

# Physician Behaviors and Hospital Influence

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## Background

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# Physician Agency

Physician with decision-making authority for treatment

- Information asymmetry
- Regulatory restrictions

Differential financial incentives between physician and hospital

- More procedures = more revenue, but location of procedure may matter to hospital
- Hospital wants less cost with fixed payment, but physician dictates resource use

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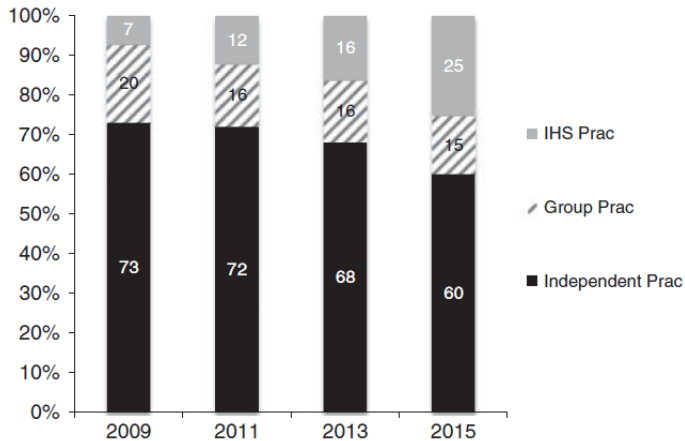
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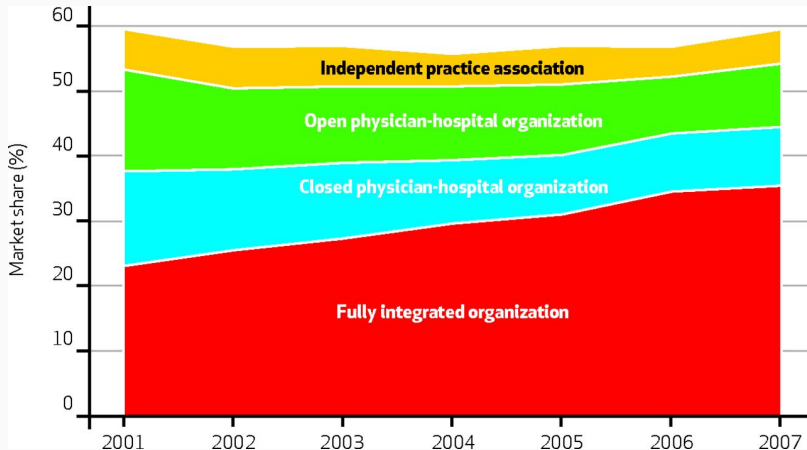
Most direct way (arguably) is to purchase physician practice

# Changing Physician Relationships



Richards *et al.*, Medical Care, 2016

# Changing Physician Relationships



Baker, Bundorf, and Kessler, Health Affairs, 2014



## What do we expect from integration?

- Hospitals claim efficiency gains via reduced fragmentation and increased coordination
- Increased bargaining power
- Financial incentives for cost increases and decreases
  - Lower costs with fixed payment versus higher costs/payments from private insurance
  - Change location of care
  - More resources due to pay-for-performance

- Physician agency (Clemens & Gottlieb 2014, AER; Afendulis & Kessler 2007, AER; Gruber & Owings 1996, RAND; Iizuka 2012, AER)
- Vertical integration (Cuellar & Gertler 2006, JHE; Ciliberto & Dranove 2006, JHE; Baker *et al.* 2016, JHE; Koch *et al.* 2017, JHE)

## 1. Motivestimation

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2. Initial Results

# Outline

1. Motivestimation
2. Initial Results
3. Event Study

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4. Instrumental Variables

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2. Initial Results
3. Event Study
4. Instrumental Variables
5. Other Outcomes

# Theoretical Framework

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Observed care at time  $t$  is

$$y_{ijk} = \arg \max_y \theta_u \tilde{u}(y; \Gamma_j, \kappa_i) + \theta_\pi \pi(y; \Gamma_k, \Gamma_j).$$

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With assumptions on linearity and separability in patient preferences:

$$y_{ijk} = \alpha_i + x_i \beta + \Gamma_{jk} + \epsilon_{ijk}$$

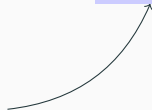
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Patient Preferences



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Patient Preferences

Physician and hospital characteristics

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2. Estimate  $\hat{\Gamma}_{jkt} = \gamma_j + \gamma_k + \tau_t + z_{jkt}\delta + \eta_{jkt}$  with physician-hospital panel. This further isolates variation to physician-hospital interaction.

## Estimation Strategy

- Draws from “match values” in labor literature (Abowd *et al.*, 2002; Card *et al.*, 2013, QJE )
- Exploits variation across inpatient stays and splits the separation of match value into two steps
- Identifies effects on match value from within-physician variation across hospitals (e.g., patient movers in Finkelstein *et al.*, 2016, QJE)



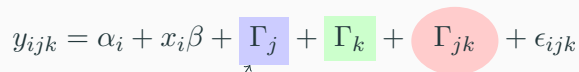
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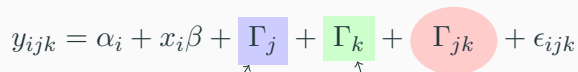
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Physician effect

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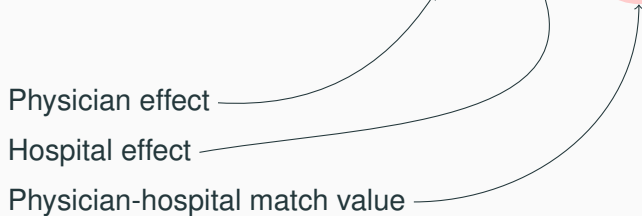
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Physician effect

Hospital effect

Physician-hospital match value

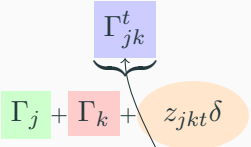
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Our approach:

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The diagram illustrates the decomposition of the interaction term  $\Gamma_{jk}^t$  in the equation. A bracket under  $\Gamma_{jk}^t$  points to a sum of three components:  $\Gamma_j$  (in a green box),  $\Gamma_k$  (in a red box), and  $z_{jkt}\delta$  (in an orange oval). An arrow from the text 'Physician, hospital, and match effect (jointly)' points to this sum. Another arrow from the text 'Physician effect' points specifically to the  $\Gamma_j$  term.

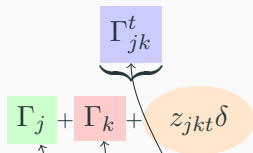
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Physician, hospital, and match effect (jointly)

Physician effect

Hospital effect

Physician-hospital integration

- Hospital influence on physicians is an interaction effect
- Physician agency is net of patient preference

# Data

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## Data Sources

- CMS: 100% inpatient and institutional outpatient Medicare claims data (2008-2015)
- SK&A: Hospital ownership of physician practices
- AHA, HCRIS, POS: Hospital characteristics
- Annual IPPS Impact Files: Hospital cost-to-charge ratios (CCR)
- ACS: County-level demographics, education, income, and employment

## Sample Construction

- Planned inpatient stays (elective admissions initiated by a physician, clinic, or HMO referral) and outpatient procedures with observed NPI for the operating physician

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  - Drop physicians operating in hospitals more than 120 miles from primary office or outside of contiguous U.S.
  - Drop physicians with NPIs not matched in the SK&A data
  - Drop lowest/highest 1% of charges and patients  $< 65$  years old
- 518,398 unique observations at the physician/hospital/year
- 7.5mm inpatient stays (47% of total) and 24mm outpatient procedures

## **Estimation of Match Values**

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Two-step estimation strategy:

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- Total inpatient and outpatient Medicare payments
- Total inpatient and outpatient hospital costs (from cost-to-charge ratios)
- Inpatient hospital costs
- Inpatient length of stay
- Outpatient hospital costs

$$y_{ijk} = \alpha_i + x_i\beta + \Gamma_{jk} + \epsilon_{ijk},$$

- Quartiles of total “other” Medicare payments and procedures
- Covers 2008 through 2015 period
- Beneficiary-specific measure of “utilization”

# Independent Variables

$$y_{ijk} = \alpha_i + \textcolor{red}{x}_i\beta + \Gamma_{jk} + \epsilon_{ijk},$$

- Age, gender, race
- Indicators for ICD9 diagnosis code groups (18 diagnosis groups per variable plus missing group)
- Indicators for primary DRGs (with at least 1000 observations in a given year)
- Minor differences between total, inpatient, and outpatient specifications

# Summary of Match Values

## 1. Calculate Cost Differential

Apply minimum cost physician-hospital combination to all of physician  $j$ 's patients:

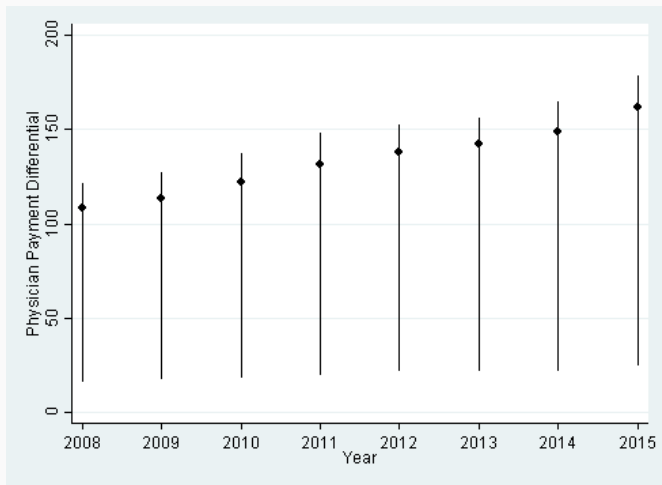
$$\begin{aligned}\Delta_k y_{ij} &= \hat{y}_{ijk} - \hat{y}_{ij\underline{k}} \\ &= \hat{\alpha}_i + x_i \hat{\beta} + \hat{\Gamma}_{jk} - \hat{\alpha}_i - x_i \hat{\beta} - \min \{ \Gamma_{j1}, \dots, \Gamma_{jK} \} \\ &= \hat{\Gamma}_{jk} - \min \{ \Gamma_{j1}, \dots, \Gamma_{jK} \} .\end{aligned}$$



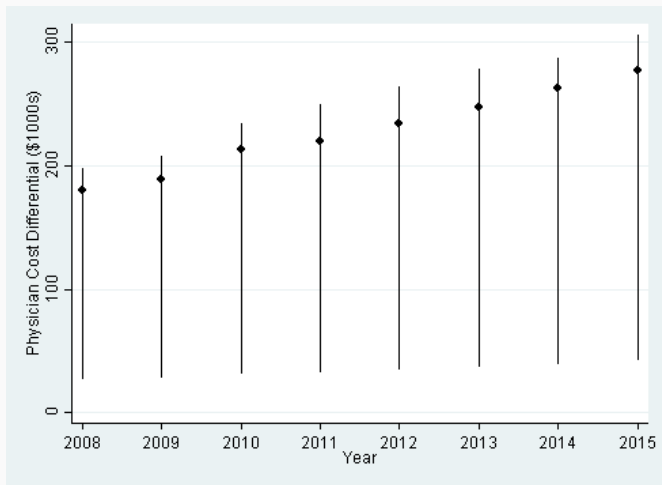
## 2. Summarize

- Total cost differential for each physician
- Limit to pairs with 5 or more procedures
- Limit to physicians with 2 or more hospitals in a year
- Present interquartile range and mean

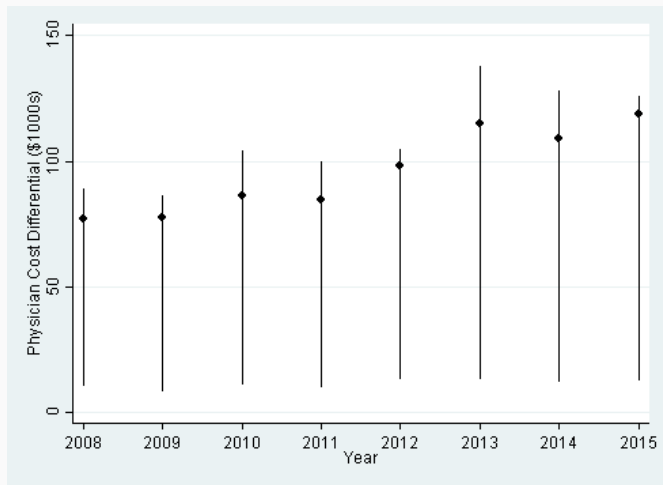
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# Main Outcomes

$$\hat{\Gamma}_{jkt} = \gamma_j + \gamma_k + \tau_t + z_{jkt}\delta + \eta_{jkt},$$

	2008	2012	2013	2014	2015	Overall
Total Payments	7,152 (7,595)	8,171 (8,472)	8,501 (8,290)	8,941 (8,724)	9,169 (8,755)	8,094 (8,228)



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Outpatient Costs	3,007 (2,135)	3,806 (2,782)	4,014 (2,925)	4,190 (3,096)	4,361 (3,195)	3,693 (2,749)

# Independent Variables

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	2008	2012	2013	2014	2015	Overall
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Other FTE	749.9 (975.5)	763.0 (1032.4)	761.8 (1076.2)	776.4 (1101.5)	806.0 (1157.2)	762.8 (1037.4)

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Beds (100s)	1.980 (2.160)	1.967 (2.142)	1.958 (2.137)	1.982 (2.172)	2.009 (2.235)	1.976 (2.154)

# Independent Variables

$$\hat{\Gamma}_{jkt} = \gamma_j + \gamma_k + \tau_t + z_{jkt}\delta + \eta_{jkt},$$

	2008	2012	2013	2014	2015	Overall
Practice Size	13.73 (32.10)	17.31 (30.70)	17.31 (29.28)	17.82 (28.46)	18.41 (28.02)	16.10 (30.05)

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Practice Size	13.73 (32.10)	17.31 (30.70)	17.31 (29.28)	17.82 (28.46)	18.41 (28.02)	16.10 (30.05)
Experience	22.55 (6.496)	23.00 (6.703)	23.94 (6.950)	23.65 (6.902)	24.77 (6.989)	23.17 (6.746)

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Experience	22.55 (6.496)	23.00 (6.703)	23.94 (6.950)	23.65 (6.902)	24.77 (6.989)	23.17 (6.746)
% Multi-Specialty	0.249	0.248	0.266	0.284	0.344	0.264
% with Surgery	0.452	0.501	0.507	0.508	0.454	0.480

# Estimated Effects of Vertical Integration

Outcome	Estimate	St. Error
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\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Estimated Effects of Vertical Integration

Outcome	Estimate	St. Error
Total Medicare Payments	108.293**	(43.335)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Estimated Effects of Vertical Integration

Outcome	Estimate	St. Error
Total Medicare Payments	108.293**	(43.335)
Total Hospital Costs	235.404***	(60.717)

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## Estimated Effects of Vertical Integration

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Total Hospital Costs	235.404***	(60.717)
Inpatient Hospital Costs	157.018***	(49.787)
Inpatient Length of Stay	-0.014	(0.017)

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Total Hospital Costs	235.404***	(60.717)
Inpatient Hospital Costs	157.018***	(49.787)
Inpatient Length of Stay	-0.014	(0.017)
Outpatient Hospital Costs	-47.940***	(18.892)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Effects on Components of Inpatient Stay

Outcome	Estimate	St. Error
Charges for:		
Medical Supplies	32.969	(30.076)
Operating Room	-7.492	(23.023)
Anesthesia	5.715	(5.044)
Labs	10.324	(8.767)
Radiology	-3.843	(6.035)
MRI	-0.207	(1.355)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Effects on Components of Inpatient Stay

Outcome	Estimate	St. Error
Counts of:		
Private Days	-0.003	(0.012)
ICU Days	0.023*	(0.013)
Radiology	-0.00	(0.00)
Procedures	0.028***	(0.009)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Threats to Identification and Interpretation

Estimator is effectively a two-way fixed effects DD with time varying treatment

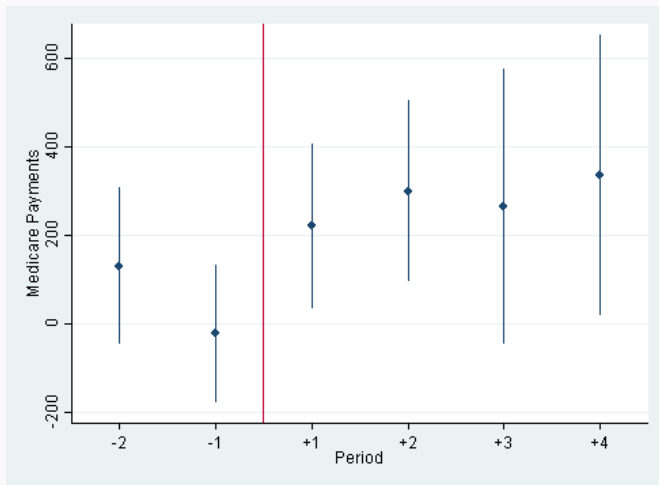
# Threats to Identification and Interpretation

Estimator is effectively a two-way fixed effects DD with time varying treatment

## Potential Problems

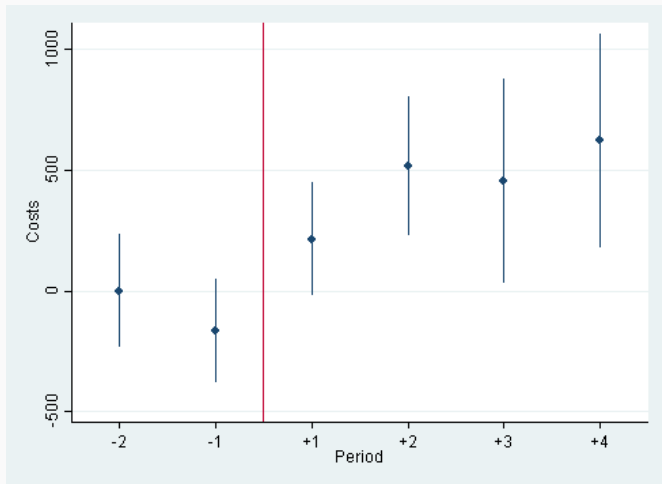
1. Vertical integration due to time-varying unobservables & outcomes (standard DD concern)
2. Weighted average of all  $2 \times 2$  DD estimates, with some potentially negative weights

## Event Study: Total Medicare Payments

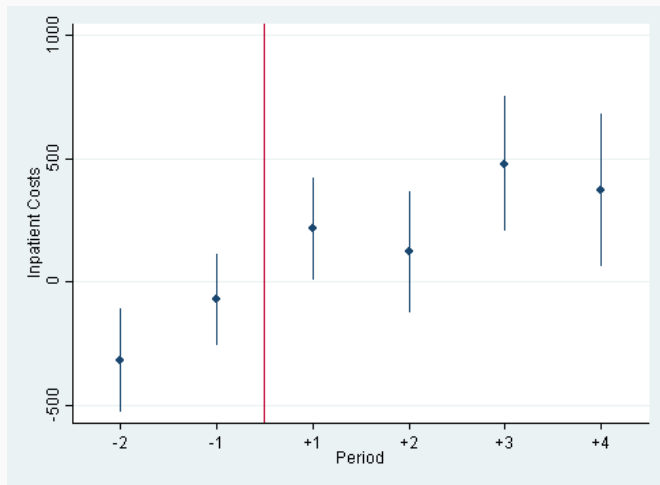




## Event Study: Total Hospital Costs



## Event Study: Inpatient Hospital Costs



## Takeaways

- Evidence of increase in payments and costs
- Evidence consistent with common trends assumption for total payments and costs
- Some concern about common trends for inpatient costs

# Endogeneity of physician-hospital integration

Integration could be driven by:

- Unobserved, time-varying practice characteristics
- Existing costs and treatment patterns

# Endogeneity of physician-hospital integration

## 1. Set of possible physician-hospital pairs

Form set of all hospitals where physician operates from 2008-2015

## 2. Estimate probability of integration

$$\Pr(I_{jk} = 1) = \frac{\exp(\lambda z_{jk})}{1 + \exp(\lambda z_{jk})}$$

- Hospital and practice characteristics
- Average differential distance (relative to nearest hospital in patient choice set)
- Differential distance interacted with hospital and practice characteristics

## 2. Estimate probability of integration

$$\hat{\Pr}(I_{jk} = 1) = \frac{\exp(\hat{\lambda}z_{jk})}{1 + \exp(\hat{\lambda}z_{jk})}$$

Intuition: Physicians less likely to seek/allow acquisition if patients live further away

## 2. Estimate probability of integration

$$\hat{\Pr}(I_{jk} = 1) = \frac{\exp(\hat{\lambda} z_{jk})}{1 + \exp(\hat{\lambda} z_{jk})}$$

Intuition: Physicians less likely to seek/allow acquisition if patients live further away

$$\hat{\Gamma}_{jkt} = \gamma_j + \gamma_k + \tau_t + \underbrace{I_{jkt}}_{\hat{I}_{jkt} = \hat{\Pr}(I_{jkt}=1)} \delta_1 + \tilde{z}_{jkt} \delta_2 + \eta_{jkt},$$



## IV Results: Aggregate Outcomes

Outcome	Estimate	St. Error
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\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## IV Results: Aggregate Outcomes

Outcome	Estimate	St. Error
Total Medicare Payments	1028.994**	(498.917)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## IV Results: Aggregate Outcomes

Outcome	Estimate	St. Error
Total Medicare Payments	1028.994**	(498.917)
Total Hospital Costs	3238.716***	(697.512)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## IV Results: Aggregate Outcomes

Outcome	Estimate	St. Error
Total Medicare Payments	1028.994**	(498.917)
Total Hospital Costs	3238.716***	(697.512)
Inpatient Hospital Costs	2922.754***	(532.646)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## IV Results: Aggregate Outcomes

Outcome	Estimate	St. Error
Total Medicare Payments	1028.994**	(498.917)
Total Hospital Costs	3238.716***	(697.512)
Inpatient Hospital Costs	2922.754***	(532.646)
Inpatient Length of Stay	0.322*	(0.181)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## IV Results: Aggregate Outcomes

Outcome	Estimate	St. Error
Total Medicare Payments	1028.994**	(498.917)
Total Hospital Costs	3238.716***	(697.512)
Inpatient Hospital Costs	2922.754***	(532.646)
Inpatient Length of Stay	0.322*	(0.181)
Outpatient Hospital Costs	-240.470	(200.800)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## IV Results: Components of Inpatient Stay

Outcome	Estimate	St. Error
Charges for:		
Medical Supplies	88.308	(310.707)
Operating Room	914.093***	(237.412)
Anesthesia	126.673***	(48.727)
Labs	-5.867	(110.491)
Radiology	-143.188**	(66.940)
MRI	-41.617***	(15.833)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## IV Results: Components of Inpatient Stay

Outcome	Estimate	St. Error
Counts of:		
Private Days	-0.343**	(0.141)
ICU Days	-0.060	(0.155)
Radiology	-0.054***	(0.016)
Procedures	0.783***	(0.096)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01



## **Allocation of Procedures and Patients**

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Other ways integration posited to affect physician behavior:

- More procedures overall (not per patient)
- Reallocating procedures from other hospitals
- Reallocating procedures across inpatient and outpatient settings
- Changing patient profile

## Results on Other Outcomes

Outcome	Estimate	St. Error
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\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.081***	(0.003)

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\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.081***	(0.003)
Physician's outpatient share	0.057***	(0.003)

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\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.081***	(0.003)
Physician's outpatient share	0.057***	(0.003)
Total patients	7.079***	(0.505)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.081***	(0.003)
Physician's outpatient share	0.057***	(0.003)
Total patients	7.079***	(0.505)
Inpatient procedures	1.102***	(0.161)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.081***	(0.003)
Physician's outpatient share	0.057***	(0.003)
Total patients	7.079***	(0.505)
Inpatient procedures	1.102***	(0.161)
Outpatient procedures	10.069***	(1.015)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01



## Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.081***	(0.003)
Physician's outpatient share	0.057***	(0.003)
Total patients	7.079***	(0.505)
Inpatient procedures	1.102***	(0.161)
Outpatient procedures	10.069***	(1.015)
Patient Procedures	0.056	(0.179)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

## Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.081***	(0.003)
Physician's outpatient share	0.057***	(0.003)
Total patients	7.079***	(0.505)
Inpatient procedures	1.102***	(0.161)
Outpatient procedures	10.069***	(1.015)
Patient Procedures	0.056	(0.179)
Patient Payments	-373.713	(293.133)

\* p-value <0.1, \*\* p-value <0.05, \*\*\* p-value <0.01

# Summary of Results

## Effects per Patient

- Increase in Medicare payments (\$110 to \$300) and hospital costs (\$235-\$500)
- Extrapolates to between \$77 and \$210 million in added Medicare payments from vertical integration
- Components of inpatient stays suggest more procedures per patient

# Summary of Results

## Sensitivity

- Event study consistent with common trends for Medicare payments and total hospital costs
- Calculation of  $2 \times 2$  DD weights suggests relatively small portion of negative weights (70% positive weights)
- No improvement in quality (mortality)
- As falsification test, no effects on payments or DRG weights per inpatient stay

# Summary of Results

## Effects on Total Patients and Allocation of Procedures

- More procedures going to acquiring hospital
- New procedures predominantly coming from outpatient side (10 to 1)
- Perhaps higher usage, lower intensity patient selection (but insignificant)

# Summary of Results

## Interpreting Main Results

- Total within-physician variation in Medicare payments of around \$140,000 per physician per year
- Increases due to vertical integration of between \$110 and \$300 per patient per year
- 5-13% of within-physician variation explained by vertical integration

**Thank You**

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