

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

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Presented at NBER Labor Studies — November 2025

# 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)

- Nearly half of rising concentration is attributable to mergers.

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- Merger evaluation has traditionally focused on **product market** consolidation and the resulting harm to **consumers**: price↑ quantity↓
- 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; DOJ-FTC Merger Guidelines 2023)

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## Our perspective:

- **Product market competitors** often **compete for workers** as well.  
(Nearly all industries? Retail, restaurants, construction, education, 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.

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  - Spillovers: **product demand**↑ and **labor supply**↑
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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

**Data:** Patient, worker, and quality outcomes + ownership panel for the universe of general-purpose hospitals in the US over 1996-2022.

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- Direct effects:
  - Patients: Price  $\uparrow 7\%$ , Quantity  $\downarrow 4\%$ .
  - Patient care occupations: Wage  $\downarrow 2\%$ , Employment  $\downarrow 9\%$ .
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  - Market-wide number of **patients** and **workers**  $\downarrow 3\%$
- Quality of care:
  - Staffing ratio**  $\downarrow 6\%$
  - Patient satisfaction**  $\downarrow 2\text{pp}$
  - Mortality**  $\uparrow 0.5\text{-}0.8\text{pp}$  (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  $\approx 20\%$  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**.

$\implies$  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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- Structural models for ex ante merger evaluation.
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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

**Context:** Industry where producers compete for consumers and workers.

**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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**Product demand curve:** The market share of producer  $h$  is,

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

## Model (2/3): Labor Supply

**Notation:**  $h$  is producer (employer),  $j$  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

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

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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 production and support labor to provide product quality to consumers 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.

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- **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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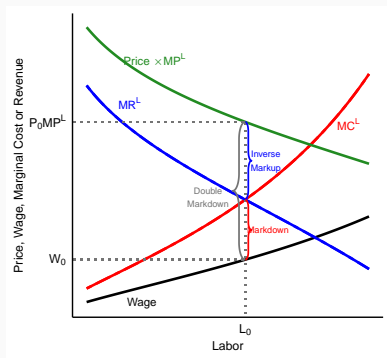
**This paper:** Accounting for simultaneous labor and product competition,

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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.

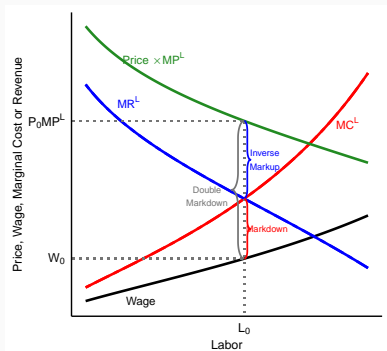


Merging Party: Before Merger

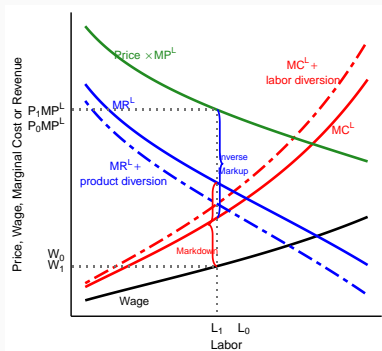
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Merging Party: After Merger

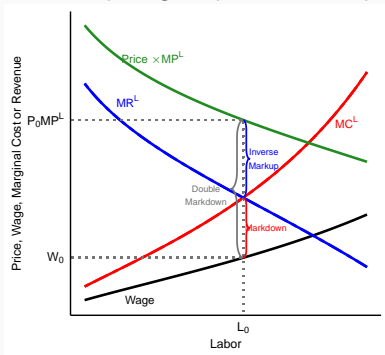
After the merger, the firm internalizes diversion:

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

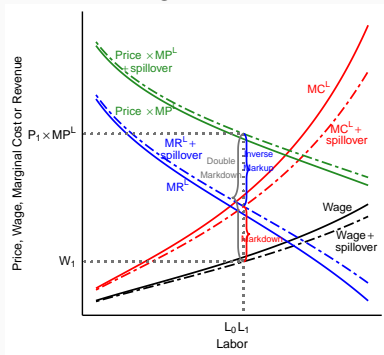
# Model-predicted Effects of a Merger (4/6)

## 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,

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As consumers value **quality** more relative to **price** ( $\beta_Y/\beta_P$ ), 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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**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** ( $\beta_Y/\beta_P$ ), more support **workers** are hired

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

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

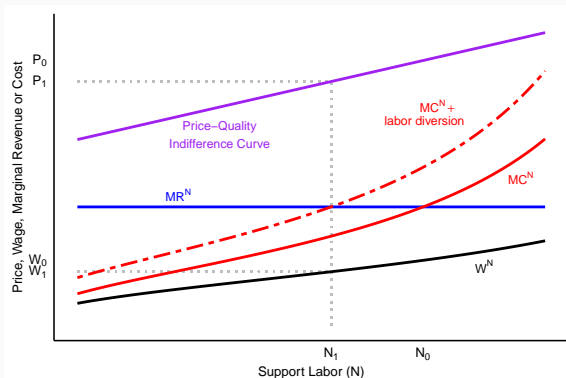
$$MR_{ht}^N = MC_{ht}^N + \underbrace{\frac{\partial W_{gt}^N}{\partial N_{ht}} N_{gt}}_{\text{labor diversion (+)}}$$

- 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  $Q$ .



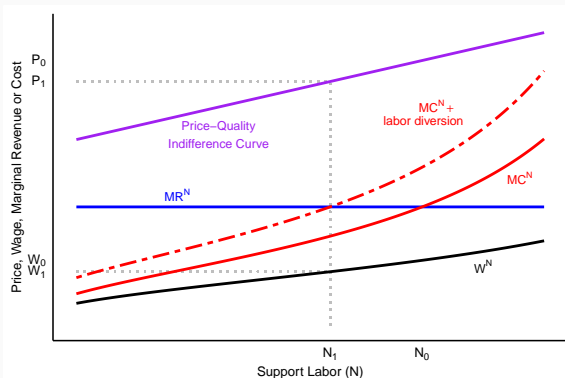
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- Increased MC of support workers causes a downward movement along the price-quality indifference curve, given  $Q$ .
- Not the full story:  $Q$  also decreases due to the reduction in  $L$ . The model allows for an increase in **quality** if  $F_{ht}^L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

# 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.

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## Labor Market Variables:

- **Labor:** We observe total hours and convert to full-time equivalence.
  - Patient care: Nurses, nursing aides, hospital's physicians.
  - Non-patient care: Admin, food, sanitation, maintenance.
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  - Non-patient care: Admin, food, sanitation, maintenance.
- **Wages:** Hourly wage (separately for Patient and Non-patient).

## 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

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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).

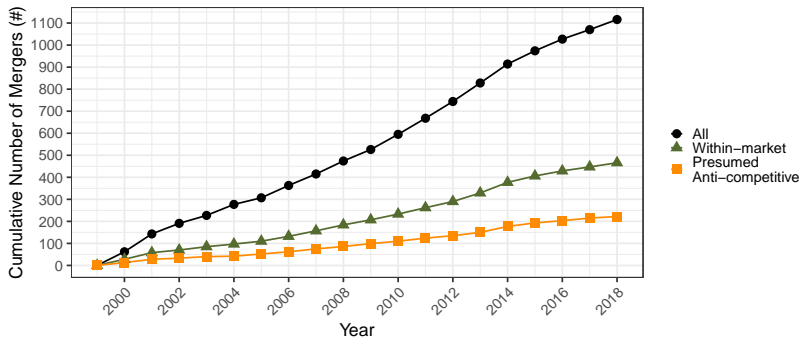
- They created and extensively validated a publicly available database on the universe of hospital mergers over 2001-2014.
- We supplement it to include 1999-2018 by following their process and using AHA Survey, Levin Associates reports, and newspapers.
- We manually verified their database as well.

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**Cumulative number of mergers over time:**



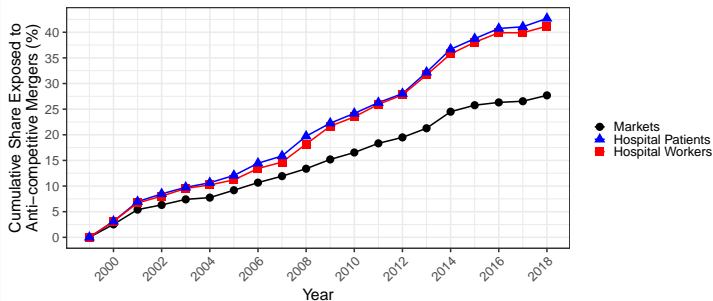
## Data Sources (4/4): Market Concentration

**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  $s_j$ ,  $HHI = \sum_j s_j^2 \times 10,000$ .

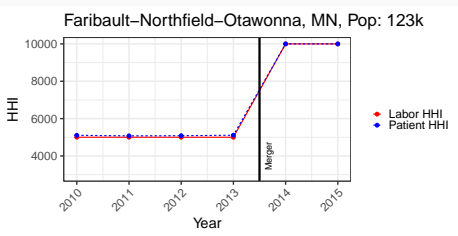
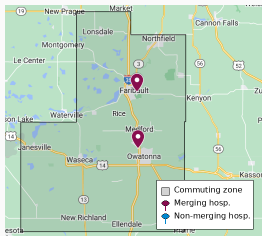
- Presumed Anti-competitive:  $HHI > 1800$ ,  $\Delta HHI > 100$  (DOJ-FTC).



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

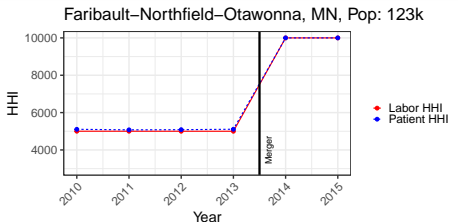
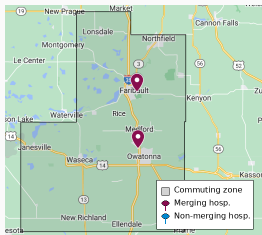
# DiD Design

# Treatment Group: Presumed Anti-competitive Mergers

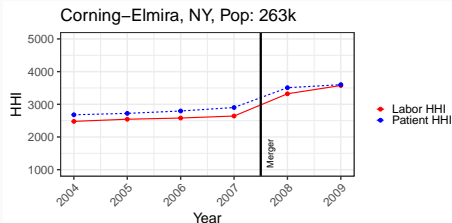
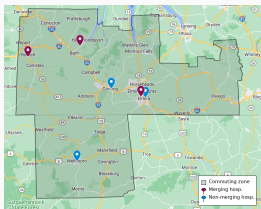


Example 1: Merger between District One & Allina Health in Minnesota

# 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.

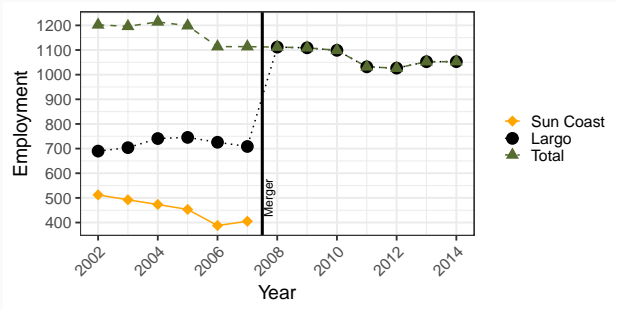
- Before merger: Sun Coast and Largo separately report employment.
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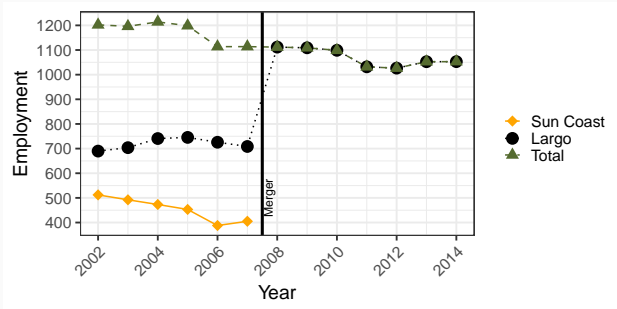


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**Solution:** Use total employment across merging hospitals, pre and post.

## **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:

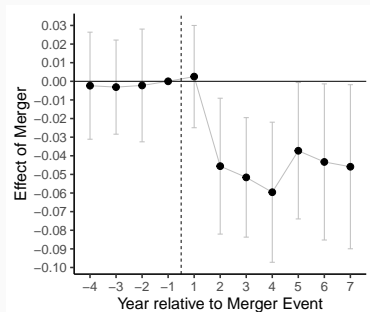
$$\text{DiD}_{h,t,e} \equiv (Y_{h,t+e} - Y_{h,t-1}) - \underbrace{\mathbb{E}[Y_{h',t+e} - Y_{h',t-1} \mid h' \in C_h]}_{\substack{\text{change from } t-1 \text{ to } t+e, \\ \text{control mergers matched to } h}}.$$

We then average across cohorts:

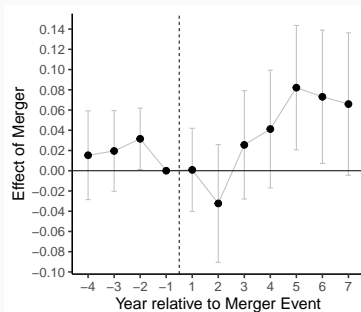
$$\text{DiD}_e \equiv \sum_t \omega_{t,e} \times \frac{1}{|\mathcal{G}_t|} \sum_{h \in \mathcal{G}_t} \text{DiD}_{h,t,e}, \quad \omega_{t,e} \equiv \frac{|\mathcal{G}_t|}{\sum_t |\mathcal{G}_t|},$$

## DiD for Direct Effects on Patients and Workers

# DiD Results: Quantities and Prices



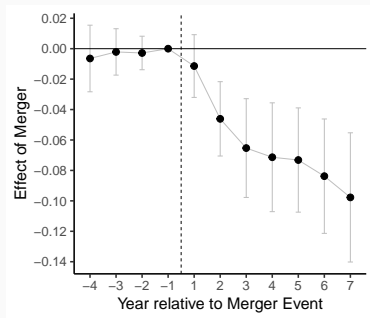
Patients (log)



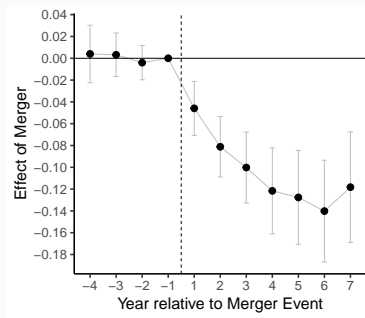
Price Index (log)

- Quantity of **patients** decrease around 4-6% after merger.
  - Composition-adjusted **price** increases around 7-10% after merger.
- ⇒ Incredibly inelastic patients.

# DiD Results: Employment by Occupation



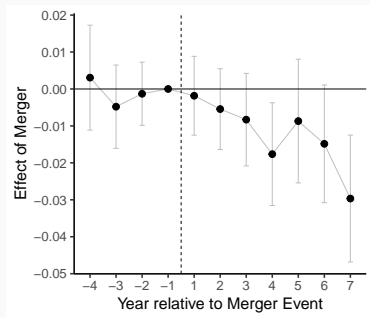
Patient Care: Employment (log)



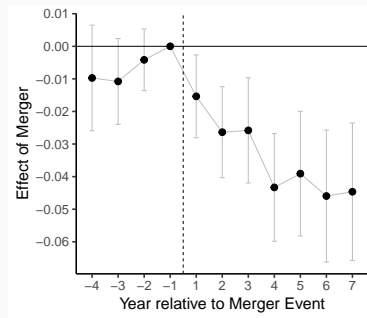
Non-patient Care: Employment (log)

- **Patient care:** 9-10% employment loss.
- **Non-patient care:** 12-14% employment loss.

# DiD Results: Wages by Occupation



Patient Care: Wage (log)



Non-patient Care: Wage (log)

- **Patient care:** 2-3% hourly wage loss.
- **Non-patient care:** 4-5% hourly wage loss.

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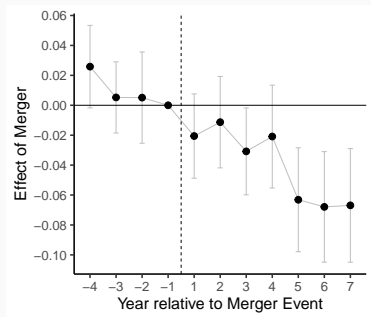
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  - Solution: Combine them. In the empirical model, I add a reduced-form representation of insurer bargaining price effects.

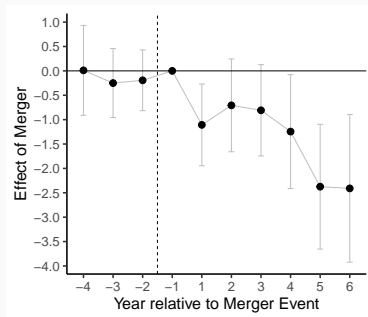
## DiD for Quality of Care Effects



# DiD Results: Staffing Ratio and Satisfaction



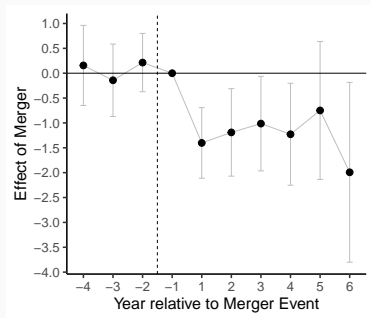
Staffing Ratio (log)



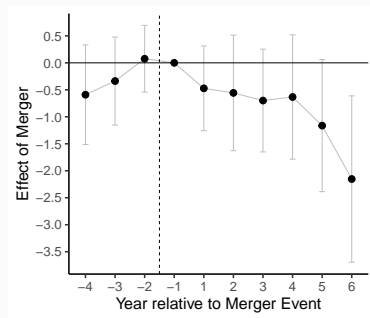
Recommend Hospital (pp)

- **Staffing ratio** decrease around 6% after merger.
- **Recommend Hospital %** from survey decreases 2-3pp after merger.
- **Highly Satisfied %** from survey also decreases 1-2pp after merger.

# DiD Results: Satisfaction Survey Items



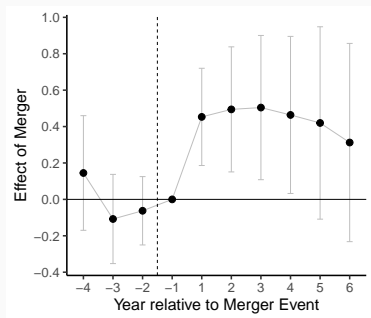
Cleanliness Rating (pp)



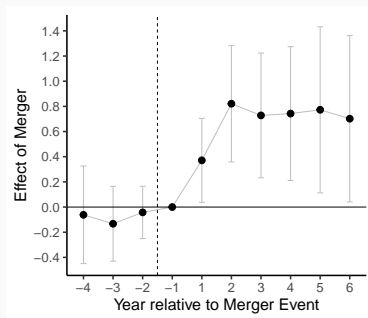
Quietness Rating (pp)

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

# DiD Results: 30-Day Mortality Rates



Heart Failure 30-Day Mortality (pp)



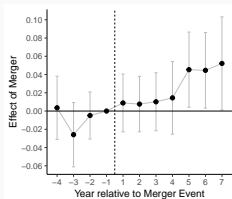
Pneumonia 30-Day Mortality (pp)

Risk-adjusted probability of death within 30-days:

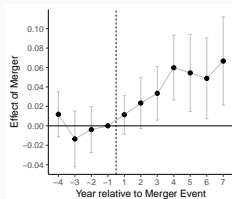
- Heart failure mortality rate increases around 0.5pp (base: 12%).
- Pneumonia mortality rate increases around 0.8pp (base: 13%).

## DiD for Spillover and Aggregate Market Effects

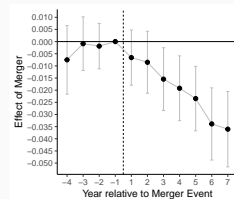
# DiD Results: Within-Market Spillover Effects



Within-Market Spillover on Patients (log)



Within-Market Spillover on Employment (log)

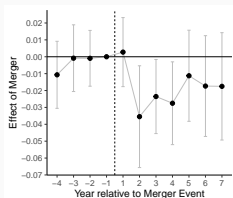


Within-Market Spillover on Hourly Wage (log)

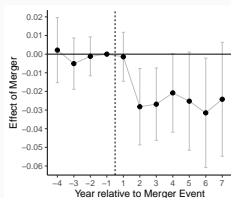
- **Local Competitor Prices** unchanged.
- **Local Competitor Patients** increase up to 5%.
- **Local Competitor Employment** increases 6%.
- **Local Competitor Hourly Wage** decreases around 3%.

Patient care vs Non-patient care

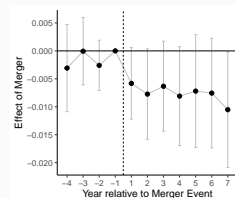
# DiD Results: Aggregate Market Effects



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  $h$ .
- $\alpha$  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 ( $\rho > 0$ ).
- returns to scale in quality may be increasing ( $\phi > 1$ ) or decreasing ( $\phi < 1$ ).



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**Global parameters to estimate:**

- **Product demand:**  $\beta_P, \beta_Y$
- **Labor supply:**  $\gamma_L, \gamma_N$
- **Treatment tech:**  $\alpha$
- **Quality tech:**  $\delta, \rho, \phi$

## Model Quantification (2/4): Mergers as Instruments

Consider the recovery of the labor supply parameter,  $\gamma_L$ .

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

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

where  $\Delta$  denotes the change induced by the merger.

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where  $\Delta$  denotes the change induced by the merger.

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

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

## Model Quantification (2/4): Mergers as Instruments

Consider the recovery of the labor supply parameter,  $\gamma_L$ .

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

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

where  $\Delta$  denotes the change induced by the merger.

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

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

- Thus, the merger-based DiD provides a valid moment to recover  $\gamma_L$  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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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,  $\mathbf{M}^{sim}(\Xi^*)$ .

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  $\Lambda_h$  is the one that results from inverting the model evaluated at  $\Xi^{msm}$ .

# Model Quantification (4/4): Insurer Bargaining Effects

## Extension: markups on insurers

- Let  $P_{ht}^{\text{hos}}$  denote the price received by the hospital from the insurer. From the hospital's perspective,  $P_{ht}^{\text{hos}}$  is the relevant price.
- Let  $P_{ht}^{\text{pat}}$  denote the price paid by the patient. From the patient's perspective,  $P_{ht}^{\text{pat}}$  is the relevant price for determining demand  $Q_{ht}$ .
- Insurer markup  $\kappa_{ht}$  satisfies the accounting identity  $P_{ht}^{\text{hos}} = \kappa_{ht} P_{ht}^{\text{pat}}$ .
- Key property: Higher  $\kappa_{ht} \implies$  higher  $P_{ht}^{\text{hos}}$  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  $\kappa_{ht}$  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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- **Bargaining power:**  $\bar{\kappa}_\Delta = 0.022 \implies$  2.2% price increase at init  $Q_h$

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

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

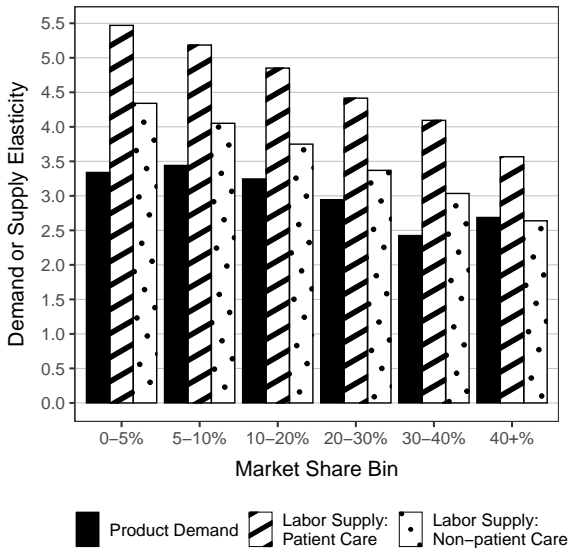
## Model Estimates (2/4): Goodness of Fit

Moment	Target	Simulated
<b>Product Market</b>		
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
<b>Quality of Care</b>		
Direct: $\Delta \log(SR_h)$	-0.044	-0.053
Direct: $\Delta \log(Y_h)$	—	-0.079
<b>Labor Market: Patient Care</b>		
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
<b>Labor Market: Non-Patient Care</b>		
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

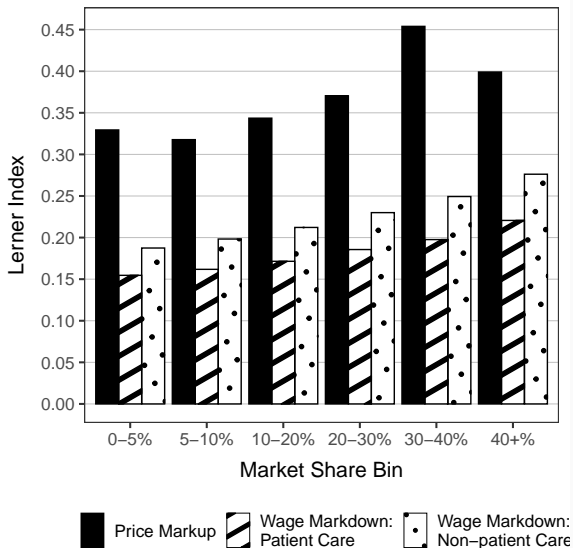
## Model Estimates (2/4): Goodness of Fit

Moment	Target	Simulated
<b>Product Market: Patients</b>		
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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.  
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.
- 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?

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

# Summary

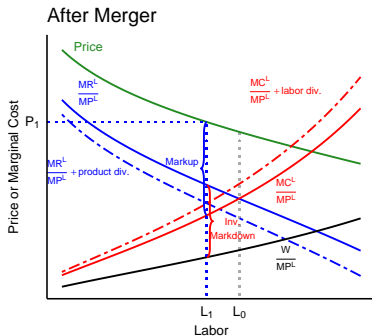
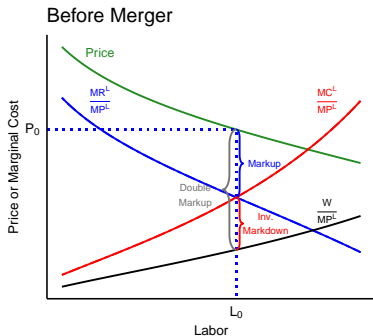
# Summary

- **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

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



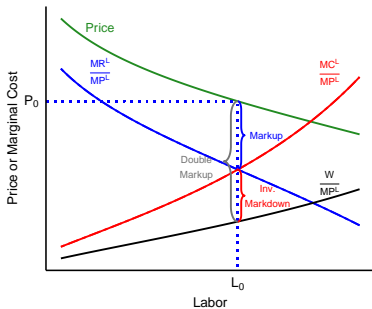
- Because of labor diversion, effective  $MC^L$  is higher.
- Because of product diversion, effective  $MR^L$  is lower.

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

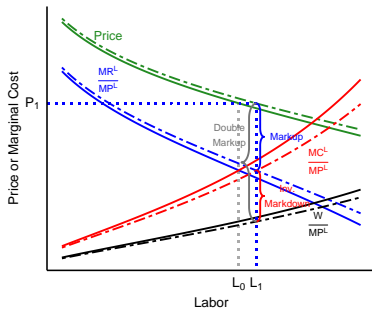


# Merger Effects

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

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

- For each  $\varepsilon^i$ ,  $U_i^{*,pre}$ , 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

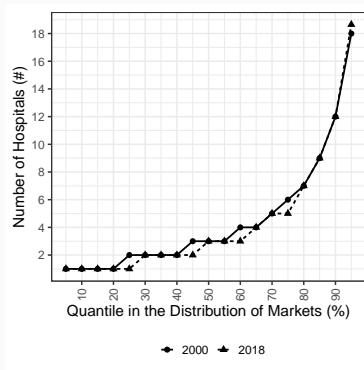
- The potential controls for a merger are all hospitals that:
  - Are in a different market.
  - Are not involved in a merger between  $t - 4$  and  $t + 7$ .
- Let  $x_j$  denote hospital  $j$ 's pre-merger covariates. Note that it must be constructed for treated units using a sum or weighted average 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:

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

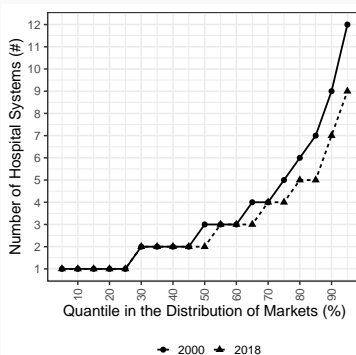
- For each merger, we choose-with-replacement the 10 potential control units with the closest estimated propensity score to the treated unit.



# Cross-sectional Market Concentration (1/2)



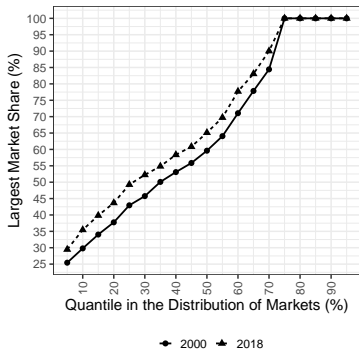
Number of Hospitals



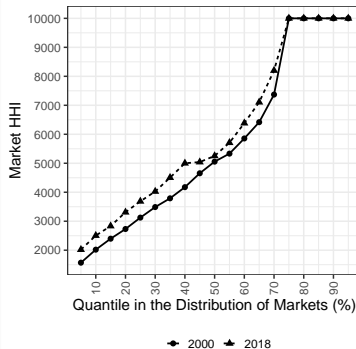
Number of Hospital Systems

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

# Cross-sectional Market Concentration (2/2)



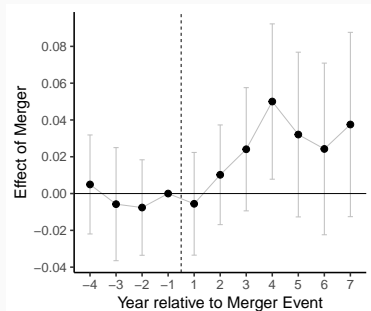
Max Market Share across Markets



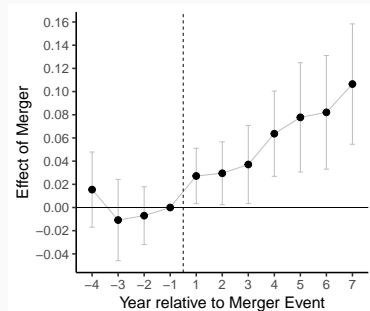
HHI across Markets

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

# DiD Results: Spillover Effects by Occupation



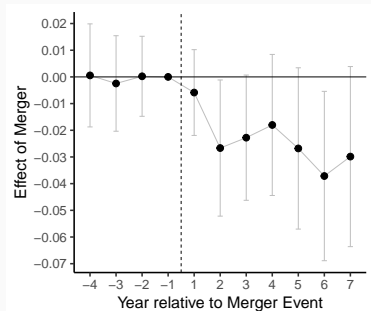
Patient Care: Spillovers on Employment (log)



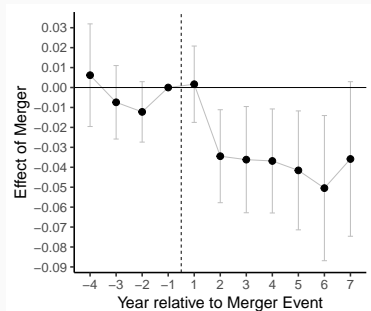
Non-patient Care: Spillovers on Employment (log)

- **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%.