitted a subset of control variables, certain insignificant predictors and certain interaction effects from our primary specification. The set of omitted control variables include Median Household Income per State, Asset to Liability Ratio, Working Capital Ratio, Average Receivable Days, Accounts Receivable Turnover and Average Length of Stay. These variables served as controls for

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facility-level financial health, liquidity, and broader economic conditions that could influence operating margins.

The results from this streamlined model remained consistent with those of our full model, with key coefficients falling within the 95% confidence intervals of our original estimates. In cases where coefficients in the reduced model slightly deviated from the confidence bounds, this discrepancy was primarily attributed to the omission of interaction effects rather than a fundamental shift in the relationships observed. For example, the estimates of Medicare payer mix and case mix of registered nurses were understated in our reduced model due to the omission of their interaction term, which plays a critical role in capturing the differential impact of higher-acuity patients in facilities with higher reliance on Medicare payments. Importantly, the direction and relative magnitudes of the estimated effects remained stable, reinforcing the validity of our primary findings. These results suggest that our core conclusions are robust to model specification changes and are not overly sensitive to the inclusion or exclusion of specific variables.

Table 4: Findings from Second Model; Robustness Check, variables omitted.

	Coefficient Estimate	95% Confidence Interval
RNHRD	-4.40***	[-4.72, -4.07]
VOCHRD	-3.81***	[-4.11, -3.52]
AIDHRD	-1.36***	[-1.54, -1.18]
CM_RN	1.33***	[1.02, 1.64]
QUALITY_RATING2	0.21	[-0.05, 0.48]
QUALITY_RATING3	0.30*	[0.04, 0.56]
QUALITY_RATING4	0.64***	[0.37, 0.91]
QUALITY_RATING5	1.06***	[0.79, 1.33]
payer_mix_medicare	7.59***	[6.91, 8.26]
payer_mix_medicaid	-2.04***	[-2.67, -1.4]
OWNERSHIPGovernment	0.17	[-0.34, 0.68]
OWNERSHIPNon profit	-2.17***	[-2.56, -1.77]
BEDCERT	0.003	[-0.01, 0.01]
covid_case_ratio	4.03***	[3.55, 4.51]
covid_death_ratio	-11.62***	[-13.22, -10.02]
rdd_year_index	-0.20***	[-0.27, -0.12]
binary_cutoff_covid	-2.90***	[-3.15, -2.65]
rdd_year_index: binary_cutoff_covid	-2.34***	[-2.56, -2.12]

Note: *** p-value < 0.001, ** p-value < 0.01, *p-value < 0.05

6. Discussion

- Major finding – facilities that are reliant on Medicaid funding are at a financial disadvantage. Potential discussion angles – Medicaid cuts under the new administration (projected to cut \$800 billion in the next 10 years) will massively impact facilities in the short and long-term. Most nursing home facilities in the U.S. are in a precarious financial situation, which these cuts will undoubtedly exacerbate – the future of elderly people in America is very questionable now.
- This also ties into a larger issue in U.S. healthcare, where low-income individuals and families face significant barriers in receiving healthcare. This is a particularly bad problem in the nursing home system – Medicaid covers long-

term stays, but Medicare only covers up to 100 days and depends on certain conditions being met. It is not only facilities, but low-income individuals are at an extreme disadvantage in this system, especially with the proposed Medicaid cuts. People can barely afford to retire nowadays, but this could cripple the already inefficient and damaged nursing home care system we have.

- Ownership finding - for-profit facilities demonstrate higher operating margins compared to non-profit facilities, while government-owned facilities show a positive but statistically insignificant effect. Facilities do not always get those high margins in an ethical way - a Dartmouth study found that for-profit nursing homes decreased operating costs by reducing wages for nurses and other staff, particularly by decreasing staffing levels of RNs by 7.2% (paper link - <https://www.tuck.dartmouth.edu/news/articles/does-profit-motive-make-nursing-homes-better-or-worse>). There is also concern with the recent healthcare market trend towards privatization, specifically nursing facilities being acquired by private equity firms.
- A 2025 report by the U.S. Department of Health and Human Services criticized private equity firms for their detrimental impact on healthcare, highlighting an 11% increase in patient deaths in nursing homes with private equity investment. This report also noted that private equity ownership often leads to decreased hospital assets and inadequate staffing, compromising patient care quality (report link - <https://www.hhs.gov/sites/default/files/hhs-consolidation-health-care-markets-rfi-response-report.pdf>).
- There is the additional issue of high provider turnover rates - “ownership changes have reduced the responsiveness of health care to local market needs” and “the changes have increased the likelihood of monopolistic or oligopolistic actions in market areas that are already at high risk for these actions.” The combination of high operating margins achieved through cost-cutting, the push for further privatization, and high provider turnover raises many concerns about the sustainability of nursing home facilities.

7. Conclusions

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