Physician Behaviors and Hospital Influence

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Background

Physician Agency

Physician with decision-making authority for treatment

- Information asymmetry
- Regulatory restrictions

Physician Agency

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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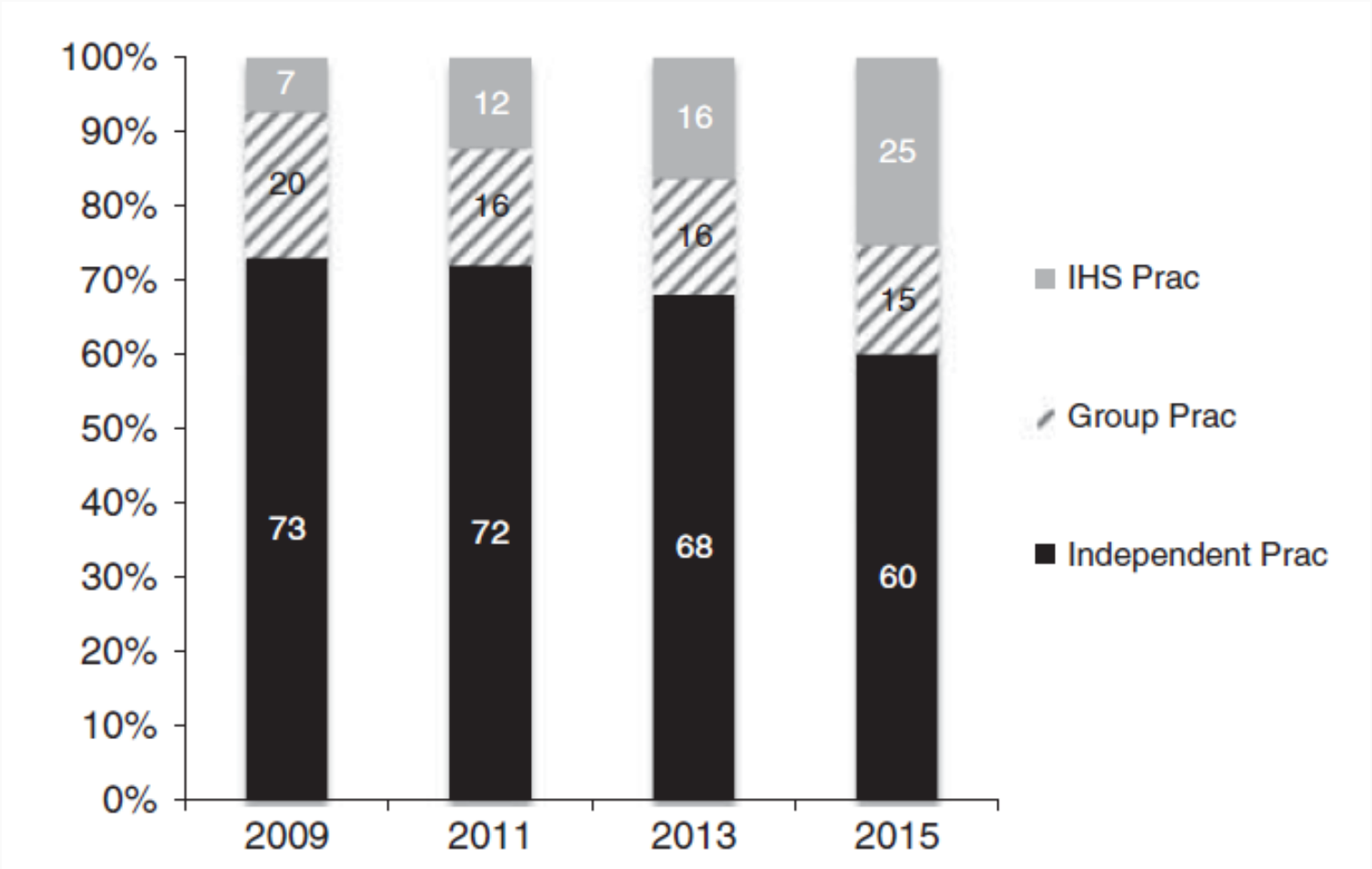
$\longrightarrow$ Incentives for hospitals to influence physicians

Most direct way (arguably) is to purchase physician practice

Changing Physician Relationships



Richards *et al.*, Medical Care, 2016

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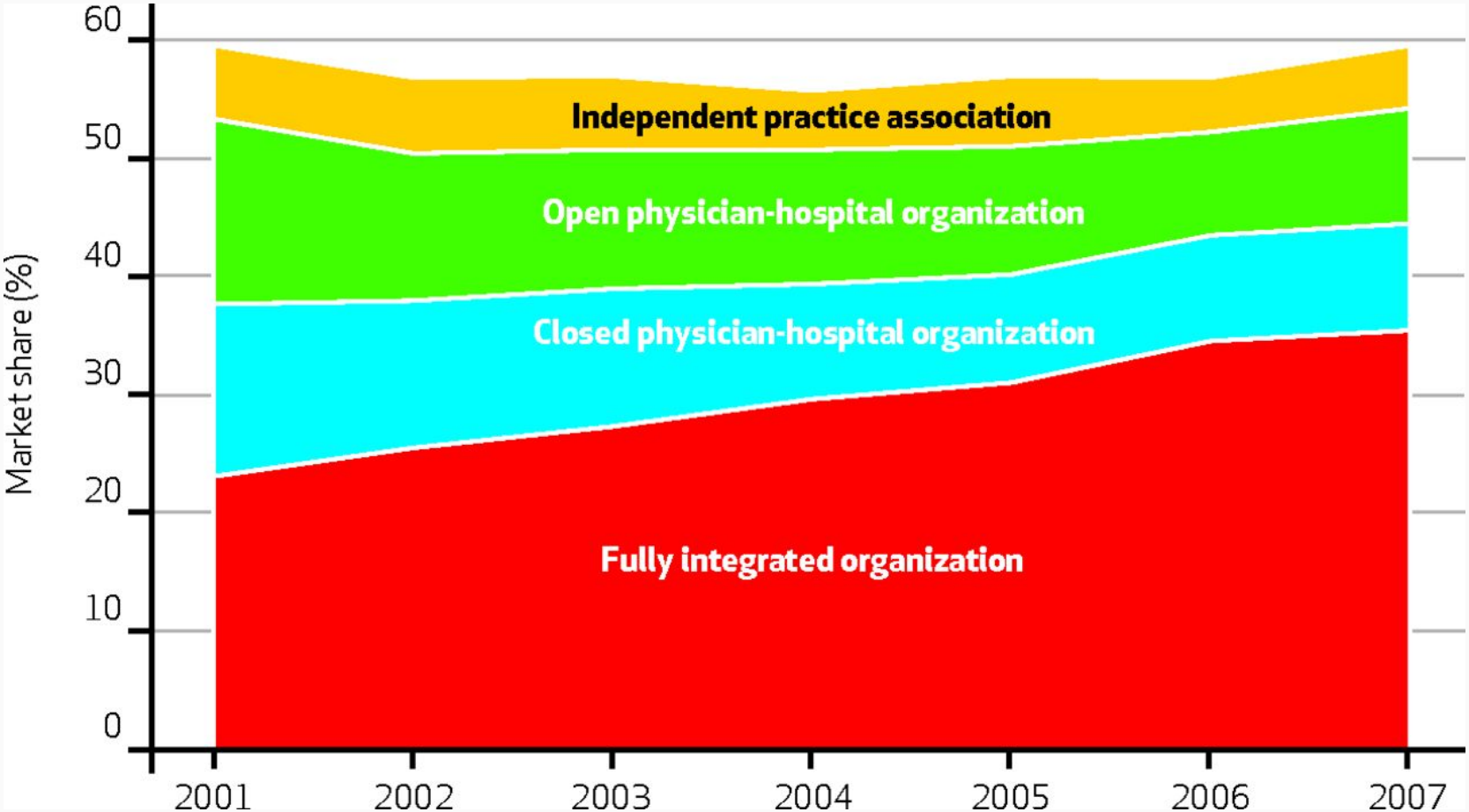

Baker, Bundorf, and Kessler, Health Affairs, 2014

What do we expect from integration?

- Hospitals claim efficiency gains, reduced fragmentation, increased coordination, etc.
- Financial incentives for cost increases and decreases
  - Lower costs with fixed payment
  - Substituting locations of care more efficiently
  - Spillovers from private insurance
  - More resources due to pay-for-performance

In context

- 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)

Outline

1. Motivestimation

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2. Initial Results

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

Theoretical Framework

Physician Agency

Observed care at time t is

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

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With linearity and separability assumptions in patient preferences:

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Patient Preferences

Physician and hospital characteristics

Estimation Strategy

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

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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Physician effect

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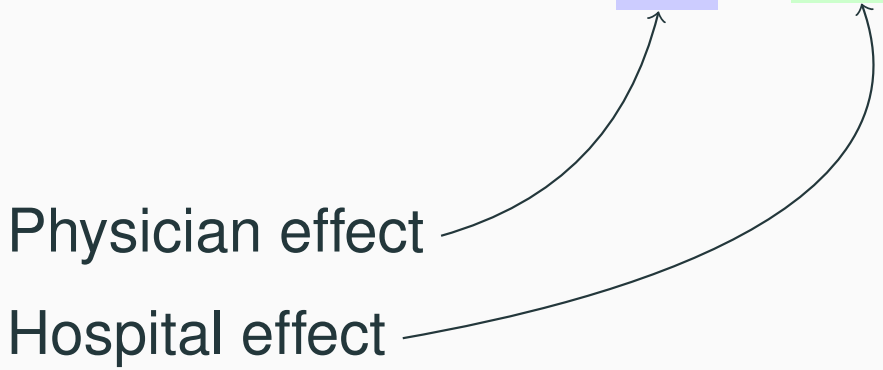

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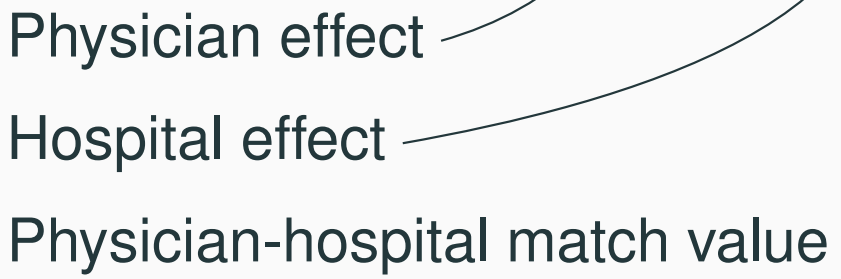

Estimation Strategy

Our approach:

$$y_{ijk} = \alpha_i + x_i\beta + \underbrace{\Gamma^t_{jk}}_{\Gamma_j + \Gamma_k + z_{jkt}\delta} + \epsilon_{ijk}$$

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Physician, hospital, and match effect (jointly)

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Physician effect

Hospital effect

Physician-hospital integration

Data

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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$\longrightarrow$ 518,398 unique observations at the physician/hospital/year
$\longrightarrow$ 7.5mm inpatient stays (47% of total) and 24mm outpatient procedures

Estimation of Match Values

Specification

Two-step estimation strategy:

1. Estimate $y_{ijk} = \alpha_i + x_i\beta + \Gamma_{jk} + \epsilon_{ijk}$ at patient level (separately by year)
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Specification

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Outcomes

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

- 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

Independent Variables

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

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

Independent Variables

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

- 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:

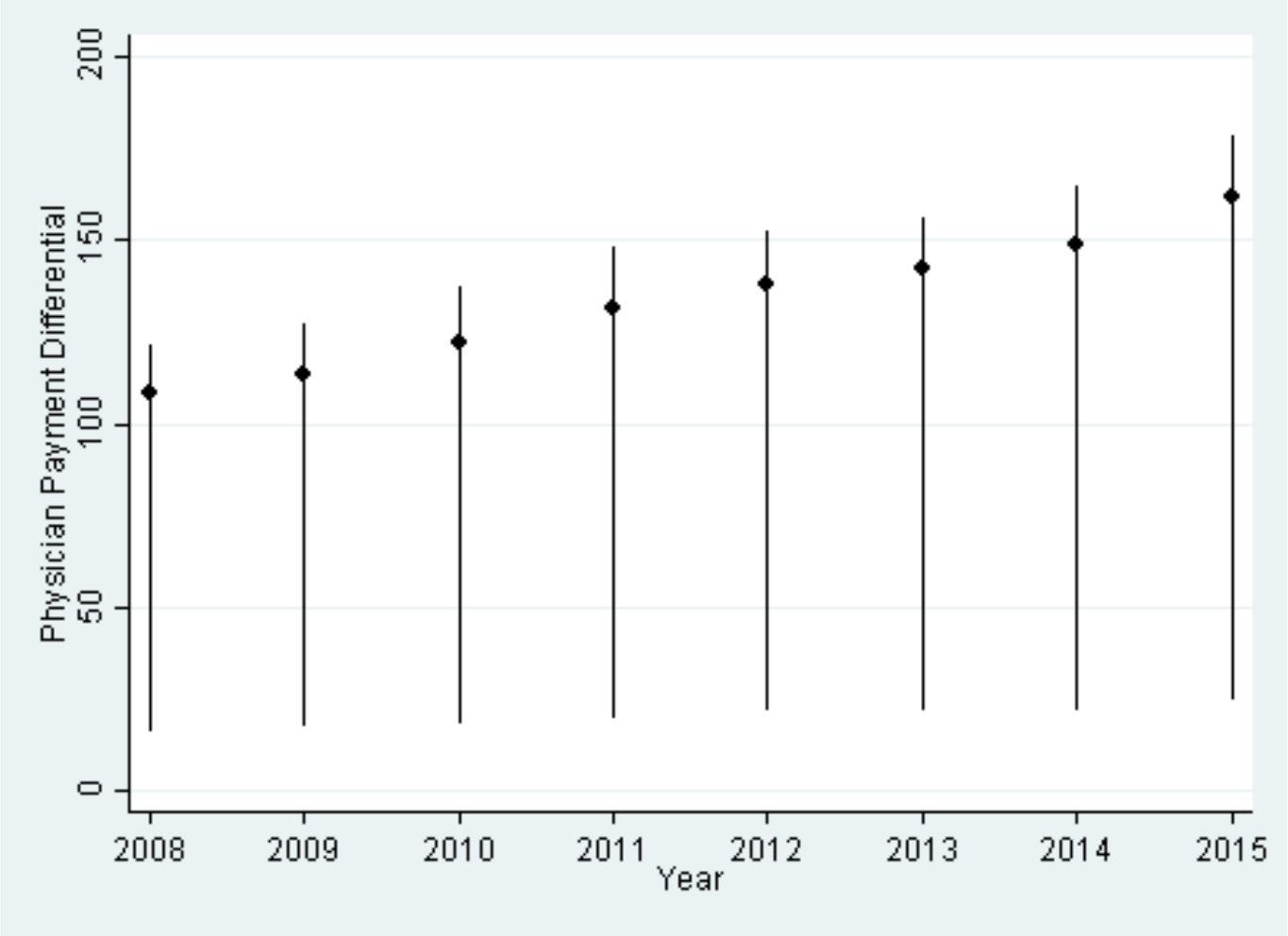
$$\begin{aligned}\Delta_k y_{ij} &= \hat{y}_{ijk} - \hat{y}_{ij\underline{\mathsf{k}}} \\ &= \hat{\alpha}_i + x_i\hat{\beta} + \hat{\Gamma}_{jk} - \hat{\alpha}_i - x_i\hat{\beta} - \min\left\{\Gamma_{j1}, ..., \Gamma_{jK}\right\} \\ &= \hat{\Gamma}_{jk} - \min\left\{\Gamma_{j1}, ..., \Gamma_{jK}\right\}.\end{aligned}$$

Summary of Match Values

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

Within-physician Variation in Payments



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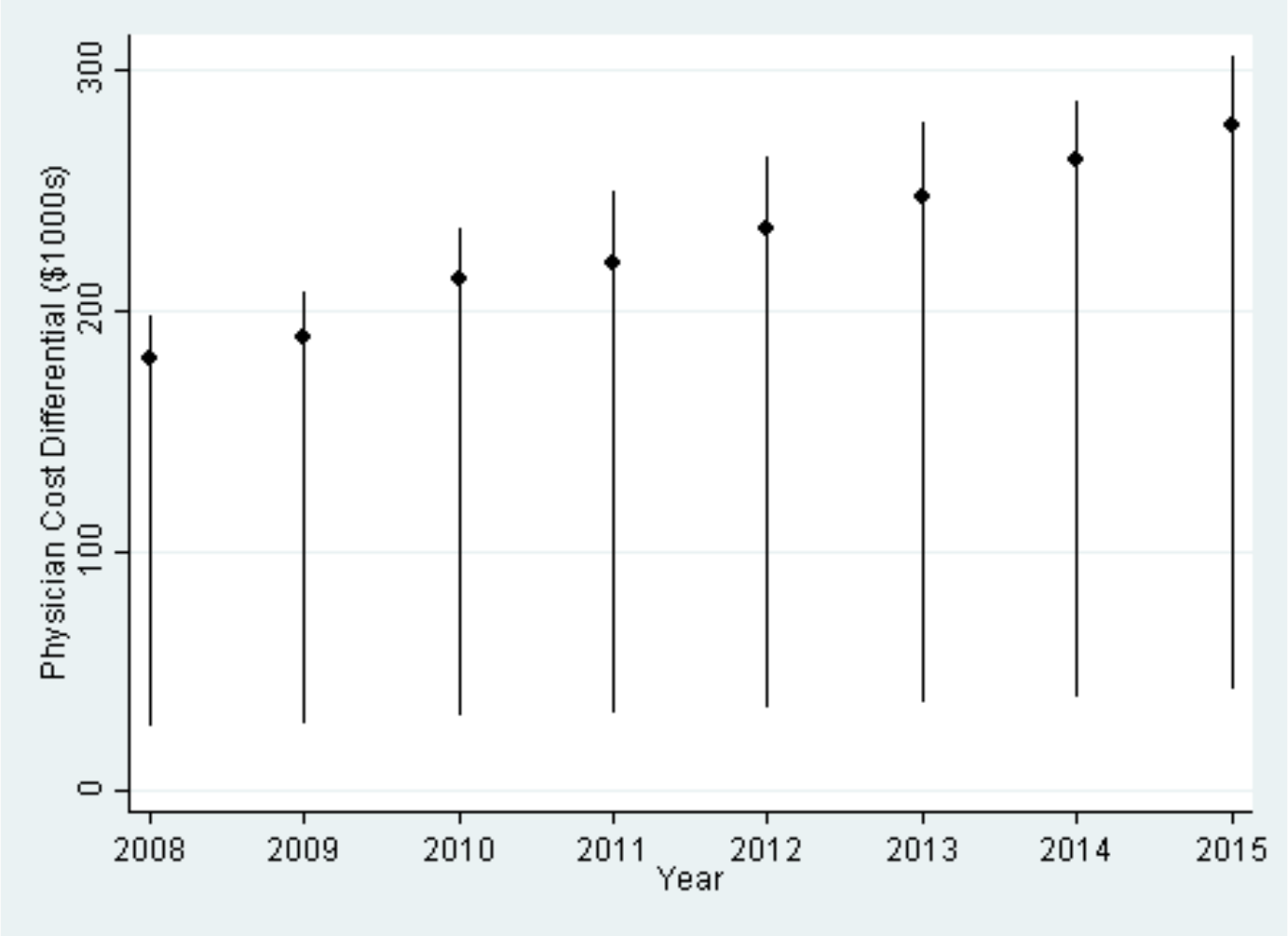

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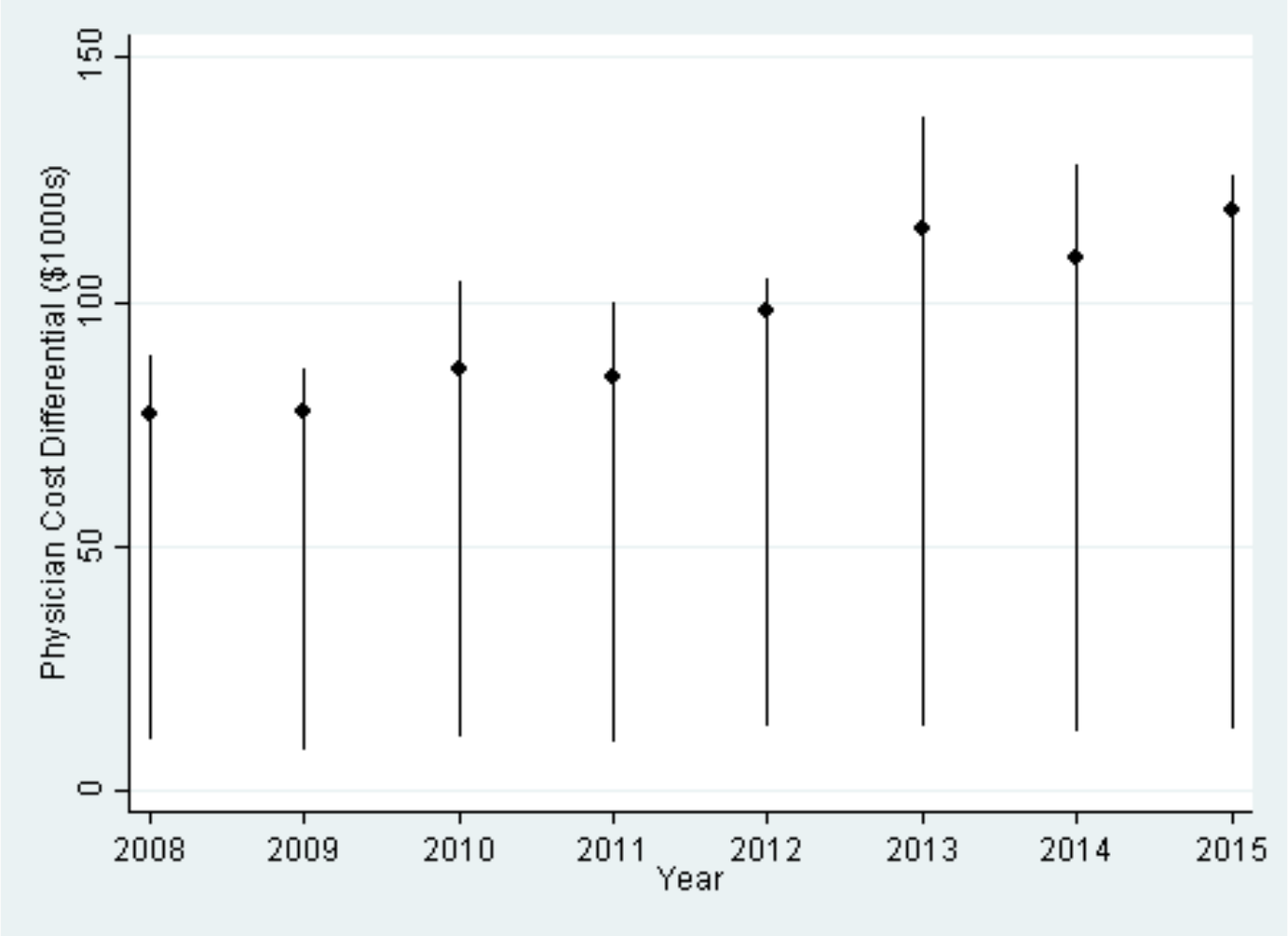

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Main Outcomes

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

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

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	(7,752)	(9,407)	(9,612)	(9,997)	(10,184)	(9,256)

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Inpatient LOS	5.984	6.021	6.002	6.062	6.029	5.960
	(2.427)	(2.493)	(2.494)	(2.513)	(2.492)	(2.436)

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

Independent Variables

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	2008	2012	2013	2014	2015	Overall
Integrated	0.130	0.206	0.233	0.255	0.332	0.196
	(0.336)	(0.404)	(0.422)	(0.436)	(0.471)	(0.397)

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	(99.28)	(109.8)	(120.5)	(120.0)	(119.5)	(110.9)

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	(108.2)	(120.4)	(121.4)	(125.9)	(127.8)	(117.8)

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Other FTE	749.9	763.0	761.8	776.4	806.0	762.8
	(975.5)	(1032.4)	(1076.2)	(1101.5)	(1157.2)	(1037.4)

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

Independent Variables

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

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	(32.10)	(30.70)	(29.28)	(28.46)	(28.02)	(30.05)
Experience	22.55	23.00	23.94	23.65	24.77	23.17
	(6.496)	(6.703)	(6.950)	(6.902)	(6.989)	(6.746)

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Experience	22.55	23.00	23.94	23.65	24.77	23.17
	(6.496)	(6.703)	(6.950)	(6.902)	(6.989)	(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

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

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Total Medicare Payments	110.945**	(46.768)

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Total Medicare Payments	110.945**	(46.768)
Total Hospital Costs	255.126***	(64.621)
Inpatient Hospital Costs	209.579***	(53.671)

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Total Medicare Payments	110.945**	(46.768)
Total Hospital Costs	255.126***	(64.621)
Inpatient Hospital Costs	209.579***	(53.671)
Inpatient Length of Stay	-0.028	(0.019)

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

Estimated Effects of Vertical Integration

Outcome	Estimate	St. Error
Total Medicare Payments	110.945**	(46.768)
Total Hospital Costs	255.126***	(64.621)
Inpatient Hospital Costs	209.579***	(53.671)
Inpatient Length of Stay	-0.028	(0.019)
Outpatient Hospital Costs	-58.581***	(20.320)

* 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

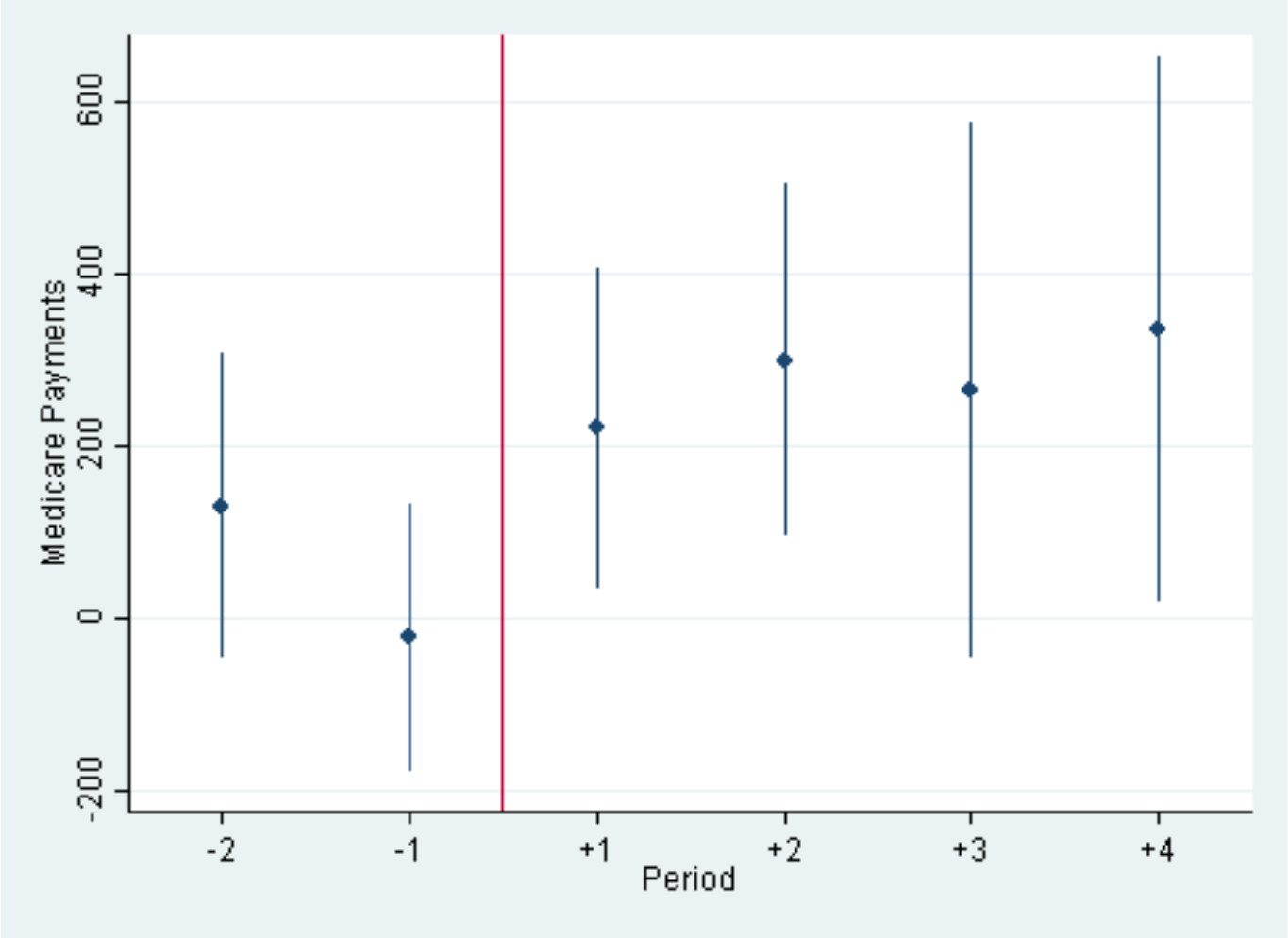
Threats to Identification and Interpretation

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

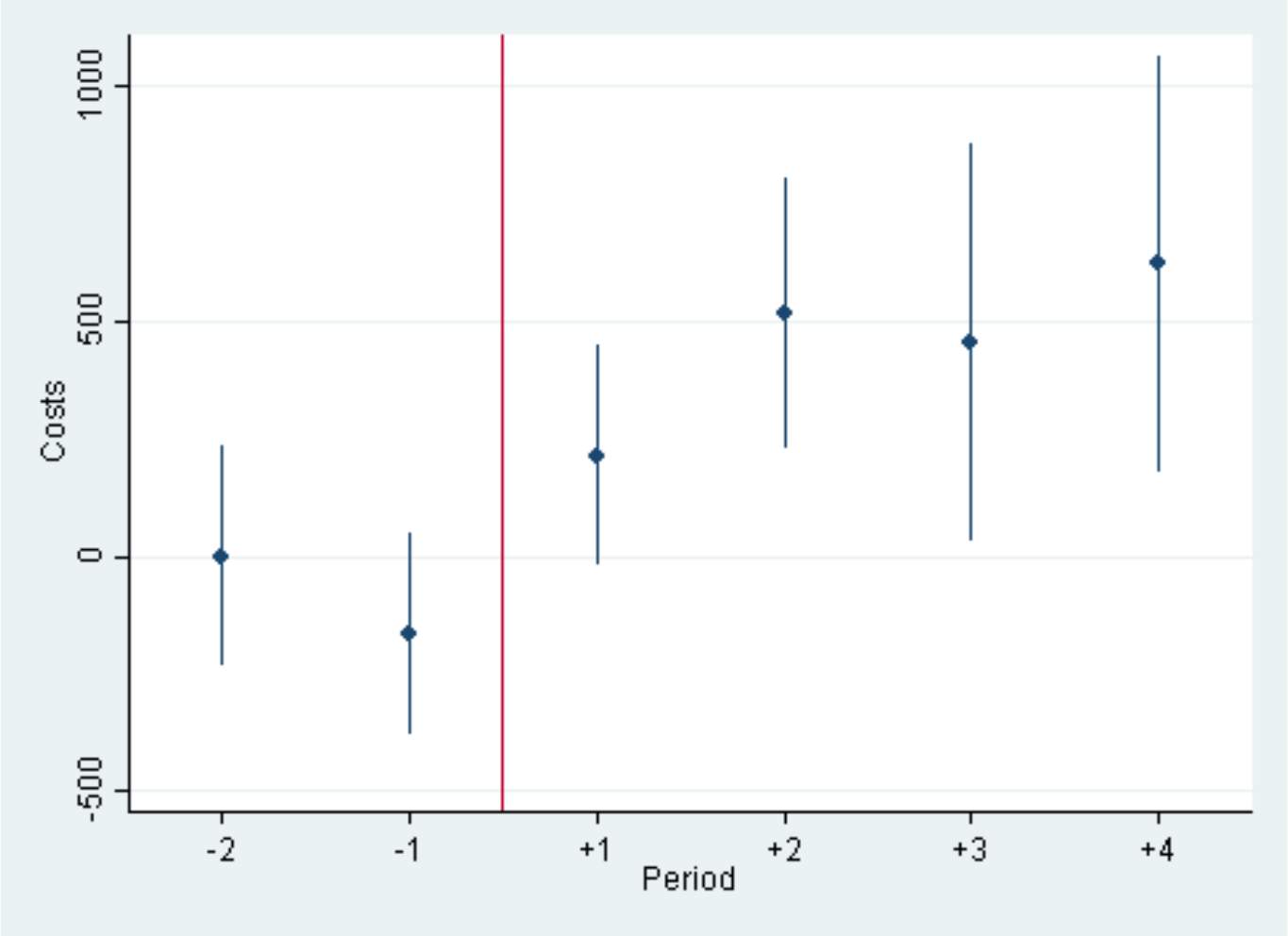
Potential Problems

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

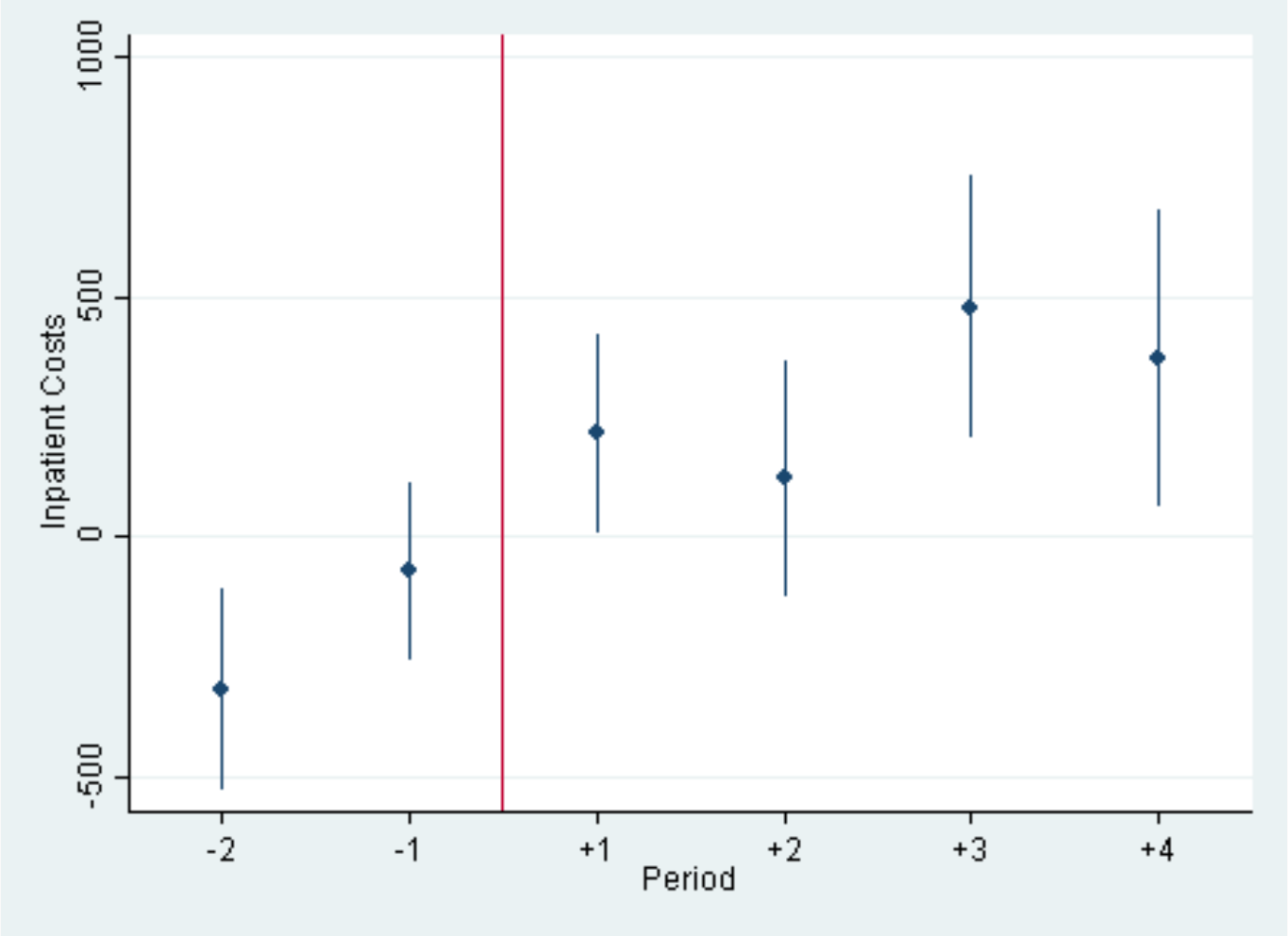
Event Study: Total Medicare Payments



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

Endogeneity of physician-hospital integration

2. Estimate probability of integration

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

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

Endogeneity of physician-hospital integration

2. Estimate probability of integration

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

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

Endogeneity of physician-hospital integration

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

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

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

Endogeneity of physician-hospital integration

Outcome	Estimate	St. Error

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

Endogeneity of physician-hospital integration

Outcome	Estimate	St. Error
Total Medicare Payments	1032.112**	(498.814)

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

Endogeneity of physician-hospital integration

Outcome	Estimate	St. Error
Total Medicare Payments	1032.112**	(498.814)
Total Hospital Costs	3213.162***	(696.032)

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

Endogeneity of physician-hospital integration

Outcome	Estimate	St. Error
Total Medicare Payments	1032.112**	(498.814)
Total Hospital Costs	3213.162***	(696.032)
Inpatient Hospital Costs	3081.788***	(533.495)

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

Endogeneity of physician-hospital integration

Outcome	Estimate	St. Error
Total Medicare Payments	1032.112**	(498.814)
Total Hospital Costs	3213.162***	(696.032)
Inpatient Hospital Costs	3081.788***	(533.495)
Inpatient Length of Stay	0.108	(0.179)

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

Endogeneity of physician-hospital integration

Outcome	Estimate	St. Error
Total Medicare Payments	1032.112**	(498.814)
Total Hospital Costs	3213.162***	(696.032)
Inpatient Hospital Costs	3081.788***	(533.495)
Inpatient Length of Stay	0.108	(0.179)
Outpatient Hospital Costs	-337.977*	(204.733)

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

Allocation of Procedures and Patients

Other Effects

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

Results on Other Outcomes

Outcome	Estimate	St. Error

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

Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.065***	(0.003)

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

Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.065***	(0.003)
Physician's outpatient share	0.047***	(0.003)

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

Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.065***	(0.003)
Physician's outpatient share	0.047***	(0.003)
Total patients	6.892***	(0.527)

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

Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.065***	(0.003)
Physician's outpatient share	0.047***	(0.003)
Total patients	6.892***	(0.527)
Inpatient procedures	0.784***	(0.169)

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

Results on Other Outcomes

Outcome	Estimate	St. Error
Physician's inpatient share	0.065***	(0.003)
Physician's outpatient share	0.047***	(0.003)
Total patients	6.892***	(0.527)
Inpatient procedures	0.784***	(0.169)
Outpatient procedures	9.929***	(1.087)

* 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 ($255-$500)
- Extrapolates to between $77 and $210 million in added Medicare payments from vertical integration

Summary of Results

Sensitivity

- Event study consistent with common trends for Medicare payments and total hospital costs
- Calculation of 2×2 DD weights suggests relatively small portion of negative weights (70% positive weights)
- 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 (13 new outpatient procedures per inpatient procedure)

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