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.
  (Farrell and Shapiro 2010; Hovenkamp and Shapiro 2018)
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- A developing literature raises concerns about anti-competitive effects on workers of mergers among employers: wage↓ employment↓
  (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.

$\Longrightarrow$ This paper: Unified framework, applied to US hospital consolidation.

This Paper (1/3): Theory

Framework: Horizontal Mergers for Oligopoly & Oligopsony

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

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  - Spillovers: product demand↑ and labor supply↑
  - Market exit↑: Overall, options in the market worsen.
- 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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  - Patient care occupations: Wage ↓2%, Employment ↓9%.
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- Quality of care:

  Staffing ratio ↓6%

  Patient satisfaction ↓1-2pp

  Mortality ↑0.5-0.8pp (among heart failure, pneumonia patients)

This Paper (3/3): Quantitative Model

Empirical Model:

- **Context-specific extension:** Hospital-insurer bargaining over price.
- **Identification:** Develop conditions under which mergers can be used as IVs to identify product demand and labor supply parameters.
- **Estimation:** Method of Simulated Moments matches simulated merger effects to 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 ≈20% for quantity and ≈50% for quality.
- Ignoring product market competition, we would understate impacts on workers along both employment and wage dimensions by ≈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.

$\Longrightarrow$ Merger evaluation must account for *any* large diversion effects.

Related Literature and Contributions

1. **Labor Market Power:**
   - Monopsonistic models: no role for concentration.
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   - Oligopsonistic models: wage markdowns depend on market share.
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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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  $\implies$ vertical differentiation
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Product demand curve: The market share of producer h is,

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

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

$$u^E_{jht} = \gamma_E \log\left(W^E_{ht}\right) + \xi^E_{ht} + \varepsilon^E_{jht}, \quad E = L, N$$

- W^L_{ht}, W^N_{ht} are the wages $\implies$ chosen by producer

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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

$$\max_{\{Q_{ht}, Y_{ht}, L_{ht}, N_{ht}\}_{h \in \mathcal{H}_H}} \sum_{h \in \mathcal{H}_H} \left(P_{ht} Q_{ht} - W^L_{ht} L_{ht} - W^N_{ht} N_{ht} \right)$$

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

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- labor supply elasticity for type E: $\theta^E_{ht} \equiv \frac{\partial E_{ht}}{\partial W^E_{ht}} \frac{W^E_{ht}}{E_{ht}}$, $E = L, N$
- marginal product of labor: $\mathrm{MP}^L_{ht} = \frac{\partial T_{ht}(\cdot)}{\partial L_{ht}}$

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

$$\underbrace{\left(1 + 1/\theta^L_{ht}\right) \times W^L_{ht}}_{\equiv \mathrm{MC}^L_{ht}} = \underbrace{\left(1 + 1/\theta^Q_{ht}\right) \times P_{ht}\mathrm{MP}^L_{ht}}_{\equiv \mathrm{MR}^L_{ht}}$$

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

$$\text{MC}^L_{ht} + \underbrace{\frac{\partial W^L_{gt}}{\partial L_{ht}} L_{gt}}_{\text{labor diversion } (+)} = \text{MR}^L_{ht} + \underbrace{\frac{\partial P_{gt}}{\partial Q_{ht}} Q_{gt}\text{MP}^L_{ht}}_{\text{product diversion } (-)}$$

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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This paper: Accounting for simultaneous labor and product competition,

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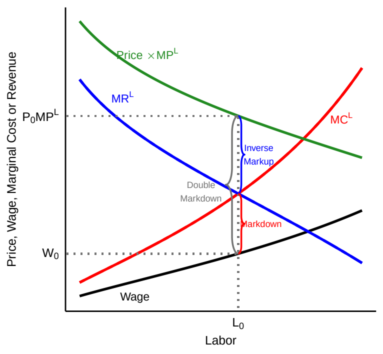
Model-predicted Effects of a Merger (3/6)

Before the merger, the firm faces:

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



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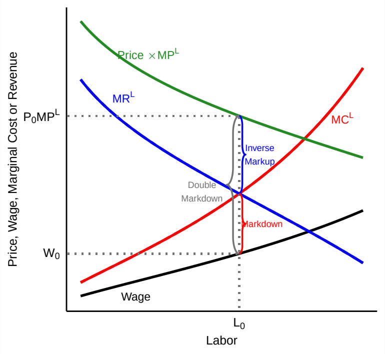

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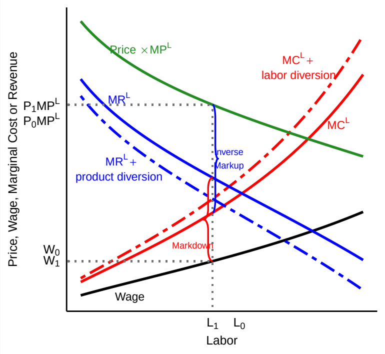


Merging Party: After Merger

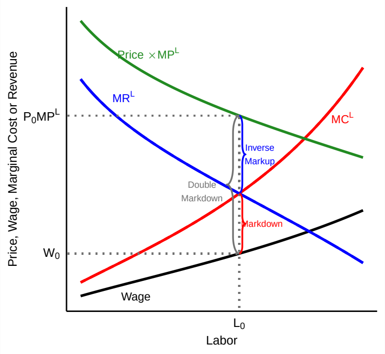
After the merger, the firm internalizes diversion:

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

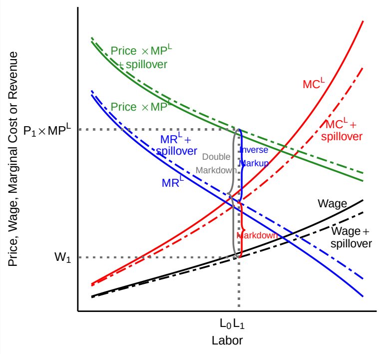
Model-predicted Effects of a Merger (4/6)

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,

$$\underbrace{\frac{\partial P_{ht}}{\partial Y_{ht}} \frac{\partial Y_{ht}}{\partial N_{ht}} Q_{ht}}_{\mathrm{MR}^N_{ht} = \frac{\beta_Y}{\beta_P}} = \underbrace{W^N_{ht} \times \left(1 + 1/\theta^N_{ht}\right)}_{\mathrm{MC}^N_{ht}}$$

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

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

$$\text{MR}^N_{ht} = \text{MC}^N_{ht} + \underbrace{\frac{\partial W^N_{gt}}{\partial N_{ht}}N_{gt}}_{\text{labor diversion }(+)}$$

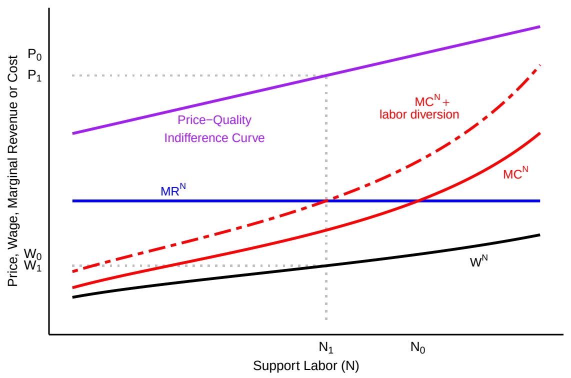
- As h increases wage to hire more support workers so that it can increase quality and thus raise prices, it poaches workers from g.

Quality of care FOC for L

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.

$\implies$ Effective MC of providing quality increases, for any given Q.



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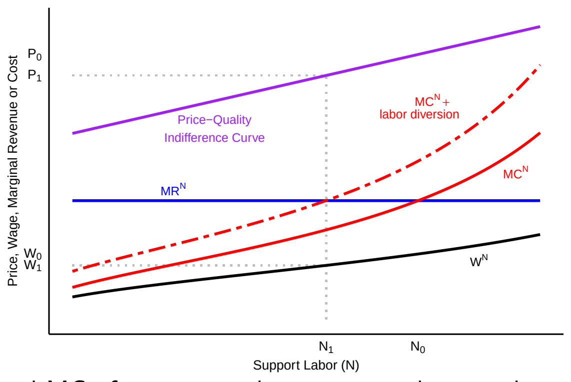

- Increased MC of support workers causes a downward movement along the price-quality indifference curve, given Q.
- Not the full story: Q also decreases due to the reduction in L. The model allows for an increase in quality if $F^L_{ht} < Y_{ht}\mathrm{MP}^L_{ht}$.

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

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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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- Includes **overall satisfaction rating** (Beaulieu, Dafny, et al. '20). We also decompose ratings into cleanliness, quietness, etc.

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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.
- We supplement it to include 1999-2018 by following their process and using AHA Survey, Levin Associates reports, and newspapers.
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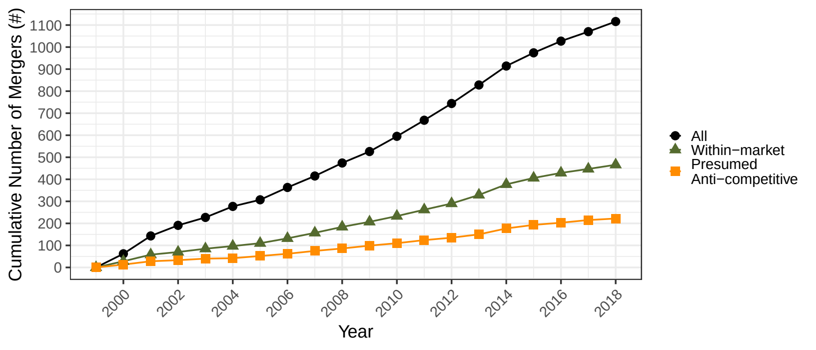
Cumulative number of mergers over time:



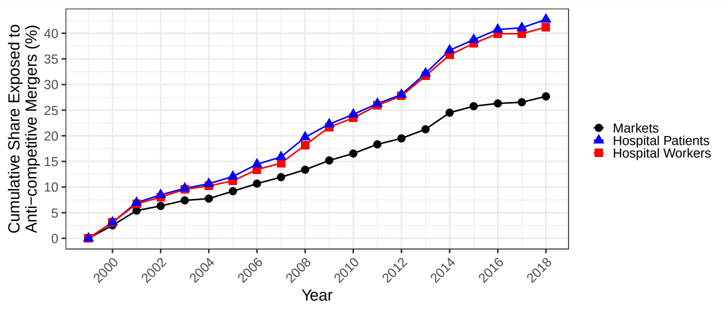
Data Sources (4/4): Market Concentration

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, $\text{HHI} = \sum_j s_j^2 \times 10,000$.

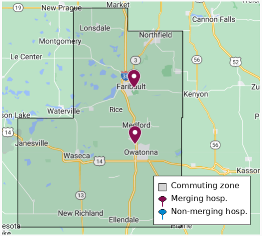
- Presumed Anti-competitive: $\text{HHI} > 1800, \Delta\text{HHI} > 100$ (DOJ-FTC).

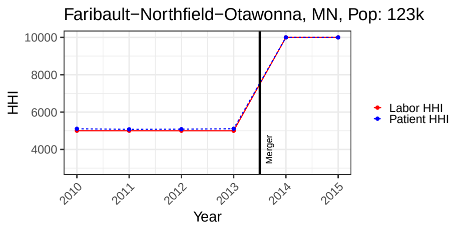


- Click for quantiles of various concentration measures.

DiD Design

Treatment Group: Presumed Anti-competitive Mergers





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

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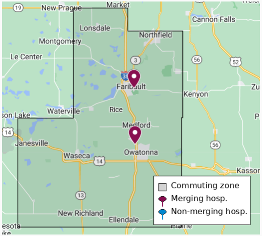

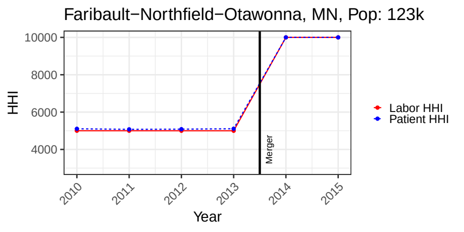

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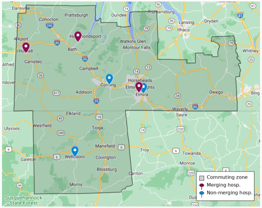

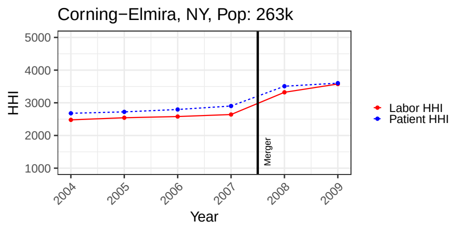

Example 2: Merger between Arnot Ogden, St. James Mercy, & Ira Davenport in New York

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.

- Before merger: Sun Coast and Largo separately report employment.
- After merger: Sun Coast stops reporting, Largo reports for both.

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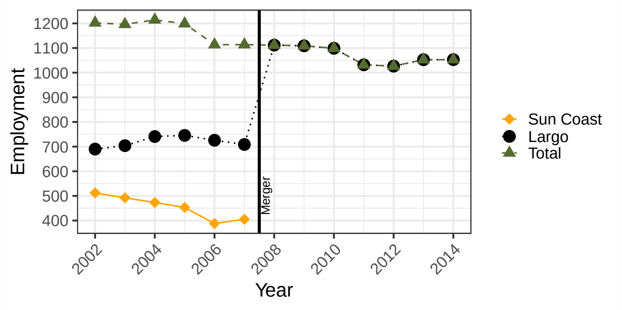

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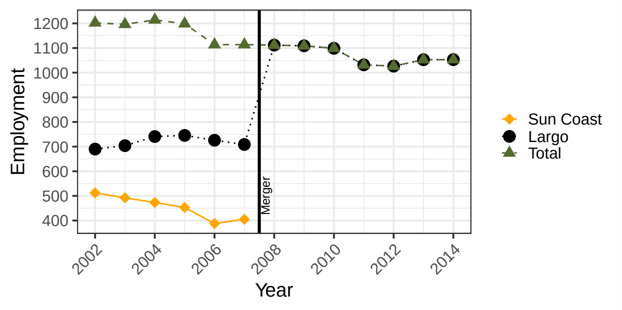

- **Bias:** We would mistakenly conclude that the merger *caused* an increase in employment at Largo, which did not happen in reality.

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

DiD Design

Treatment group: Time-consistent merging firms.

- Presumed anti-competitive mergers (HHI$>$1800, ΔHHI$>$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:

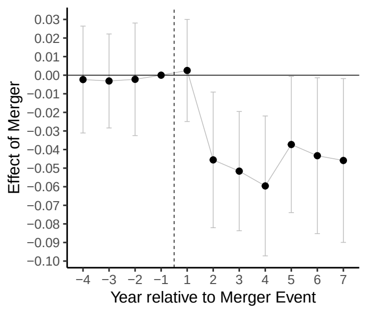
$$\mathrm{DiD}_{h,t,e} \equiv (Y_{h,t+e} - Y_{h,t-1}) - \underbrace{\mathbb{E}\left[Y_{h',t+e} - Y_{h',t-1} \mid h' \in C_h\right]}_{\substack{\text{change from } t-1 \text{ to } t+e, \\ \text{control mergers matched to } h}}.$$

We then average across cohorts:

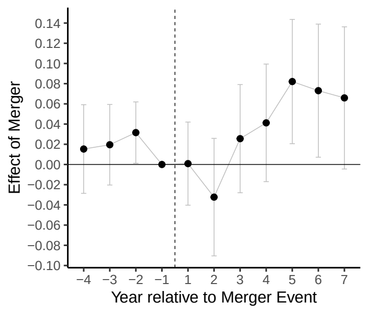
$$\mathrm{DiD}_e \equiv \sum_t \omega_{t,e} \times \frac{1}{|\mathcal{G}_t|} \sum_{h \in \mathcal{G}_t} \mathrm{DiD}_{h,t,e}, \quad \omega_{t,e} \equiv \frac{|\mathcal{G}_t|}{\sum_t |\mathcal{G}_t|},$$

DiD for Direct Effects on Patients and Workers

DiD Results: Quantities and Prices



Patients (log)

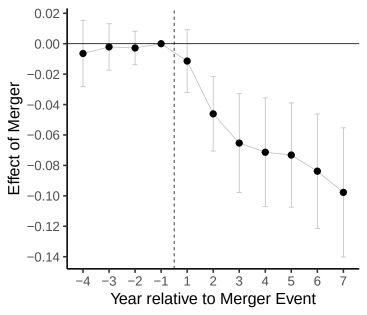


Price Index (log)

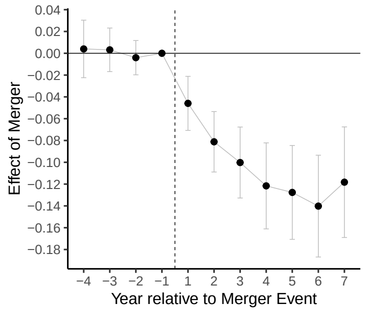
- Quantity of **patients** decrease around 4% after merger.
- Composition-adjusted **price** increases around 7% after merger.

$\implies$ Incredibly inelastic patients.

DiD Results: Employment by Occupation



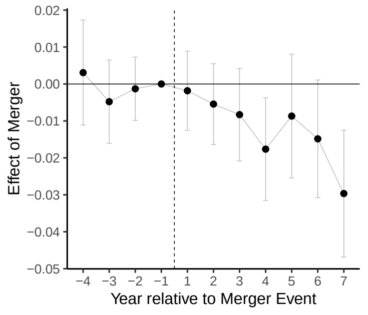
Patient Care: Employment (log)



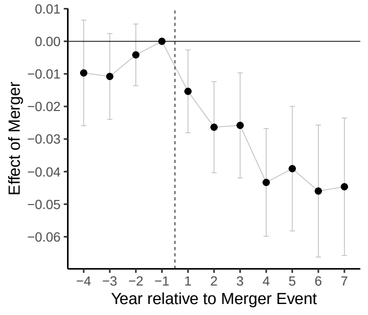
Non-patient Care: Employment (log)

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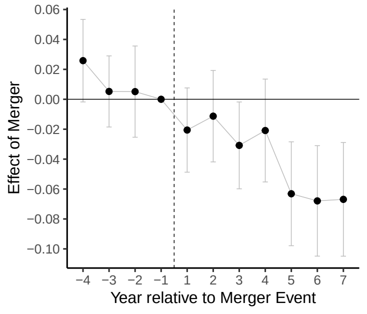
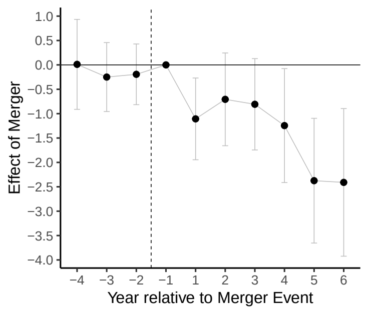
  - However, the bargaining model doesn't predict our large patient reductions and cross-hospital diversion effects (Ho & Lee '19)
  - Solution: Combine them. In the empirical model, I add a reduced-form representation of insurer bargaining price effects.

DiD for Quality of Care Effects

DiD Results: Staffing Ratio and Satisfaction



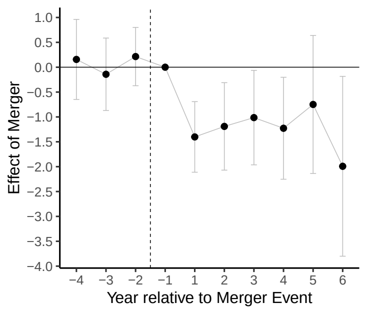
Staffing Ratio (log)



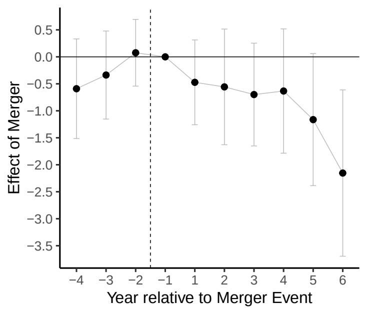
Recommend Hospital (pp)

- 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



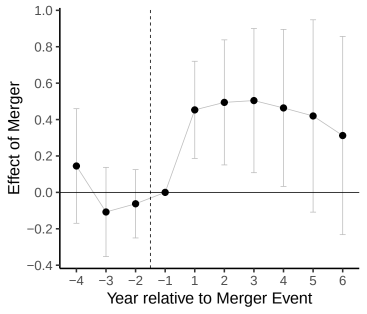
Cleanliness Rating (pp)



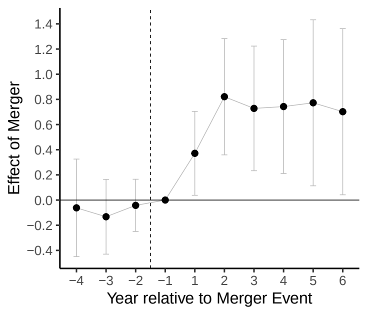
Quietness Rating (pp)

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

DiD Results: 30-Day Mortality Rates



Heart Failure 30-Day Mortality (pp)



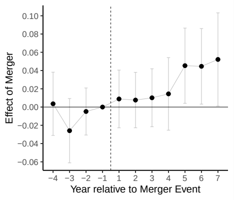
Pneumonia 30-Day Mortality (pp)

Risk-adjusted probability of death within 30-days:

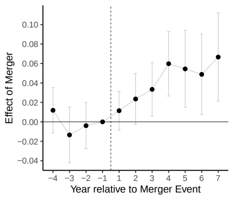
- Heart failure mortality rate increases around 0.5pp (base: 12%).
- Pneumonia mortality rate increases around 0.8pp (base: 13%).

DiD for Spillover and Aggregate Market Effects

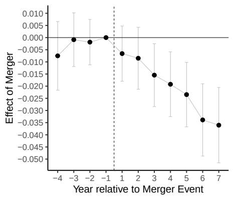
DiD Results: Within-Market Spillover Effects



Within-Market Spillover on Patients (log)



Within-Market Spillover on Employment (log)

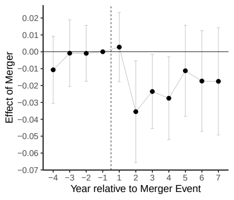


Within-Market Spillover on Hourly Wage (log)

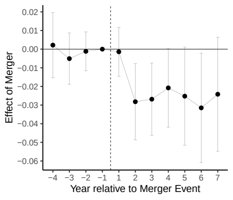
- **Local Competitor Prices** unchanged.
- **Local Competitor Patients** increase up to 5%.
- **Local Competitor Employment** increases 6%.
- **Local Competitor Hourly Wage** decreases around 3%.

Patient care vs Non-patient care

DiD Results: Aggregate Market Effects



Market-wide Patients (log)



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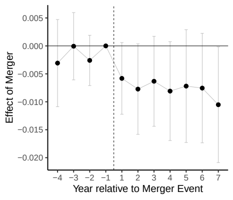

Market-wide Hourly Wage (log)

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

- patient and non-patient care labor may be gross complements ($\rho < 0$) or gross substitutes ($\rho > 0$).
- returns to scale in quality may be increasing ($\phi > 1$) or decreasing ($\phi < 1$).

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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,

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

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where Δ denotes the change induced by the merger.
- Using that $\Delta \log s_h^L = \Delta \log L_h$ and $\Delta \log s_0^L \approx -\Delta \log \sum L_j$,

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

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where Δ denotes the change induced by the merger.
- Using that $\Delta \log s_h^L = \Delta \log L_h$ and $\Delta \log s_0^L \approx -\Delta \log \sum L_j$,

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

- 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"

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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: $\Delta \log(\mathrm{SR}_h)$	-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
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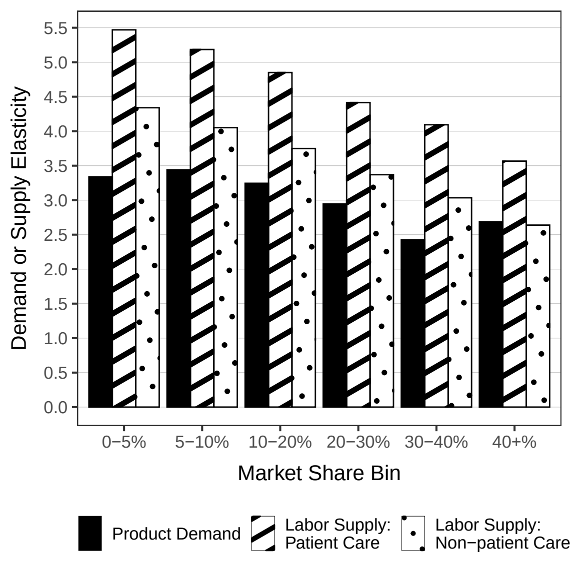
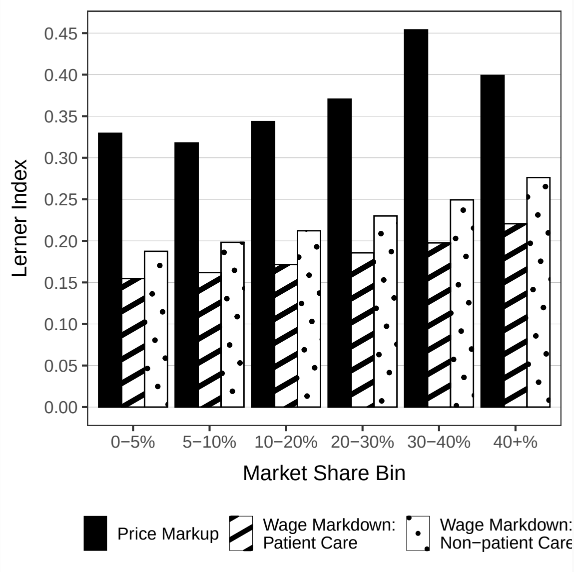
Model Estimates (3/4): Demand and Labor Supply Elasticities



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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- Exercise 1: Simulate merger effects on consumers, with/without accounting for labor market diversion effects.

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- 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.
- Shutting down product diversion, we predict employment and wage effects that are 80% weaker.

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- Shutting down labor diversion, we predict 20% weaker quantity effects and 45% weaker quality effects.
- Shutting down product diversion, we predict employment and wage effects that are 80% weaker.
- Why is product market diversion more important for labor outcomes than labor market diversion?

$$\mathrm{MC}^L_{ht} + \underbrace{\frac{\partial W^L_{gt}}{\partial L_{ht}} L_{gt}}_{\text{labor diversion: \$1,100}} = \mathrm{MR}^L_{ht} + \underbrace{\frac{\partial P_{gt}}{\partial Q_{ht}} Q_{gt} \mathrm{MP}^L_{ht}}_{\text{product diversion: \$9,500}}$$

Summary

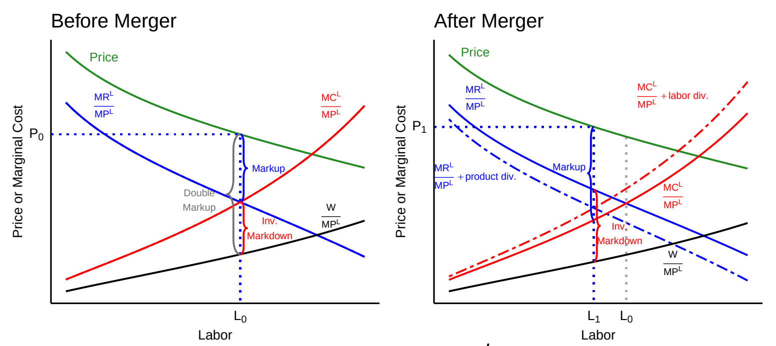
Summary

- **Context:** product market competitors often compete for workers as well, yet merger evaluation considers one or the other in isolation.
- **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:** Use 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 diversion.
- Thank you – comments welcome.

Appendix

Merger Effects

$$\mathrm{MC}^L_{ht} + \underbrace{\frac{\partial W^L_{gt}}{\partial L_{ht}} L_{gt}}_{\text{labor diversion } (+)} = \mathrm{MR}^L_{ht} + \underbrace{\frac{\partial P_{gt}}{\partial Q_{ht}} Q_{gt} \mathrm{MP}^L_{ht}}_{\text{product diversion } (-)}$$

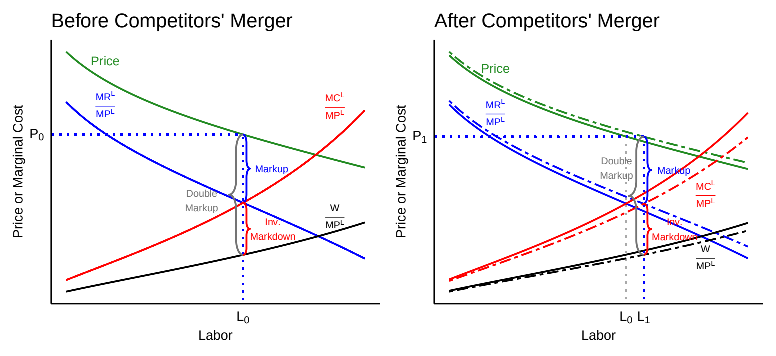


- Because of labor diversion, effective MC^L is higher.
- Because of product diversion, effective MR^L is lower.

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

Back

Merger Effects



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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.

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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,

$$\underbrace{\left(1+(\theta^L_{ht})^{-1}\right)\times W^L_{ht}}_{\equiv \mathrm{MC}^L_{ht}} = \underbrace{\left(1+(\theta^Q_{ht})^{-1}\right)\times P_{ht}\mathrm{MPL}_{ht} + \frac{\partial P_{ht}}{\partial Y_{ht}}\frac{\partial Y_{ht}}{\partial L_{ht}}Q_{ht}}_{\equiv \mathrm{MP}^L_{ht}}$$

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

$$\mathrm{MC}^L_{ht} + \underbrace{\frac{\partial W^L_{gt}}{\partial L_{ht}}L_{gt}}_{\text{labor diversion}} = \mathrm{MP}^L_{ht} + \underbrace{\frac{\partial P_{gt}}{\partial Q_{ht}}Q_{gt}\mathrm{MPL}_{ht}}_{\text{product diversion}}$$

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.

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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 $i = 1, ..., I$ whose empirical distribution as $I \to \infty$ 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,

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

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Price Definition

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

$$Rev_h \equiv \frac{(\mathrm{IPSC}_h + \mathrm{IPIC}_h + \mathrm{IPANC}_h)\left(1 - \frac{\mathrm{CONTDISC}_h}{\mathrm{GROSSREV}_h}\right) - \mathrm{MCPRIM}_h - \mathrm{MCAP}_h}{(\mathrm{DISCH}_h - \mathrm{MDISCH}_h)}$$

- $IPSC_h$: 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

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Price Definition

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

$$Rev_{ht} = \beta_1 \text{CMI}_{ht} + \beta_2 \% \text{ Medicare}_{ht} + \beta_3 \% \text{ Medicaid}_{ht} + \gamma_t + \varepsilon_{ht}$$

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

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

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

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

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.

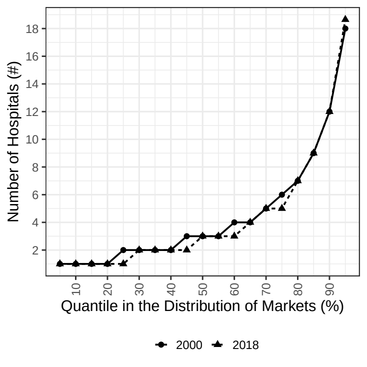
Time-consistent Merging Firm and Matching

- 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:

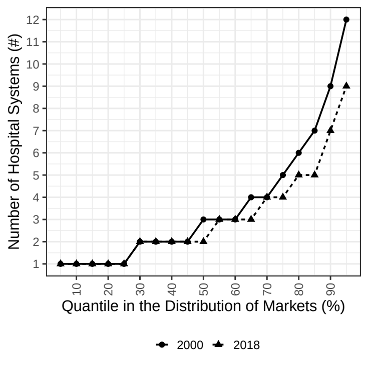
$$\mathbb{P}(Merger_j) = \beta x_j + \epsilon_j$$

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

Cross-sectional Market Concentration (1/2)



Number of Hospitals



Number of Hospital Systems

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

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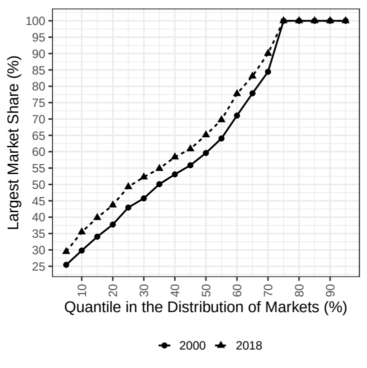
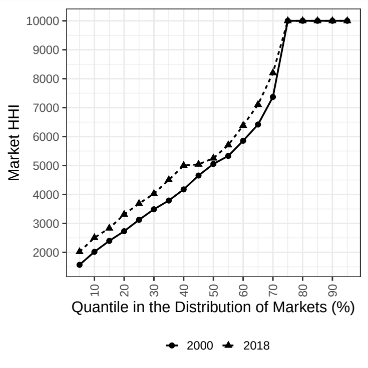
Cross-sectional Market Concentration (2/2)



Max Market Share across Markets



HHI across Markets

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

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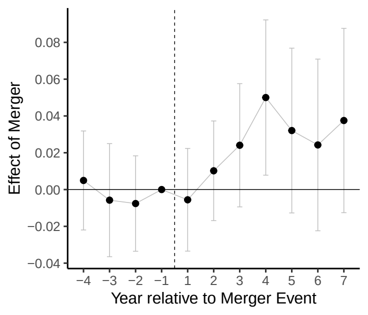
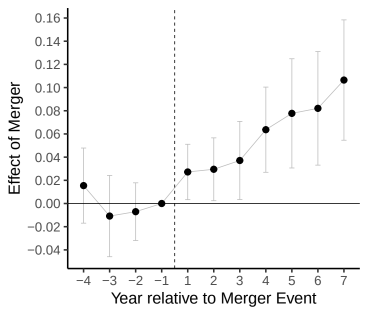
DiD Results: Spillover Effects by Occupation



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 ≈8%.

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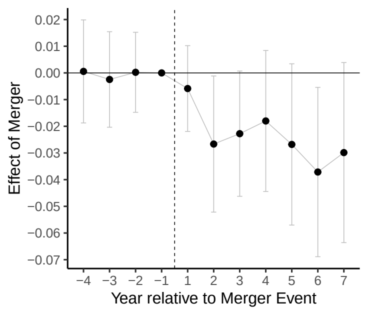
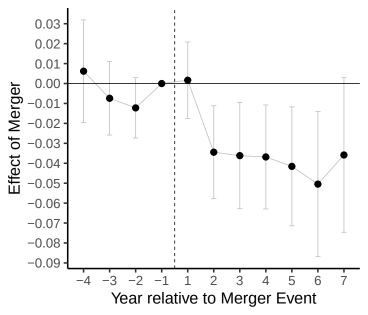
DiD Results: Aggregate Market Effects by Occupation



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%.

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