

Labor and Product Market Power, Endogenous Quality, and the Consolidation of the US Hospital Industry

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Motivation

Background:

- Recent literature on rising market concentration in US **product** and **labor** markets prompts concerns about increasing market power.
(Autor, Dorn, Katz, Patterson, and van Reenen, 2020; de Loecker, Eeckhout, and Unger, 2020)
- Mergers are a natural avenue for market consolidation, and antitrust authorities use economic models to predict harmful mergers.
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(Hemphill and Rose 2018; Naidu, Posner, and Weyl 2018; Marinescu and Hovenkamp 2019)
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Our perspective:

- **Product market competitors** often **compete for workers** as well.
(Nearly all industries? Retail, restaurants, construction, health care, etc.)
- Yet existing structural analyses of market consolidation focus on *either* **labor** *or* **product** market competition in isolation.

⇒ This paper: Unified framework, applied to US hospital consolidation.

This Paper (1/3): Theory

Framework: Horizontal Mergers for Oligopoly & Oligopsony

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Model Predictions for Mergers:

- Direct effects on prices and quantities:
 - **Price**↑, **Number of consumers**↓
 - **Wage**↓, **Number of workers**↓
 - **Amplification**: these effects reinforce one another.

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- **Quality**: Greater **labor** market power \implies greater quality MC.
 - Depending on congestion, theory permits quality ↑ or ↓.

This Paper (2/3): Empirics

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Confirm and quantify model predictions: Diff-in-diffs for high-concentration within-market hospital mergers finds:

- Direct effects:
 - Patients: Price $\uparrow 7\%$, Quantity $\downarrow 4\%$.
 - Patient care occupations: Wage $\downarrow 2\%$, Employment $\downarrow 9\%$.
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 - **Number of workers** $\uparrow 6\%$ despite **wage** $\downarrow 3\%$
 - Market-wide number of **patients** and **workers** $\downarrow 3\%$

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 - Market-wide number of **patients** and **workers** $\downarrow 3\%$
- Quality of care:
 - Staffing ratio** $\downarrow 6\%$
 - Patient satisfaction** $\downarrow 1\text{pp}$
 - Mortality** $\uparrow 0.5\text{-}0.8\text{pp}$ (among heart failure, pneumonia patients)

This Paper (3/3): Quantitative Model

Empirical Model: Extends the theoretical framework to also account for hospital-insurer bargaining effects on prices, tailored to empirical context.

Identification: Develop the conditions under which mergers can be used as instruments to identify product demand and labor supply parameters.

Estimation: Method of Simulated Moments matches model-simulated merger effects to the estimated effects, augmented with model-inversion.

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Model Implication: Wages are marked down by 18-27%, while prices are marked up 32-40%. Product market less competitive than labor market.

Merger Counterfactuals: Simulating merger effects (like in antitrust),

- Ignoring labor market competition, we would understate impacts on consumers by $\approx 20\%$ for quantity and $\approx 50\%$ for quality.
- Ignoring product market competition, we would understate impacts on workers along both employment and wage dimensions by $\approx 80\%$.
- Why is most of worker harm explained by product market power? Patients are less elastic than workers; larger diversion term in FOC.

Key Insight: Labor and production fundamentally linked. Incentives to exploit labor or product market power harm both consumers and workers.

⇒ If firms compete both for consumers and workers, we must account for any large diversion effects on either side.

Related Literature and Contributions

1. Labor Market Power:

- Monopsonistic models: no role for concentration.
 - (Card, Cardoso, Heining & Kline '18; Lamadon, Mogstad & Setzler '22)
- Oligopsonistic models: wage markdowns depend on market share.
 - (Berger, Herkenhoff & Mongey '22; Azar, Berry & Marinescu '22)
- Contribution: Oligopoly + oligopsony + multi-establishment firms.

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- Structural models for ex ante merger evaluation.
 - (E.g. Nevo '00; Bjornerstedt & Verboven '16; Miller & Weinberg '17)
- Models of endogenous product quality. (Fan '13; Wollmann '24)
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3. Diff-in-diffs for US Hospital Mergers:

- Increase price (Dafny '09; Cooper et al '19; Brand et al '23), decrease wage (Prager & Schmitt '21), decrease satisfaction (Beaulieu et al '20).
- Contributions: Quantity effects (fewer patients, fewer workers), spillover and aggregate effects (patients, workers), and mortality.

Model: Mergers under Oligopoly & Oligopsony

Model (1/3): Product Demand

Notation: h is producer, i is consumer, t is market-year, Q is output.

Consumer preferences: Consumer i 's utility from consuming h is

$$u_{iht}^Q = -\beta_P P_{ht} + \beta_Y Y_{ht} + \xi_{ht}^Q + \varepsilon_{iht}^Q$$

- P_{ht} is the price \implies chosen by producer
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- ξ_{ht}^Q is other pre-determined quality or amenity (unobserved to us)
 \implies vertical differentiation
- ε_{iht}^Q is idiosyncratic match-specific taste (unobserved to producer, us)
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Product demand curve: The market share of producer h is,

$$s_{ht}^Q \equiv \frac{Q_{ht}}{\bar{Q}_t} = \frac{\exp\left(\beta_Y Y_{ht} - \beta_P P_{ht} + \xi_{ht}^Q\right)}{1 + \sum_{h'} \exp\left(\beta_Y Y_{h't} - \beta_P P_{h't} + \xi_{h't}^Q\right)}$$

Model (2/3): Labor Supply

Notation: h is hospital, j is **worker**, t is market.

- L : labor for production.
- N : labor for support services and administration.

Worker Preferences: Worker j 's indirect utility from working at h is

$$u_{jht}^E = \gamma_E \log(W_{ht}^E) + \xi_{ht}^E + \varepsilon_{jht}^E, \quad E = L, N$$

- W_{ht}^L, W_{ht}^N are the **wages** \implies chosen by producer

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Labor supply curve: The employment shares of producer h are,

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where \bar{E}_t denotes the total number of workers of type E in market t .

Model (3/3): Production Function and Firm's Problem

Production Technology: To produce output Q_{ht} , the amount of production labor required is determined by the production function:

$$Q_{ht} \leq T_{ht}(L_{ht})$$

Quality Technology: The producer combines patient and non-patient care labor to provide quality of care to patients as follows:

$$Y_{ht} \leq \frac{F(L_{ht}, N_{ht})}{Q_{ht}}$$

where the right-hand side is the effective staffing ratio.

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Multi-product Firm's Problem: Firm H owning the set of producers \mathcal{H}_H solves the following problem

$$\max_{\{Q_{ht}, Y_{ht}, L_{ht}, N_{ht}\}_{h \in \mathcal{H}_H}} \sum_{h \in \mathcal{H}_H} (P_{ht} Q_{ht} - W_{ht}^L L_{ht} - W_{ht}^N N_{ht})$$

subject to the production technology, the quality technology, product demand, and labor supply for each occupational category.

Model-predicted Effects of a Merger (1/6)

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- **product demand** elasticity: $\theta_{ht}^Q \equiv \frac{P_{ht}}{Q_{ht}} \frac{\partial Q_{ht}}{\partial P_{ht}}$
- **labor supply** elasticity for type E : $\theta_{ht}^E \equiv \frac{\partial E_{ht}}{\partial W_{ht}^E} \frac{W_{ht}^E}{E_{ht}}$, $E = L, N$
- marginal product of labor: $MP_{ht}^L = \frac{\partial T_{ht}(\cdot)}{\partial L_{ht}}$

Before merger: The labor FOC at (single-producer) firm h is,

$$\underbrace{\left(1 + 1/\theta_{ht}^L\right) \times W_{ht}^L}_{\equiv MC_{ht}^L} = \underbrace{\left(1 + 1/\theta_{ht}^Q\right) \times P_{ht} MP_{ht}^L}_{\equiv MR_{ht}^L}$$

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After merger: If producer h merges with producer g , the h FOC is:

$$MC_{ht}^L + \underbrace{\frac{\partial W_{gt}^L}{\partial L_{ht}} L_{gt}}_{\text{labor diversion (+)}} = MR_{ht}^L + \underbrace{\frac{\partial P_{gt}}{\partial Q_{ht}} Q_{gt} MP_{ht}^L}_{\text{product diversion (-)}}$$

Firm H internalizes costs imposed on g when making choices at h :

- **Labor diversion:** as h increases **wage**, it poaches **workers** from g .
- **Product diversion:** as h lowers **price**, it poaches **consumers** from g .

Model-predicted Effects of a Merger (2/6)

Three approaches to merger evaluation:

Product Market Diversion Only: Ignoring competition for workers,

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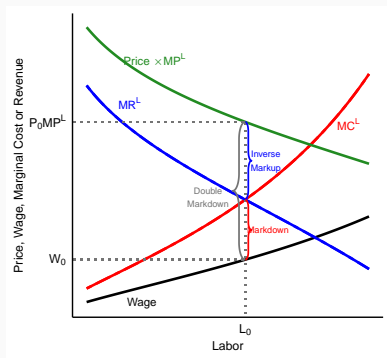
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Model-predicted Effects of a Merger (3/6)

Before the merger, the firm faces:

- Increasing MC^L due to upward-sloping **labor** supply.
- Decreasing MR^L due to downward-sloping **product** demand.

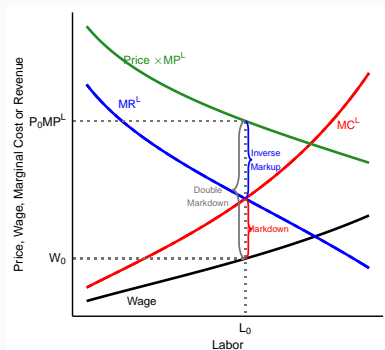


Merging Party: Before Merger

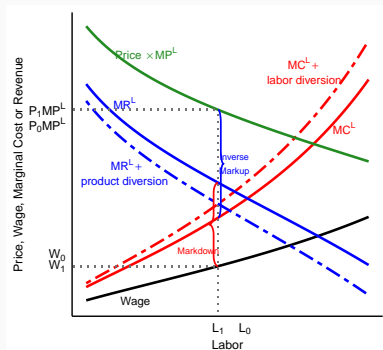
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Merging Party: After Merger

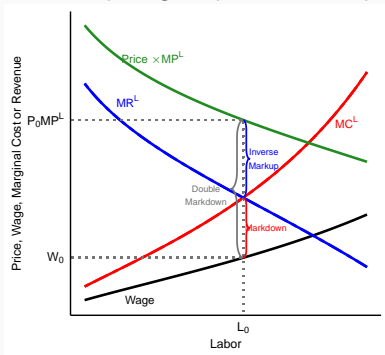
After the merger, the firm internalizes diversion:

- Because of **labor** diversion, perceived MC^L is higher.
- Because of **product** diversion, perceived MR^L is lower.

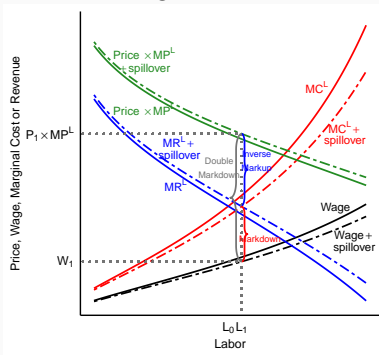
Model-predicted Effects of a Merger (4/6)

Spillovers on Competitors:

- **Labor:** Since workers lose jobs at the merging firms, they will accept worse wages at competitors, increasing local labor supply.
- **Product:** Since patients lose care at the merging firms, they will accept higher prices at competitors, increasing local demand.



Competitor: Before Merger



Competitor: After Merger

Result: Diversion of jobs and consumers to local competitors.
(Price and wage effects are theoretically ambiguous for competitors.)

Model-predicted Effects of a Merger (5/6)

Now, we consider optimal **quality** (Y). We focus on the FOC for support **labor** (N), which most directly relates to quality Y .

Before merger: The FOC for N_{ht} at (single-product) firm h is,

$$\underbrace{\frac{\partial P_{ht}}{\partial Y_{ht}} \frac{\partial Y_{ht}}{\partial N_{ht}} Q_{ht}}_{MR_{ht}^N = \frac{\beta_Y}{\beta_P}} = \underbrace{W_{ht}^N \times (1 + 1/\theta_{ht}^N)}_{MC_{ht}^N}$$

As consumers value **quality** more relative to **price** (β_Y/β_P), more support **workers** are hired

\implies compensating differential in product space: can charge higher price when offering better quality, holding output fixed.

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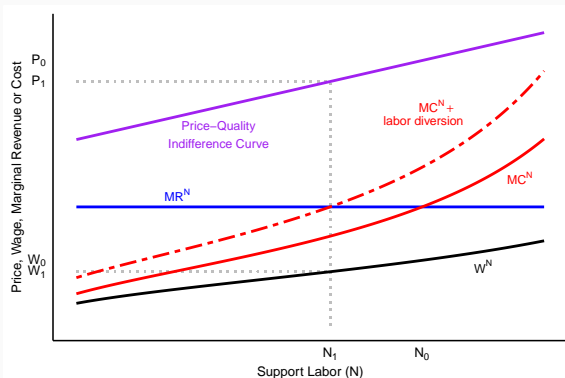
$$MR_{ht}^N = MC_{ht}^N + \underbrace{\frac{\partial W_{gt}^N}{\partial N_{ht}} N_{gt}}_{\text{labor diversion (+)}}$$

- As h increases **wage** to hire more support **workers** so that it can increase **quality** and thus raise **prices**, it poaches workers from g .

Model-predicted Effects of a Merger (6/6)

The firm internalizes that hiring more support workers (N) at one producer poaches N from its other local producer.

⇒ Effective MC of providing quality increases, for any given Q .

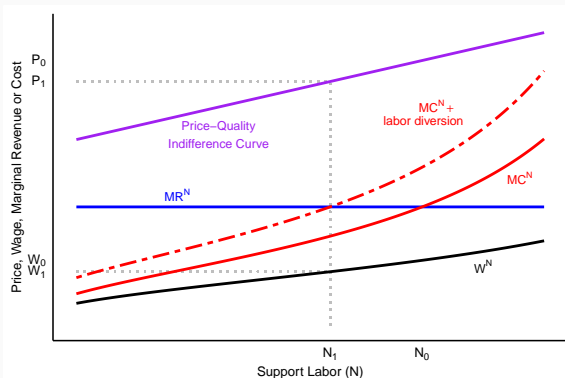


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- Increased MC of support workers causes a downward movement along the price-quality indifference curve, given Q .
- Not the full story: Q also decreases due to the reduction in L . The model allows for an increase in **quality** if $F_{ht}^L < Y_{ht} MP_{ht}^L$.

Data and Descriptive Patterns: The US Hospital Industry

Data Sources (1/4) : Wage, Labor, Price, Quantity

CMS Hospital Cost Reports (HCRIS):

- Government-mandated reports from all Medicare-certified hospitals.
- 1996-2022 hospital-level panel for near-universe of US hospitals.
- Following literature, we drop specialty and critical-access hospitals.
- Sample size: 3,400 unique hospitals, 81,000 annual observations.

Data Sources (1/4) : Wage, Labor, Price, Quantity

CMS Hospital Cost Reports (HCRIS):

- Government-mandated reports from all Medicare-certified hospitals.
- 1996-2022 hospital-level panel for near-universe of US hospitals.
- Following literature, we drop specialty and critical-access hospitals.
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- **Labor:** We observe total hours and convert to full-time equivalence.
 - Patient care: Nurses, nursing aides, hospital's physicians.
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Product Market Variables:

- **Patients:** Total inpatient discharges ('inpatient' means overnight).
- **Prices:** Revenue-per-patient among non-Medicare inpatients.
 - This follows Dafny '09 and Dafny, Ho & Lee '19.
 - Then, we standardize prices as if all hospitals had the same payer and case mix, following Brot et al. '24.

Data Sources (2/4): Quality of Care

Labor-based quality measures:

- **Staffing ratio:** workers per patient (Hackmann '19 nursing homes)
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Medical outcome-based quality measures:

- HQI 2008-2021 panel covering universe of hospitals.
- Risk-adjusted 30-day all-cause mortality rates among those originally treated at the hospital for **heart failure** or for **pneumonia**.
- Estimated using Medicare claims and eligibility information, adjusting for patient observables at arrival that increase mortality.

Data Sources (3/4): Ownership Changes

Ownership panel: We use the database from Cooper et al. ('19).

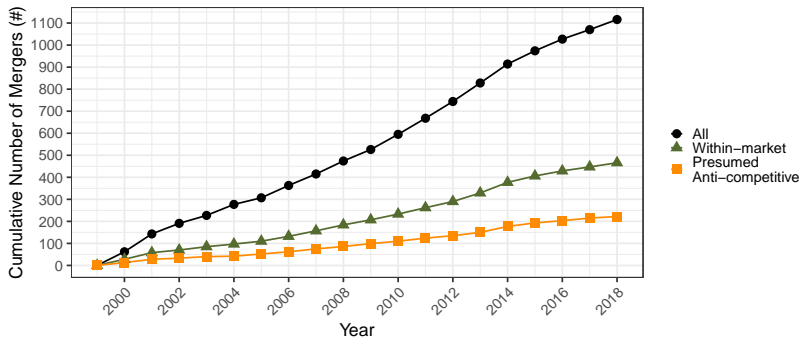
- They created and extensively validated a publicly available database on the universe of hospital mergers over 2001-2014.
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Cumulative number of mergers over time:



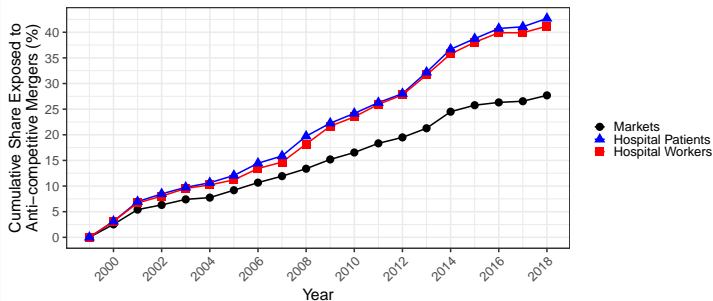
Data Sources (4/4): Market Concentration

Market Definition: 561 commuting zones.

- Follows Prager & Schmitt '21 (hospital workers) and Finkelstein Gentzkow Williams '21 (patient care).
- Robustness check: We find very similar effects when defining a hospital market as a 30-mile radius (similar to Brot et al. '24).

HHI: Denoting market share by s_j , $HHI = \sum_j s_j^2 \times 10,000$.

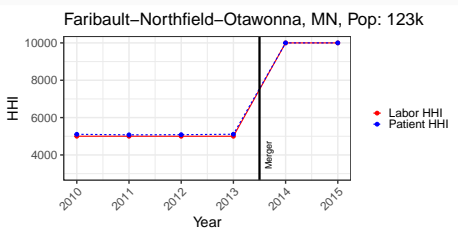
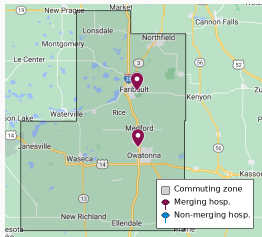
- Presumed Anti-competitive: $HHI > 1800$, $\Delta HHI > 100$ (DOJ-FTC).



- [Click](#) for quantiles of various concentration measures.

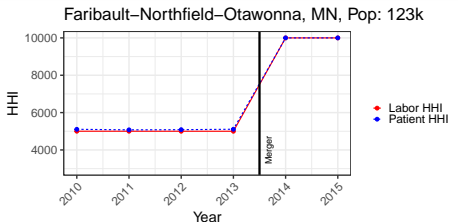
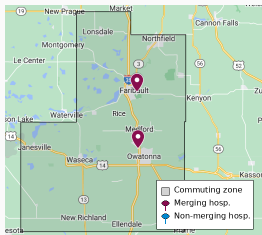
DiD Design

Treatment Group: Presumed Anti-competitive Mergers

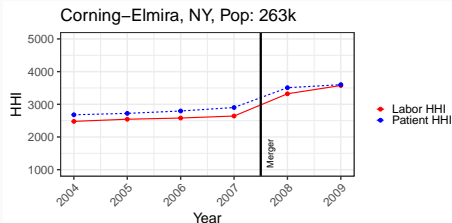
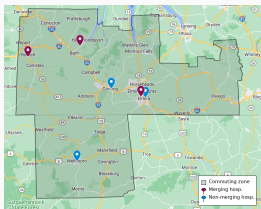


Example 1: Merger between District One & Allina Health in Minnesota

Treatment Group: Presumed Anti-competitive Mergers



Example 1: Merger between District One & Allina Health in Minnesota



Example 2: Merger between Arnot Ogden, St. James Mercy, & Ira Davenport in New York

Treatment Group: Time-consistent Merging Firm

Challenge: In about 20% of cases, hospitals jointly report outcomes to CMS after merging \implies hospital-specific event study is infeasible.

Example: 2008 Largo-Sun Coast hospital merger near Tampa, Florida.

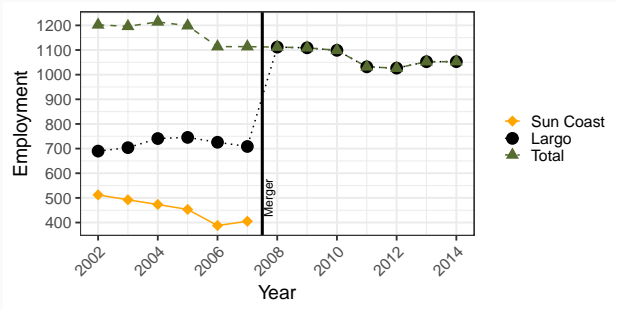
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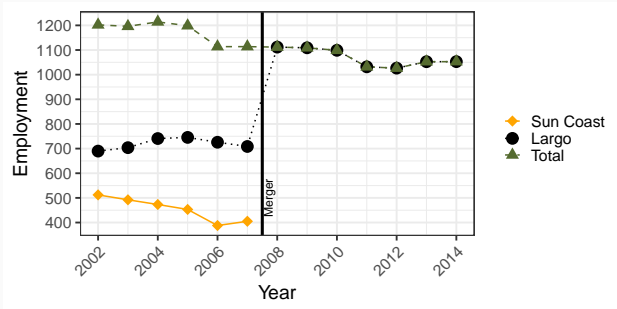
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Solution: Use total employment across merging hospitals, pre and post.

Treatment group: Time-consistent merging firms.

- Presumed anti-competitive mergers ($HHI > 1800$, $\Delta HHI > 100$).
- Define outcome consistently in pre-period and post-period as the sum (or weighted average) among hospitals that will consolidate.
- In cases with multiple mergers, we focus on the first.
- Sample: 147 first-time mergers and nearly 400 treated hospitals.

Control group: Similar to Brot et al. '24, we match each merging firm to 10 control hospitals from CZs without mergers. We match on propensity estimated from a large set of pre-merger covariates.

Details

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Regression specification: staggered DiD (Callaway & Sant'Anna '21).

We compare time-consistent merger h with its matched control mergers:

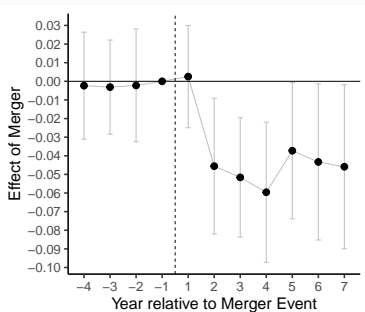
$$\text{DiD}_{h,t,e} \equiv (Y_{h,t+e} - Y_{h,t-1}) - \underbrace{\mathbb{E}[Y_{h',t+e} - Y_{h',t-1} \mid h' \in C_h]}_{\substack{\text{change from } t-1 \text{ to } t+e, \\ \text{control mergers matched to } h}}.$$

We then average across cohorts:

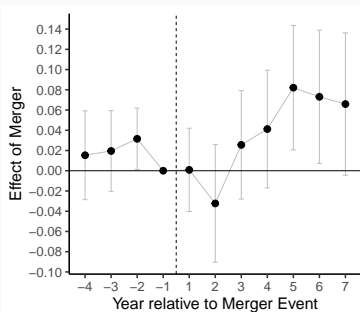
$$\text{DiD}_e \equiv \sum_t \omega_{t,e} \times \frac{1}{|\mathcal{G}_t|} \sum_{h \in \mathcal{G}_t} \text{DiD}_{h,t,e}, \quad \omega_{t,e} \equiv \frac{|\mathcal{G}_t|}{\sum_t |\mathcal{G}_t|},$$

DiD for Direct Effects on Patients and Workers

DiD Results: Quantities and Prices



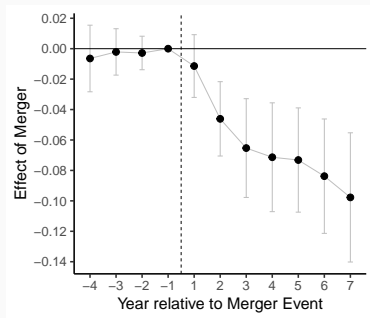
Patients (log)



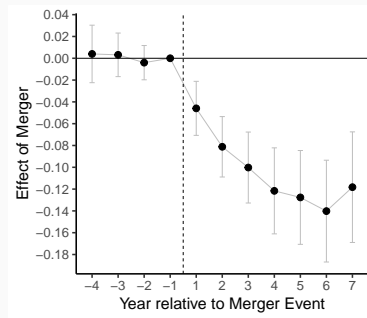
Price Index (log)

- Quantity of **patients** decrease around 4% after merger.
 - Composition-adjusted **price** increases around 7% after merger.
- ⇒ Incredibly inelastic patients.

DiD Results: Employment by Occupation



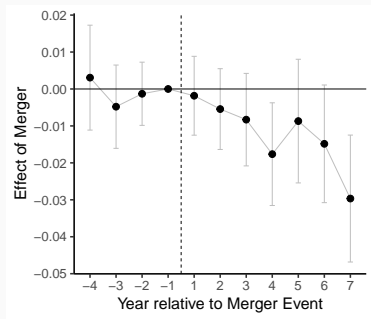
Patient Care: Employment (log)



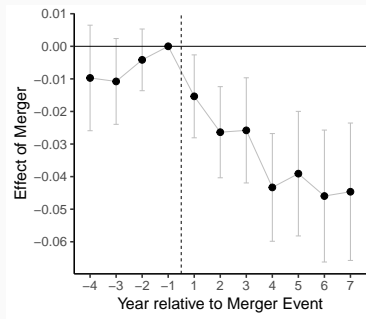
Non-patient Care: Employment (log)

- **Patient care:** 9% employment loss.
- **Non-patient care:** 12% employment loss.

DiD Results: Wages by Occupation



Patient Care: Wage (log)



Non-patient Care: Wage (log)

- **Patient care:** 2% hourly wage loss.
- **Non-patient care:** 4% hourly wage loss.

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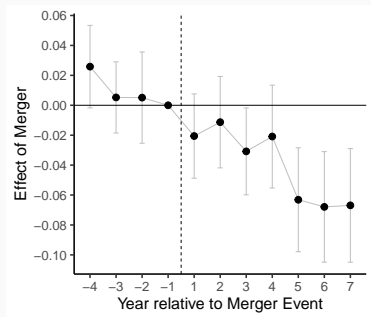
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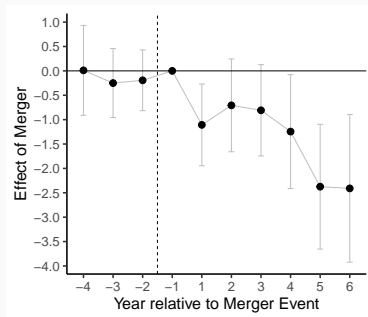
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 - However, the bargaining model doesn't predict our large patient reductions and cross-hospital diversion effects (Ho & Lee '19)
 - Solution: Combine them. In the empirical model, I add a reduced-form representation of insurer bargaining price effects.

DiD for Quality of Care Effects

DiD Results: Staffing Ratio and Satisfaction



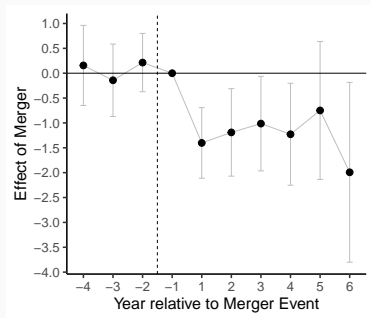
Staffing Ratio (log)



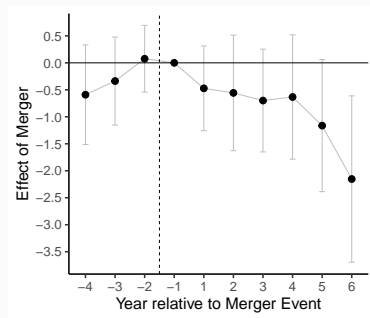
Recommend Hospital (pp)

- **Staffing ratio** decrease around 6% after merger.
- **Recommend Hospital %** from survey decreases 1-2pp after merger.
- **Highly Satisfied %** from survey also decreases 1-2pp after merger.

DiD Results: Satisfaction Survey Items



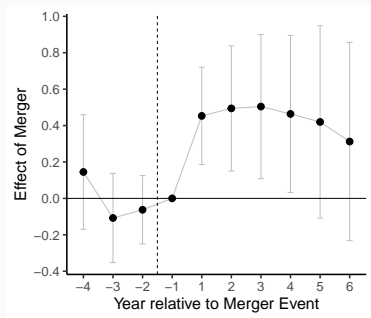
Cleanliness Rating (pp)



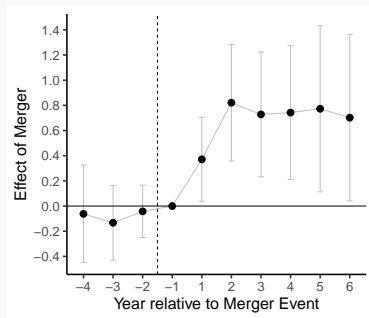
Quietness Rating (pp)

- Cleanliness rating decreases >1pp after merger.
- Quietness rating decreases >1pp after merger.

DiD Results: 30-Day Mortality Rates



Heart Failure 30-Day Mortality (pp)



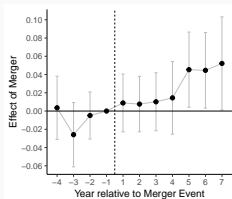
Pneumonia 30-Day Mortality (pp)

Risk-adjusted probability of death within 30-days:

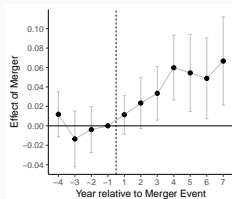
- Heart failure mortality rate increases around 0.5pp (base: 12%).
- Pneumonia mortality rate increases around 0.8pp (base: 13%).

DiD for Spillover and Aggregate Market Effects

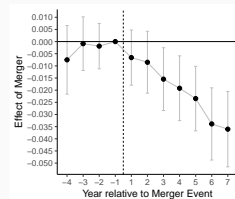
DiD Results: Within-Market Spillover Effects



Within-Market Spillover on Patients (log)



Within-Market Spillover on Employment (log)

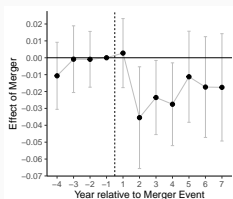


Within-Market Spillover on Hourly Wage (log)

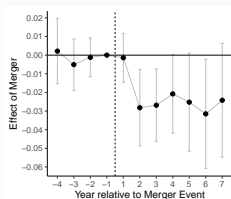
- **Local Competitor Prices** unchanged.
- **Local Competitor Patients** increase up to 5%.
- **Local Competitor Employment** increases 6%.
- **Local Competitor Hourly Wage** decreases around 3%.

Patient care vs Non-patient care

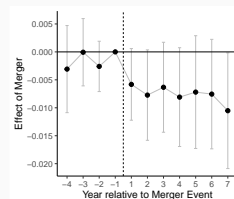
DiD Results: Aggregate Market Effects



Market-wide Patients (log)



Market-wide Employment (log)



Market-wide Hourly Wage (log)

- **Market-wide Price** unchanged.
- **Market-wide Patients** decreases up to 4%, recovers to 1%.
- **Market-wide Employment** decreases 3%.
- **Market-wide Hourly Wage** decreases around 1%.

Patient care vs Non-patient care

Model Quantification and Counterfactuals

Model Quantification (1/4): Parameters to Estimate

Recall: The theory was non-parametric with respect to the two technologies. We need to parameterize for the counterfactual exercises.

Treatment Technology: $T_{ht}(L_{ht}) = A_{ht}L_{ht}^{\alpha}$.

- A_{ht} is the relative productivity of h .
- α is the elasticity of patients to employment.

Quality Technology: $F(L_{ht}, N_{ht}) = (\delta (L_{ht})^{\rho} + (1 - \delta) (N_{ht})^{\rho})^{\phi/\rho}$.

- patient and non-patient care labor may be gross complements ($\rho < 0$) or gross substitutes ($\rho > 0$).
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Global parameters to estimate:

- **Product demand:** β_P, β_Y
- **Labor supply:** γ_L, γ_N
- **Treatment tech:** α
- **Quality tech:** δ, ρ, ϕ

Model Quantification (2/4): Mergers as Instruments

Consider the recovery of the labor supply parameter, γ_L .

- From the inverse labor supply curve for labor L , we have,

$$\mathbb{E}[\Delta \log W_h^L] = \frac{1}{\gamma_L} (\mathbb{E}[\Delta \log s_h^L] - \mathbb{E}[\Delta \log s_0^L] + \mathbb{E}[\Delta \xi_h^L]) .$$

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- Using that $\Delta \log s_h^L = \Delta \log L_h$ and $\Delta \log s_0^L \approx -\Delta \log \sum L_j$,

$$\gamma_L \approx \frac{\overbrace{\mathbb{E}[\Delta \log L_h]}^{\text{direct DiD for } L} + \overbrace{\mathbb{E}[\Delta \log(\sum L_j)]}^{\text{aggregate DiD for } L}}{\underbrace{\mathbb{E}[\Delta \log W_h^L]}_{\text{direct DiD for } W^L}} + \frac{\overbrace{\mathbb{E}[\Delta \xi_h^L]}^{\text{amenity bias for } L}}{\mathbb{E}[\Delta \log W_h^L]} .$$

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- Thus, the merger-based DiD provides a valid moment to recover γ_L if it does not systematically shift amenities, i.e, $\mathbb{E}[\Delta \xi_h^L] = 0$.

Similar arguments hold for product demand and technology parameters:

- Mergers identify all parameters if they do not induce systematic changes in unobserved heterogeneity.

Model Quantification (3/4): Method of Simulated Moments

Inner solver:

1. Guess global parameters $\Xi^* \equiv (\{\beta_P^*, \beta_Y^*\}, \{\gamma_L^*, \gamma_N^*\}, \{\alpha^*, \delta^*, \rho^*, \phi^*\})$.
Calibrate outside shares $s_0^{L,*}, s_0^{N,*}, s_0^{Q,*}$.
2. Given global parameters, the labor supply, product demand, and technology equations can be inverted to recover the unobserved heterogeneity, $\Lambda_h^* \equiv (\xi_h^{L,*}, \xi_h^{N,*}, \xi_h^{Q,*}, A_h^*)$.
3. All model parameters are now specified, so the equilibrium can be solved numerically, with and without the merger, to recover the simulated merger effects on the various outcomes, $\mathbf{M}^{sim}(\Xi^*)$.

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Outer solver:

$$\Xi^{msm} = \arg \min_{\Xi^*} (\mathbf{M}^{obs} - \mathbf{M}^{sim}(\Xi^*))' \mathbf{W} (\mathbf{M}^{obs} - \mathbf{M}^{sim}(\Xi^*)).$$

where \mathbf{M}^{obs} is the set of DiD moments and \mathbf{W} is a weighting matrix.

The MSM estimate of Λ_h is the one that results from inverting the model evaluated at Ξ^{msm} .

Model Quantification (4/4): Insurer Bargaining Effects

Extension: markups on insurers

- Let P_{ht}^{hos} denote the price received by the hospital from the insurer. From the hospital's perspective, P_{ht}^{hos} is the relevant price.
- Let P_{ht}^{pat} denote the price paid by the patient. From the patient's perspective, P_{ht}^{pat} is the relevant price for determining demand Q_{ht} .
- Insurer markup κ_{ht} satisfies the accounting identity $P_{ht}^{\text{hos}} = \kappa_{ht} P_{ht}^{\text{pat}}$.
- Key property: Higher $\kappa_{ht} \implies$ higher P_{ht}^{hos} for given $(Q_{ht}, P_{ht}^{\text{pat}}) \implies$ reduced-form “gain in bargaining power over insurers”

Model Quantification (4/4): Insurer Bargaining Effects

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Empirical implementation

- The baseline value of κ_{ht} is obtained by inverting the FOC (similar to conjectural variation)
- Parameterization: $\Delta \log \kappa_{ht} = \bar{\kappa}_{\Delta}$ among merging firms. (proportional gain relative to baseline)
- $\bar{\kappa}_{\Delta}$ is chosen to best fit the simulated merger impacts in the MSM.

Model Estimates (1/4): Parameter Values

- **Product Demand:** MRS $\beta_Y/\beta_P = 2.9 \implies$ Patients would sacrifice 0.44 SDs in the price distribution to improve 1 SD quality.
- **Labor Supply:** Labor preference for the log-wage is
 - $\gamma_L = 5.6 \implies$ markdown at least 15% below MRPL
 - $\gamma_N = 4.5 \implies$ markdown at least 18% below MRPL(in line with 3-7 range from Lamadon et al '22, Kroft et al '25)

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- **Quality tech:**
 - $\delta = 0.38 \implies$ more intensive in N labor.
 - $\rho = -1.6 \implies \text{EoS} = 0.39 \implies L, N$ are gross complements.
 - $\phi = 1.2 \implies$ increasing returns to scale in labor for quality.

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$$\underbrace{\mathbb{E}[\Delta \log P_h^{\text{hos}}]}_{4.2\%} = \underbrace{\mathbb{E}[\Delta \log P_h^{\text{pat}}]}_{1.3\%} + \underbrace{\bar{\kappa}_\Delta}_{2.2\%} + \underbrace{\text{residual}}_{0.7\%}.$$

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- **Outside shares:** Workers: $s_0^L = s_0^N = 0.4$. Patients: $s_0^Q = 0.25$.

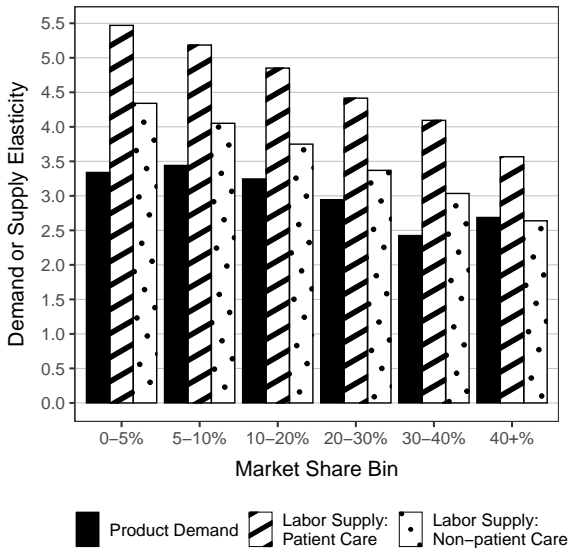
Model Estimates (2/4): Goodness of Fit

Moment	Target	Simulated
Product Market		
Direct: $\Delta \log P_h$	0.042	0.035
Direct: $\Delta \log Q_h$	-0.047	-0.058
Spillover: $\Delta \log \sum_{j \neq h} Q_j$	0.029	0.009
Aggregate: $\Delta \log \sum_j Q_j$	-0.022	-0.018
Quality of Care		
Direct: $\Delta \log(SR_h)$	-0.044	-0.053
Direct: $\Delta \log(Y_h)$	—	-0.079
Labor Market: Patient Care		
Direct: $\Delta \log W_h^L$	-0.014	-0.023
Direct: $\Delta \log L_h$	-0.073	-0.110
Spillover: $\Delta \log \sum_{j \neq h} L_j$	0.030	0.017
Aggregate: $\Delta \log \sum_j L_j$	-0.027	-0.030
Labor Market: Non-Patient Care		
Direct: $\Delta \log W_h^N$	-0.038	-0.028
Direct: $\Delta \log N_h$	-0.115	-0.113
Spillover: $\Delta \log \sum_{j \neq h} N_j$	0.066	0.018
Aggregate: $\Delta \log \sum_j N_j$	-0.039	-0.020

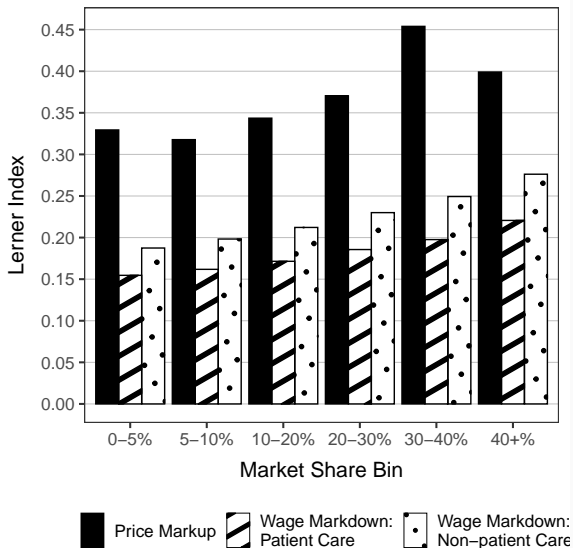
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Model Estimates (3/4): Demand and Labor Supply Elasticities



Model Estimates (4/4): Lerner Markups and Markdowns



Counterfactual Exercises (1/2)

Question of interest: How would the model-predicted effects of mergers be different if we ignored the role of labor or product market power?

- Exercise 1: Simulate merger effects on **consumers**, with/without accounting for **labor** market diversion effects.
i.e., the hospitals merge and coordinate in the **patient** market, but compete as before in the labor market.

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i.e., the hospitals merge and coordinate in the **patient** market, but compete as before in the labor market.
- Exercise 2: Simulate merger effects on **workers**, with/without accounting for **patient** market diversion effects.
i.e., the hospitals merge and coordinate in the **labor** market, but compete as before in the product market.

Counterfactual Exercises (2/2)

Panel A. Patient Outcomes			Panel B. Labor Outcomes		
	Baseline	No Labor Div		Baseline	No Product Div
Quantity (log)	-0.071 (100.0%)	-0.057 (80.8%)	Employment (log)	-0.134 (100.0%)	-0.028 (21.2%)
Price (log)	0.011 (100.0%)	0.014 (122.7%)	Wage (log)	-0.028 (100.0%)	-0.006 (21.1%)
Markup (Lerner)	0.054 (100.0%)	0.048 (88.8%)	Markdown (Lerner)	0.095 (100.0%)	0.013 (13.8%)
Quality of Care (log)	-0.118 (100.0%)	-0.065 (55.4%)			
Outside share (log)	0.031 (100.0%)	0.028 (87.8%)	Outside share (log)	0.024 (100.0%)	0.005 (20.8%)

- Shutting down labor diversion, we predict 20% weaker quantity effects and 45% weaker quality effects for patients.
- Shutting down product diversion, we predict employment and wage effects that are 80% weaker.

Summary

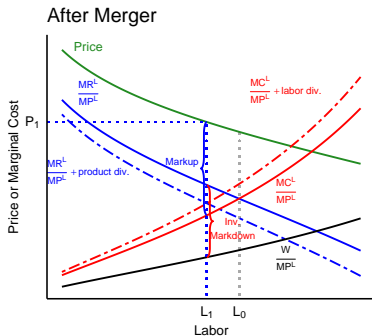
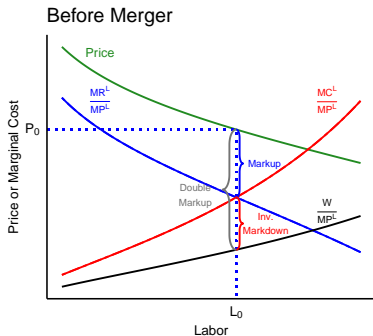
Summary

- **Context:** **product** market competitors often compete for **workers** as well, yet merger evaluation treats it as one or the other.
- **Model:** To understand how firms exploit simultaneous oligopoly and oligopsony, I develop a novel merger evaluation framework featuring:
 - **oligopoly** in the product market;
 - **oligopsony** in the labor market;
 - endogenous **quality** whose cost is affected by market power.
- **Empirical Findings:** Local hospital mergers cause:
 - **patients** to pay higher prices, receive lower quality of care, and fewer patients receive treatment;
 - **workers** receive lower wages, lose jobs, and also receive lower wages at other local hospitals.
- **Quantitative Model:** Using estimated model to analyze:
 - **patient** markets are less competitive than **labor** markets and have much greater diversion effects;
 - ex ante merger evaluation understates harm to **patients** (**workers**) if it ignores **labor** (**product**) market power.
- Thank you – comments welcome.

Appendix

Merger Effects

$$MC_{ht}^L + \underbrace{\frac{\partial W_{gt}^L}{\partial L_{ht}} L_{gt}}_{\text{labor diversion (+)}} = MR_{ht}^L + \underbrace{\frac{\partial P_{gt}}{\partial Q_{ht}} Q_{gt} MP_{ht}^L}_{\text{product diversion (-)}}$$

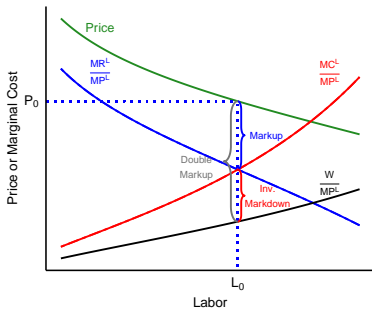


- Because of labor diversion, effective MC^L is higher.
- Because of product diversion, effective MR^L is lower.

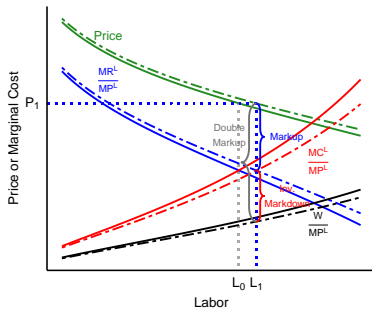
Result: Reduce employment and wages, as well as patients and prices.

Merger Effects

Before Competitors' Merger



After Competitors' Merger



Proposition: Direct Effects of a Merger

Proposition (Direct effects on the merging hospitals)

Suppose quality is pre-determined and hospitals compete a la Bertrand or a la Cournot. If hospitals h and g in market m merge at time t to form a two-hospital system H , the optimal choices of system H satisfy:

- (a) The **price** and **markup** increase for hospital h .*
- (b) The number of **patients** treated decreases for system H .*
- (c) The **wage** decreases and the **markdown** strengthens for hospital h .*
- (d) The number of **workers** employed decreases for system H .*
- (e) When g has greater **product** market share, effects (a-d) are greater.*
- (f) When g has greater **labor** market share, effects (a-d) are greater.*

Merger Effects

Quality of care: In addition to medical care labor, hospitals now employ support services labor N to provide quality of care.

Before merger: The labor FOC at (single-establishment) hospital h is,

$$\underbrace{(1 + (\theta_{ht}^L)^{-1}) \times W_{ht}^L}_{\equiv MC_{ht}^L} = \underbrace{\left(1 + (\theta_{ht}^Q)^{-1}\right) \times P_{ht} \text{MPL}_{ht} + \frac{\partial P_{ht}}{\partial Y_{ht}} \frac{\partial Y_{ht}}{\partial L_{ht}} Q_{ht}}_{\equiv MP_{ht}^L}$$

After merger: If hospital h merges with hospital g , the FOC becomes:

$$MC_{ht}^L + \underbrace{\frac{\partial W_{gt}^L}{\partial L_{ht}} L_{gt}}_{\text{labor diversion}} = MP_{ht}^L + \underbrace{\frac{\partial P_{gt}}{\partial Q_{ht}} Q_{gt} \text{MPL}_{ht}}_{\text{product diversion}}$$

System H internalizes costs imposed on g when making choices at h :

- Labor diversion: as h increases wage, it poaches workers from g .
- Product diversion: as h lowers price, it poaches customers from g .

Approximation of $\mathbb{E}[CV^E]$

Following McFadden (1999), we approximate $\mathbb{E}[CV^E]$ using the following procedure:

- Draw a sequence of vectors ε^i for $i = 1, \dots, I$ whose empirical distribution as $I \rightarrow \infty$ approximates a TIEV distribution.
- For each ε^i , find

$$U_i^{*,pre} \equiv \max_h \left\{ \gamma_E \log(W_{ht}^{E,pre}) + \xi_h^E + \varepsilon_{hi}^E \right\}$$

- For each ε^i , $U_i^{*,pre}$, find the number C_i such that

$$U_i^{*,pre} = \max_h \left\{ \gamma_E \log(W_{ht}^{E,post} + C_i) + \xi_h^E + \varepsilon_{hi}^E \right\}$$

- Finally,

$$\mathbb{E}[CV^E] \approx \frac{1}{I} \sum_{i=1}^I C_i$$

Price Definition

Following Dafny ('09), the average non-Medicare inpatient revenue per discharge for hospital h is

$$Rev_h \equiv \frac{(IPSC_h + IPIC_h + IPANC_h) \left(1 - \frac{CONTDISC_h}{GROSSREV_h}\right) - MCPRIM_h - MCAP_h}{(DISCH_h - MDISCH_h)}$$

$IPSC_h$: hospital's inpatient routine service charges

$IPIC_h$: intensive care charges

$CONTDISC_h$: contractual discounts

$GROSSREV_h$: gross revenues

$MCPRIM_h$: Medicare primary payer amounts

$MCAP_h$: Medicare total amount payable

$DISCH_h$: total inpatient discharges

$MDISCH_h$: Medicare inpatient discharges

Price Definition

To control for possible changes in patient characteristics, we first estimate the following equation:

$$Rev_{ht} = \beta_1 CMI_{ht} + \beta_2 \% Medicare_{ht} + \beta_3 \% Medicaid_{ht} + \gamma_t + \varepsilon_{ht}$$

where h denotes a hospital and t denotes a year. CMI_{ht} is the Med. case mix index, and $\% Medicare_{ht}$ and $\% Medicaid_{ht}$ denote the perc. of Medicare and Medicaid patients.

We define our price index for hospital h in year t as

$$P_{ht} \equiv \hat{\beta}_1 \overline{CMI}_t + \hat{\beta}_2 \overline{\% Medicare}_t + \hat{\beta}_3 \overline{\% Medicaid}_t + \hat{\gamma}_{ht} + \hat{\varepsilon}_{ht}$$

where \overline{CMI}_t , $\overline{\% Medicare}_t$, and $\overline{\% Medicaid}_t$ are the averages of each variable across all hospitals in year t .

Special Cases

68 hospitals that stop reporting during 4 years following a merger.

- We drop 8 mergers where one facility becomes a
 - Outpatient facility
 - Critical Access Hospital
 - Long-term care facility
 - Urgent care center

Since we cannot track wages & employment for these facilities.

- We drop 4 mergers where we could not verify why a hospital stopped reporting.
- Of the remaining 56 hospitals
 - 51 report under another facility's number.
 - In 5 cases, merging hospitals consolidate into single facility.

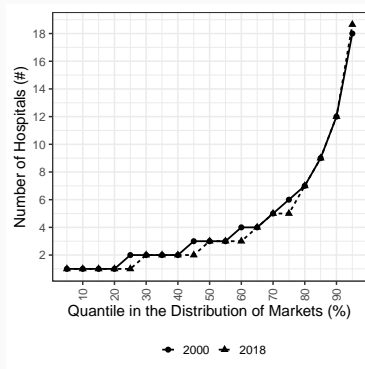
Time-consistent Merging Firm and Matching

- The potential controls for a merger are all hospitals that:
 - Are in a different market.
 - Are not involved in a merger between $t - 4$ and $t + 7$.
- Let x_j denote hospital j 's pre-merger covariates. Note that it must be constructed for treated units using a sum or weighted average across the hospitals involved in the merger.
- We include the following in x_j :
 - Product market: % Medicare patients, % Medicaid patients, case mix index, number of beds, number of inpatient discharges, price index.
 - Labor market: wage for patient care workers, wage for non-patient care workers, number of patient care workers, number of non-patient care workers.
 - CZ characteristics: unemployment rate, average income, % of local workforce employed in healthcare.
- Given this large vector x_j , we estimate propensity scores using a logistic regression of the form:

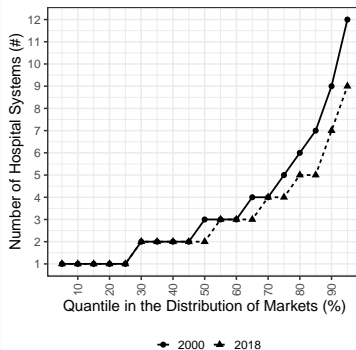
$$\mathbb{P}(\text{Merger}_j) = \beta x_j + \epsilon_j$$

- For each merger, we choose-with-replacement the 10 potential control units with the closest estimated propensity score to the treated unit.

Cross-sectional Market Concentration (1/2)



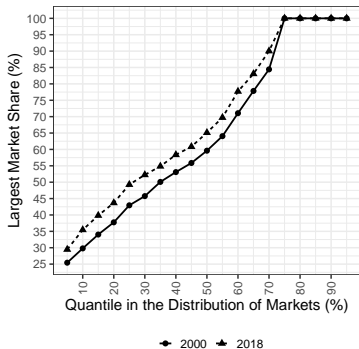
Number of Hospitals



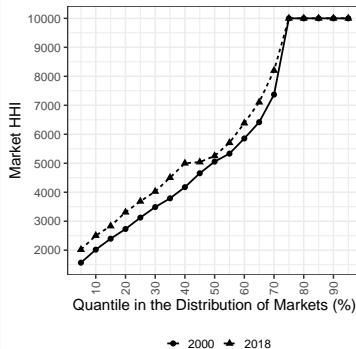
Number of Hospital Systems

- Median CZ: 3 hospitals.
- Median CZ: 2 hospital systems.

Cross-sectional Market Concentration (2/2)



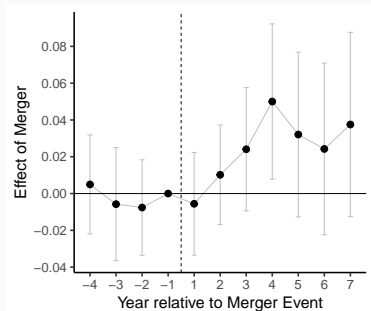
Max Market Share across Markets



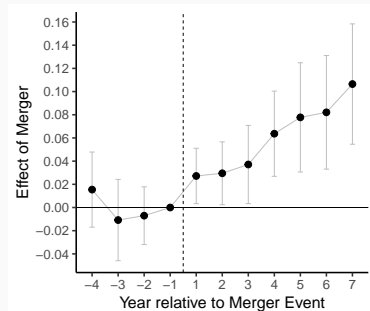
HHI across Markets

- Median CZ: Largest hospital system has 65% share of patients.
- Median CZ: HHI of 5,000.

DiD Results: Spillover Effects by Occupation



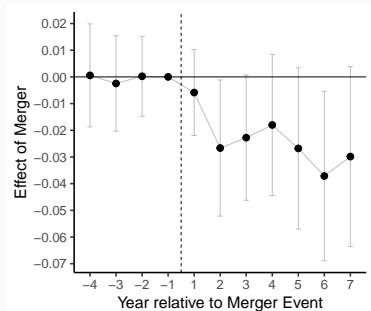
Patient Care: Spillovers on Employment (log)



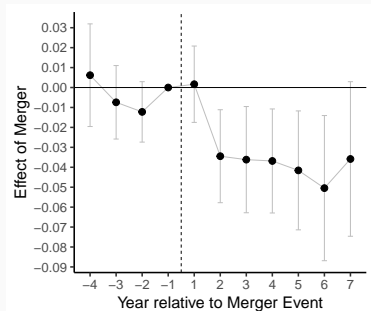
Non-patient Care: Spillovers on Employment (log)

- **Spillovers on Patient Care:** Employment increases around 4%.
- **Spillovers on Non-patient Care:** Employment increases $\approx 8\%$.

DiD Results: Aggregate Market Effects by Occupation



Patient Care: Market-wide
Employment (log)



Non-patient Care: Market-wide
Employment (log)

- **Market-wide Patient Care:** Employment decreases 3-4%.
- **Market-wide Non-patient Care:** Employment decreases 3-4%.