How have COVID-19 and the Policy Objective of Access to Care Altered the Cost-Volume-Profit Relationships of U.S. Hospitals?

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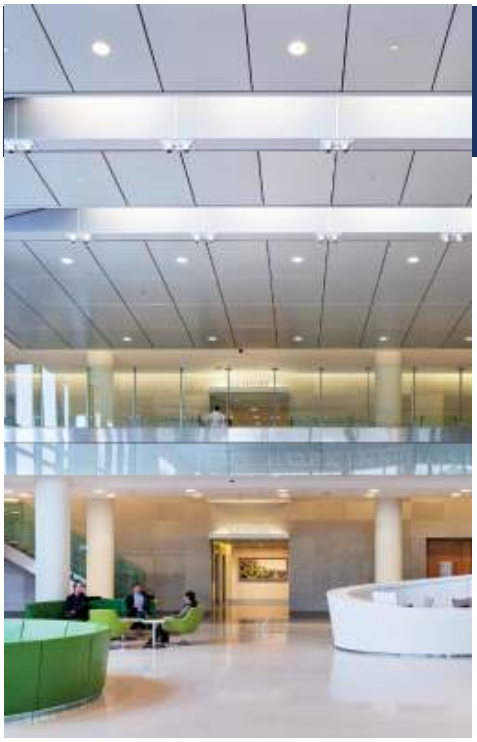
35th Annual Conference PCSI
Patient Classification Systems International
Reykjavík, Iceland
27–30. September 2022



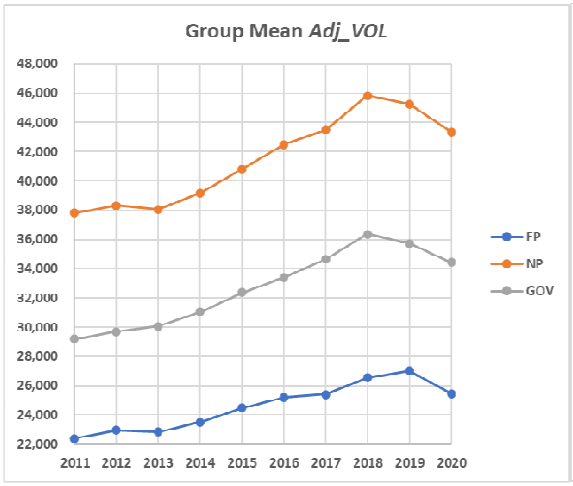
PURPOSE

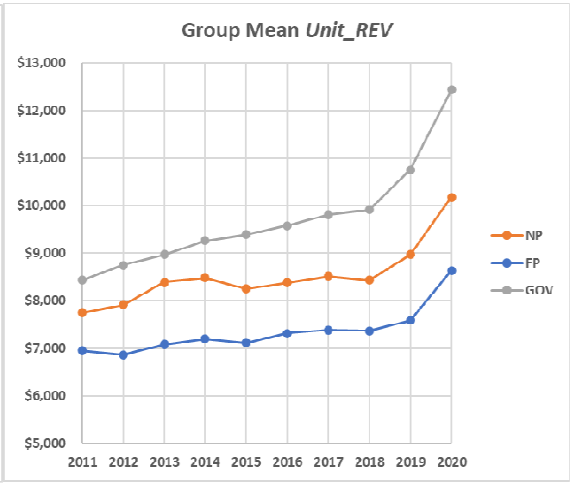
- Examine how
  - COVID-19 and the
  - Policy objective of Access to Care
  - Affected Cost-Volume-Profit (CVP) relationships in
    - U.S. Hospitals
  - How effects vary with economic incentives in
    - Types of control
      - For-profit (FP)
      - Non-profit (NP)
      - Governmental (GOV)

WHY?

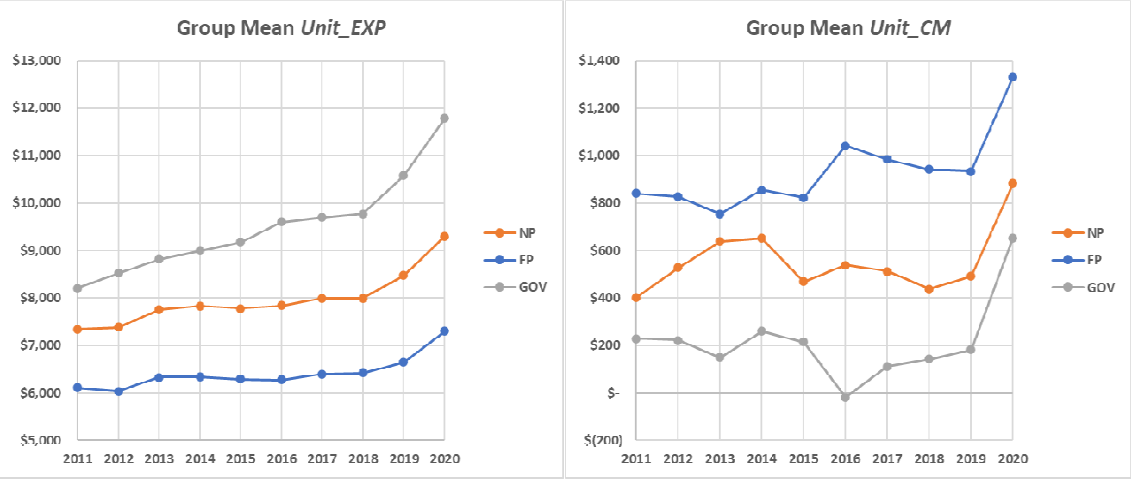
- 1st Documented case of COVID-19 in U.S.
  - January 2020 (*AJMC* 2021)
    - Many occurred earlier
- Federal & State governments implemented controversial policies
  - Economic lockdowns
  - Financial subsidies to
    - Hospitals
    - Individuals
- Patients with COVID-19 began to crowd-out other hospital services
  - Essential care
  - Profitable elective procedures
- Thus, hospitals had significantly affected "CVP"
  - *Costs*
  - Patient *Volumes*
  - *Profitability*

WHY?





WHY?



PATIENT VOLUME

- Volume is composed of
  - Patient discharges, adjusted by
  - Case Mix Index
  - Quality of Care
  - Ongoing shift to Outpatient setting

(Eldenburg & Kallapur 1997; Eldenburg *et al.* 2017)

CONTRIBUTIONS

- First study to directly adjust patient volumes by Quality of Care using
  - Medicare Readmission Rates and examine
  - Hospital responses to the effects of
    - COVID-19 Pandemic and
    - Government policy / subsidy initiatives
- Fills a gap in the literature by directly addressing
  - Per Unit
    - Revenues
    - Costs
    - Contribution Margins

CONTRIBUTIONS (cont'd)

- Examines patient Volume adjusted for
  - Case Mix
  - Quality of care
  - Relative Outpatient-Inpatient service provision
    - On national scale, as influenced by
    - Public subsidies and conditioned on
    - Comprehensive set of Control Variables
- Develops research expectations from the perspective of
  - Agency Theory
  - Resource Dependency Theory and demonstrates
    - Significance of constructs in this salient context

CONTRIBUTIONS (cont'd)

- Thus, our study provides Information Useful for the
  - Development and Tests of Economic Theory
  - Evidence-based Public Health Policy making with regard to
    - Services and Payment System effects
  - Advancement of Hospital Management Practice relative to
    - Unexpected Shocks in the health service delivery system

HYPOTHESES

Using NP hospitals as our reference group:

H_{01}: The onset of COVID-19 has no effect on hospital CVP relationships.

H_2: The economic incentives inherent in the FP type of control will be negatively associated with effects of COVID-19 on hospital revenues, costs and volumes.

H_3: The economic incentives inherent in the GOV type of control will be positively associated with effects of COVID-19 on hospital revenues, costs and volumes.

VOLUME METRIC

***QUALITY* = (1 – *Medicare Readmission Rate*)**

***CMI* = Medicare Case Mix Index indicating a hospital's relative mix of complex and resource intensive patients, compared to the national average**

OP-IP_Adj* = Adjustment factor for the relative proportion of Outpatient to Inpatient service provision by a hospital: *(Outpatient Charges + Inpatient Charges) / Inpatient Charges

***Adj_VOL* = Adjusted patient service volume:**
Total Inpatient Discharges* × *QUALITY* × *CMI* × *OP-IP_Adj

MODELS

Revenues:

$$UNIT\_REV = \beta_0 + \beta_1 ROA + \beta_2 LEV + \beta_3 SIZE + \beta_4 COVID + \beta_5 FP + \beta_6 FP*COVID + \beta_7 GOV + \beta_8 DISTR + \beta_9 SPCLTY + \beta_{10} URBAN + \beta_{11} CHAIN + \beta_{12} TEACH + \beta_{13} State\ Fixed\ Effects + e \quad (1)$$

$$UNIT\_REV = \beta_0 + \beta_1 ROA + \beta_2 LEV + \beta_3 SIZE + \beta_4 COVID + \beta_5 FP + \beta_6 GOV + \beta_7 GOV*COVID + \beta_8 DISTR + \beta_9 SPCLTY + \beta_{10} URBAN + \beta_{11} CHAIN + \beta_{12} TEACH + \beta_{13} State\ Fixed\ Effects + e \quad (2)$$

H_{01}: The onset of COVID-19 has no effect on hospital CVP relationships.

MODELS (cont'd)

Costs:

$$UNIT\_EXP = \beta_0 + \beta_1 ROA + \beta_2 LEV + \beta_3 SIZE + \beta_4 COVID + \beta_5 FP + \beta_6 FP*COVID + \beta_7 GOV + \beta_8 DISTR + \beta_9 SPCLTY + \beta_{10} URBAN + \beta_{11} CHAIN + \beta_{12} TEACH + \beta_{13} State\ Fixed\ Effects + e \quad (3)$$

$$UNIT\_EXP = \beta_0 + \beta_1 ROA + \beta_2 LEV + \beta_3 SIZE + \beta_4 COVID + \beta_5 FP + \beta_6 GOV + \beta_7 GOV*COVID + \beta_8 DISTR + \beta_9 SPCLTY + \beta_{10} URBAN + \beta_{11} CHAIN + \beta_{12} TEACH + \beta_{13} State\ Fixed\ Effects + e \quad (4)$$

H_2: (FP, negative association)
H_3: (GOV, positive association)

MODELS (cont'd)

Volume:

$$LnAdj\_VOL = \beta_0 + \beta_1 ROA + \beta_2 LEV + \beta_3 SIZE + \beta_4 COVID + \beta_5 FP + \beta_6 FP*COVID + \beta_7 GOV + \beta_8 DISTR + \beta_9 SPCLTY + \beta_{10} URBAN + \beta_{11} CHAIN + \beta_{12} TEACH + \beta_{13} State\ Fixed\ Effects + e \quad (5)$$

$$LnAdj\_VOL = \beta_0 + \beta_1 ROA + \beta_2 LEV + \beta_3 SIZE + \beta_4 COVID + \beta_5 FP + \beta_6 GOV + \beta_7 GOV*COVID + \beta_8 DISTR + \beta_9 SPCLTY + \beta_{10} URBAN + \beta_{11} CHAIN + \beta_{12} TEACH + \beta_{13} State\ Fixed\ Effects + e \quad (6)$$

H_2: (FP, negative association)
H_3: (GOV, positive association)

RESULTS

TABLE 1
Sample Derivation

Beginning Sample Data (hospital years 2011-2020)	**61,935**
Less: Hospital years with missing or out of range data values	(27,729)
Less: Long Term Care hospital years	(5,100)
Less: Hospitals with less than 10 years of data	(7,106)
Less: Hospitals that changed control type	(1,500)
Final Sample (2,050 unique hospitals with 10 years of data)	**20,500**

Note: Data is from U.S. Centers for Medicare & Medicaid Services, *Hospital Cost Report Form CMS 2552-10*.

RESULTS (cont'd)

TABLE 4: *UNIT_REV*

		Model 1		Model 2	
Variable	***Expect.***	***Coeff.***	***p > |t|***	***Coeff.***	***p > |t|***
ROA	+	782.746***	0.000	779.641***	0.000
LEV	–	–30.859	0.574	–29.084	0.596
SIZE	–	21.587	0.752	23.223	0.734
COVID	±	**1,996.332*** **	**0.000**	**1,693.952*** **	**0.000**
FP	–	–311.499***	0.000	–384.622***	0.000
FP*COVID	–	**–720.254*** **	**0.003**		
GOV	+	1,468.515***	0.000	1,348.787***	0.000
GOV*COVID	+			**1,238.330*** **	**0.004**
DISTR	+	1,059.867***	0.000	1,061.643***	0.000
SPCLTY	–	–194.664	0.270	–190.909	0.279
URBAN	–	–69.544	0.310	–70.593	0.303
CHAIN	–	–371.506***	0.000	–363.460***	0.000
TEACH	+	1,366.252***	0.000	1,361.923***	0.000
State Fixed Effects		Yes		Yes	
R^2		25.8%		25.8%	
n		20,500		20,500	

RESULTS (cont'd)

TABLE 5: *UNIT_EXP*

		Model 3		Model 4	
Variable	***Expect.***	***Coeff.***	***p > |t|***	***Coeff.***	***p > |t|***
ROA	–	–744.082***	0.000	–747.007***	0.000
LEV	+	408.891***	0.000	410.835***	0.000
SIZE	–	13.034	0.810	14.6314	0.787
COVID	±	**1,630.646*** **	**0.000**	**1,339.095*** **	**0.000**
FP	–	–490.743***	0.000	–564.767***	0.000
FP*COVID	–	**–729.448*** **	**0.001**		
GOV	+	1,697.684***	0.000	1,587.387***	0.000
GOV*COVID	+			**1,143.079*** **	**0.005**
DISTR	+	725.900***	0.000	727.639***	0.000
SPCLTY	–	–370.489**	0.021	–366.909**	0.023
URBAN	–	–106.024*	0.094	–107.019*	0.091
CHAIN	–	–416.290***	0.000	–408.425***	0.000
TEACH	+	1,285.323***	0.000	1,280.981***	0.000
State Fixed Effects		Yes		Yes	
R^2		31.3%		31.4%	
n		20,500		20,500	

RESULTS (cont'd)

TABLE 6: *LnAdj_VOL*

		Model 5		Model 6	
Variable	***Expect.***	***Coeff.***	***p > |t|***	***Coeff.***	***p > |t|***
ROA	+	3,470.589***	0.000	3,467.023***	0.000
LEV	–	–884.528***	0.002	–876.392***	0.002
SIZE	+	34,865.220***	0.000	34,868.370***	0.000
COVID	±	**2,451.918*** **	**0.000**	**1,955.084*** **	**0.000**
FP	–	–9,152.417***	0.000	–9,351.303***	0.000
FP*COVID	–	**–1,966.195***	**0.061**		
GOV	+	130.254	0.801	48.558	0.927
GOV*COVID	+			**896.029**	**0.565**
DISTR	+	22,898.780***	0.000	22,902.310***	0.000
SPCLTY	–	23,294.700***	0.000	23,299.960***	0.000
URBAN	–	–4,065.773***	0.000	–4,067.146***	0.000
CHAIN	–	–1,934.606***	0.000	–1,918.998***	0.000
TEACH	+	5,318.893***	0.000	5,308.022***	0.000
State Fixed Effects		Yes		Yes	
R^2		69.5%		69.5%	
n		20,500		20,500	

ROBUSTNESS TESTS

- Generalized Least Squares (GLM) model specifications
  - Our results hold
- Pairwise *t*-tests of differences in respective group mean values
  - Separate sample into
    - NP *vs.* FP
    - NP *vs.* GOV
    - FP *vs.* GOV
  - We find significant differences ($p \leq 0.05$) between all groups for all tested variables

LIMITATIONS

- We examine only Short-Term Acute Care and Specialty Hospitals
  - In the U.S.
  - With complete data for the 10-year period
- We do not examine
  - Critical Access Hospitals
  - Long Term Care Hospitals
  - Hospitals in other countries
- Adjustment for Quality of care limited by Medicare's readmission rate measurement program
  - Scope of procedures
  - Hospital types included

CONCLUSIONS

- We examine how
  - COVID-19 and the
  - Policy objective of Access to Care
- Affected the CVP relationships of U.S. hospitals
- We use the most recent 10-years of primary source data of
  - 2,050 short-term hospitals throughout the U.S.
- We find the economic incentives inherent in the different forms of FP, NP and GOV control are
  - Significantly associated with hospital responses to the pandemic crowding-out effects

CONCLUSIONS (cont'd)

- In the COVID period, revenues, expenses and volumes generally increased
  - However, unit revenues, unit expenses, and adj. volume are
    - Lower for FPs than ref. groups NP, GOV, DISTR
    - Higher for GOV than ref. groups FP, NP, DISTR
- Our findings are consistent with theory and thus
- Provide information useful for the
  - Development & tests of Economic Theory
  - Evidence-based Public Health Policy making
    - With regard to Services, Payment Systems and Subsidies
  - Advancement of Hospital Management Practice
    - With respect to the incentives and constraints inherent in the different types of organizational Control
    - Unexpected Shocks in the health service delivery system

FUTURE DIRECTIONS

- Examine the effects of COVID-19 on
  - Critical Access Hospitals
  - Long Term Care Hospitals
  - Hospitals in other countries
- As improved measures of Quality of Care become available
  - Adjustment for quality can be made with
    - Broader scope & applicability of the metrics

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