Intermediation and Vertical Integration in the Market for Surgeons

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Motivation

- Rapid acquisition of physician practices by large, integrated health systems
- July 2012 to July 2016:
  - % of U.S. physician practices owned by a health system: 14% $\rightarrow$ 29%
  - % of U.S. physicians employed by a health system: 26% $\rightarrow$ 42%
- Along with many other forms of financial contracting

- Encouraged by new innovations in public and private reimbursement (Accountable Care Organizations, risk contracts, etc.)

Motivation

- Integration allows coordination between PCPs and specialists, creating trade-off:
  - Coordination may improve **productive** efficiency of care provision
  - But may damage **allocative** efficiency by encouraging PCP 'steering' of referrals towards less-efficient integrated specialists
- Akin to 'efficiencies vs. foreclosure' trade-off

- U.S. health care context:
  - Substantial productivity dispersion $\rightarrow$ weak productive efficiency (Fisher et al 2003)
  - Patient cost-insensitivity $\rightarrow$ weak allocative efficiency (Brot-Goldberg et al 2017, Lieber 2017, Sood et al 2013)
  - Gaynor 2006: "Is Vertical Integration Anticompetitive? Definitely Maybe (But That's Not Final)"

This Paper

- How does vertical integration shape the productivity of health care?
- What drives heterogeneity in 'the effect' of vertical integration?
  1. Productive efficiencies
  2. Allocative distortions
  3. Market structure

- Application: Orthopedic joint specialists in Massachusetts
  - Highly integrated market: Nearly every PCP and orthopedist integrated in some way, 2/3 of patients have integrated PCP & orthopedist

- Pervasive integration and complex VI effects make identification of counterfactual tricky

Roadmap

1. Setting
   - PCPs + Orthopedists
   - Data
   - Model
2. Estimation
   - Cost model
   - Demand model
3. Counterfactual Simulations

Vertical Integration with Primary Care Providers

- Why integrate?
- **Integration allows for coordination across providers**
  - Anti-kickback laws restrict ability of providers to contract across firm boundaries
  - HIPAA restricts communication about patients
  - Integrated organizations may facilitate communications for trust/convenience reasons
- Why efficient? **Non-duplication of effort**
- Limit use of imaging, time spent on evaluation, etc.

- Systems can use incentives to encourage PCPs to steer patient referrals internally
- Pay-for-referrals is illegal, but systems use other payments to circumvent

Steward Health Care pressured doctors to restrict referrals outside chain, suit says

- *Sometimes Steward representatives would call his patients...incorrectly telling them they had to [go to] a Steward facility...other times, they would cancel appointments Zappala's office had made for patients at competing hospitals...*
- *...when he refused to comply...[Steward] disciplined him for minor infractions...*
- *...the company rejected outside referrals regardless of patients' preferences — and publicly "shamed" physicians who refused to comply.*
- *Steward withheld his $25,000 bonus...*
- *Steward terminated Zappala for...a serious charge...which he denies.*

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- *Steward withheld his $25,000 bonus...*
- *Steward terminated Zappala for...a serious charge...which he denies.*
- Steward's lawyer: These practices "legal and extremely common"

▸ Even more quotes

Data

Two data sources:

- Massachusetts All-Payer Claims Database
  - Near-universe of commercial health insurance claims from 2010-2014
  - Patient demographics, insurer information, participation in supply-side incentives
  - Claim-line level data on procedures performed
  - **Cannot see referrals directly**–only where patients saw care

- Massachusetts Provider Directory
  - Matches physicians to their practice & larger organizational hierarchies
  - Observe snapshot from December 2014
  - Measure vertical integration between PCP and orthopedist, V_{jk}, as any organizational link

Data: Massachusetts Provider Directory

Participation in six largest systems:

Health System	PCP Share	Orthopedist Share
Atrius	0.09	0.06
Beth Israel	0.11	0.09
NEQCA	0.08	0.11
Partners	0.22	0.30
Steward	0.10	0.17
UMass	0.07	0.04
Any of the 6	0.67	0.75

Setting: Orthopedic Joint Specialists

- Orthopedists second-highest-paid medical specialty (Medscape 2018)
- 8% of medical spending, 1.3% of GDP
- Joint surgery is major target of Medicare cost and quality maintenance efforts

- Large volume, primarily non-emergent: Good for understanding referral patterns
- Substantial discretion over treatment plan:
  - Surgical: Arthroscopy; total joint replacements
  - Non-surgical: Pain management; cortisone shots

- Our sample: MA-based orthopedists who perform $>$5 joint replacements in 2010-2014

Summary Statistics

Joint Orthopedists

	Full Sample	Matched to MPD
% Male	95.9%	97.6%
% In Boston HRR	77.1%	78.1%
% Matched to MPD	80.1%	100%
% PCP Link	-	98.5%
% Membership in Large System	-	75.2%
# of total joint replacement surgeries per year		
Mean	59	65
25th	11	13
75th	69	73
N	258	206

Sample Construction

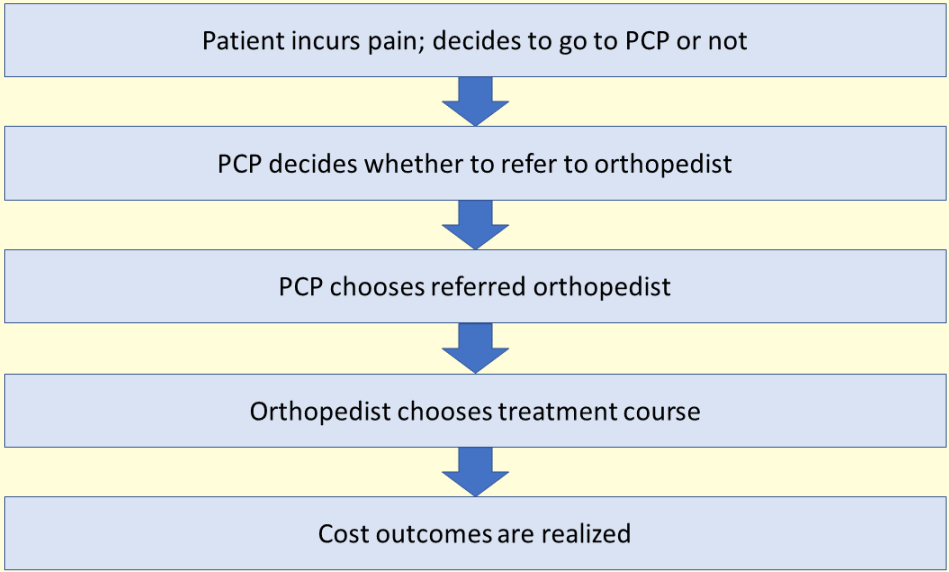
- We want database where observation unit is a referral handoff
- Pull all orthopedist claims
- Index at each patient's first evaluative office visit
  - Use only CPT codes starting with '992'
- Assign them a PCP based on physician seen most in prior 12 months for E&M office visits (Pham et al. 2009, Agha et al. 2018)
- Restrict to 2012-2014
- Drop cases where PCP cannot be assigned
- Drop cases where PCP or orthopedist do not match to MPD

Summary Statistics

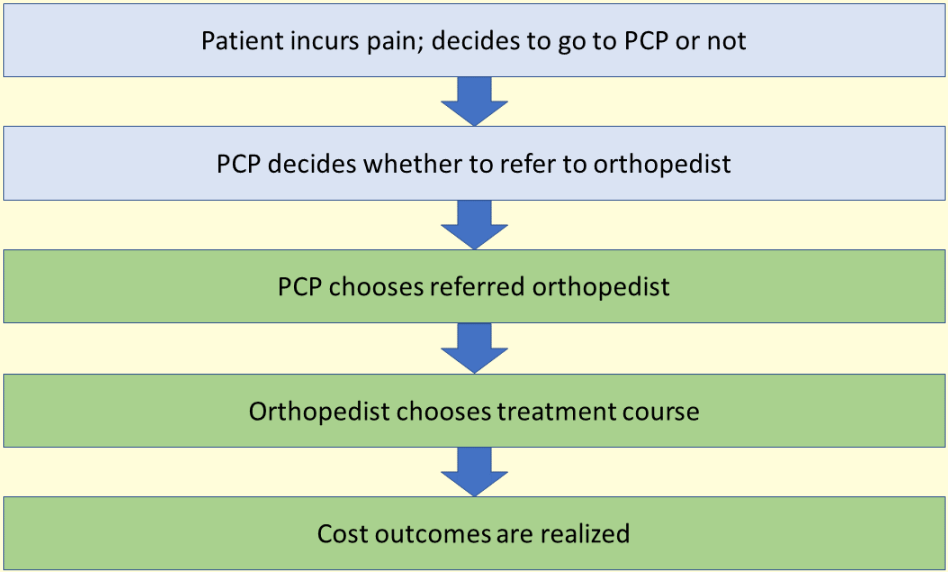
Patients

	Full Sample	Matched to PCP	Matched to MPD
% Male	45.0%	42.7%	42.6%
Average Age	48.9	50.4	50.6
% In Boston HRR	75.9%	75.4%	75.5%
% Employer-Sponsored Ins.	76.9%	75.7%	77.6%
% With Vertically-Tied PCP	-	-	96.1%
% Internal Referral	-	-	63.1%
% 1-Year Receives Surgery	18.6%	19.3%	19.5%
Avg. 1-Year Post Spending	$14,013	$12,935	$14,202
N	222,380	167,183	126,956
Num. PCPs	-	5,550	4,115
Num. Orthopedists	262	258	206

Patient Flow Through Health System



Patient Flow Through Health System



Model

- Patient i is sent by PCP j to orthopedist k
- Cost outcomes:

$$Y_{ijk} = g(X_i, k, V_{jk}, v_{ijk})$$

  for patient demographics X_i and vertical integration term V_{jk}

- Choice utility of patient-PCP pair:

$$u_{ijk} = f(X_i, \mathbb{E}[Y_{ijk}], Z_k, V_{jk}, \epsilon_{ijk})$$

  with orthopedist characteristics Z_k

- Productive efficiencies $\eta = \mathbb{E}[g(X, k, 1, v) - g(X, k, 0, v)]$
- Steering effect $T = \mathbb{E}[f(X, \mathbb{E}[Y], Z, 1, \epsilon) - f(X, \mathbb{E}[Y], Z, 0, \epsilon)]$

Model

- How does vertical integration affect outcomes?

- First-order effect on demand for k:

$$\Delta D_{ijk} = \frac{\partial D_{ijk}}{\partial u_{ijk}} \left(T - \frac{\partial u_{ijk}}{\partial Y_{ijk}} \eta \right)$$

- First-order effect on cost outcomes:

$$\Delta Y_{ij} = D_{ijk}\eta + \Delta D_{ijk} \left((Y_{ijk} + \eta) - Y_{ijk'} \right)$$

- Effect of vertical integration depends on market structure (u_{ijk}, Y_{ijk}) and vertical conduct (T, η)

Empirical Strategy

Face two challenges to identification:

1. Effects of VI on main two outcomes include both η and T
   - Solution: Use two-step estimation process
   - First estimate η as spending effect of VI *conditional on orthopedist choice*
   - Then estimate T as effect of VI on orthopedist choice *given* η *estimate*

2. Nearly all doctors integrated, so how can we estimate no-integration counterfactual?
   - Solution: Use variation in integration of PCP-orthopedist **pairs**
   - Need to make a set of no-sorting assumptions for patients, PCPs
   - Uncover effect of pairwise integration, not affiliation

Roadmap

1. Estimate cost function for orthopedic treatment
   - Get estimates of Y_{ijk} and η
2. Estimate demand for orthopedists
   - Get estimates of u_{ijk} and T
3. Use parameter estimates to simulate counterfactuals
   - Measure counterfactual demand flows and costs without integration

Estimating Orthopedist Cost Function

- Model Y_i, 1-year all-cause spending after first orthopedist visit:

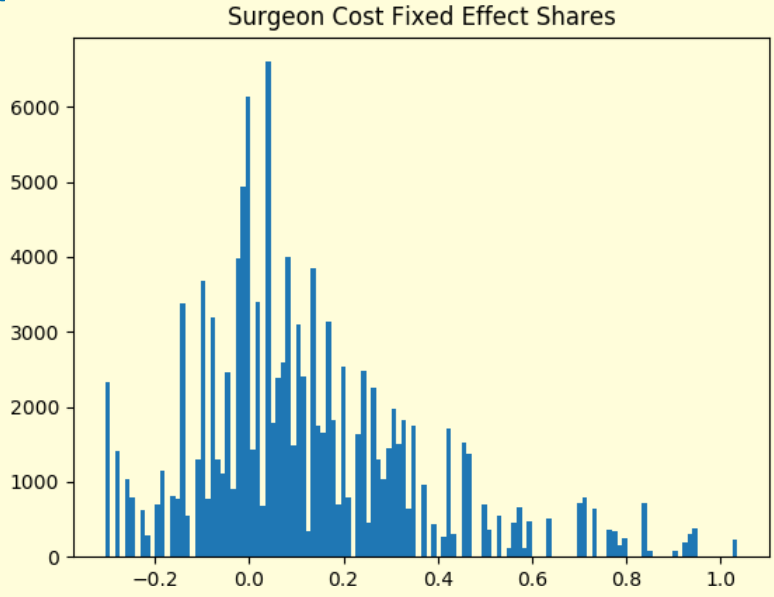
$$\log Y_i = \gamma_{k(i)} + \eta V_{j(i)k(i)} + \xi X_i + v_i$$

- X_i: Demographics, health status, insurer-plan FEs, PCP FEs
- γ_k is risk-adjusted cost of treatment by k
- Empirical Bayes shrinkage of γ_k (Chetty et al 2014, Chandra et al 2016)
- η is measure of vertical efficiencies
- Identification: No sorting on unobservables ▸ Limited sorting on unobservables
- η identified by *within-orthopedist* variation *across PCPs* in PCP-ortho integration

Orthopedist Cost Estimates

Standard Deviation of $\hat{\gamma}_k$	0.29	0.32
η (Vertical Efficiencies)		
Constant	-0.06	-0.04
	(0.01)	(0.02)
Partners (high-cost)		0.02
		(0.03)
Atrius (medium-cost)		-0.17
		(0.04)
Steward (low-cost)		0.00
		(0.04)

Share-Weighted Distribution of γ



Robustness

- Extensive-margin surgery propensity explains 30% of variation ▸ Details
- 1σ: 10pp increased odds of any surgery
- Match to ProPublica Surgeon Scorecard to measure orthopedist quality
- $\hat{\gamma}_k$ uncorrelated with quality measures ▸ Details
- Efficiencies come from other services (e.g. imaging), not directly-provided orthopedist services ▸ Details
- Limited evidence for sorting on observables ▸ Details

Demand for Orthopedists

- With cost function estimated, we now must estimate demand model
- Choice utility of PCP j for patient i at orthopedist k:

$$u_{ik} = \beta_i^Y(\widehat{\gamma_k} + \widehat{\eta} V_{j(i)k}) + V_{j(i)k} T_{m(j(i))} + \beta_i^Z Z_k + \epsilon_{ik}$$

- Z_k: Surgery propensity, distance, quality, system dummies
- β depends on age bracket, gender, comorbidities, PCP capitation status
- β^Y, T can vary across systems m
- Identification: E.g. Atrius PCPs' preferences over Partners vs. Steward informative about counterfactual Partners PCPs' preferences ▸ Illustration
- Need integration to *only* affect choice utility at own orthopedists

Parameter Estimates

	Average β_i^Y	T
Average	-0.02	1.63
	(0.05)	(0.01)
Partners (high-cost)	0.04	1.81
	(0.05)	(0.02)
Atrius (medium-cost)	-0.01	2.65
	(0.05)	(0.02)
Steward (low-cost)	-0.10	1.40
	(0.05)	(0.02)

- Virtually no cost-sensitivity
  - In utility terms: 1σ higher $\epsilon = 213\sigma$ higher costs
- T not increasing in potential system rents ▸ Scatterplot
  - High Atrius T, although Atrius owns no hospitals

Counterfactuals

- How does vertical integration affect outcomes?
- Simulate breaking all vertical relationships
  - Go from status quo to no efficiencies ($\eta = 0$)
  - Go from no efficiencies to no integration ($V_{jk} = 0$)
- Measure effects on internal referral rates and expected cost outcomes
- Change parameters, recompute orthopedist market shares, compute expected log costs from cost model
- Abstract from general equilibrium price/quantity responses

Counterfactuals

Internal Referrals

PCP Org.	Status Quo	Internal Referral Rate No Efficiencies	No Integration
All PCPs	63.0%	61.6%	25.7%
Partners (high-cost)	76.4%	76.0%	38.6%
Atrius (medium-cost)	59.9%	54.1%	8.90%
Steward (low-cost)	67.2%	66.8%	42.3%

▸ Full Table

- Integration explains 59% of internal referral volumes, efficiencies explain 3%

Counterfactuals

Costs

- Cost difference relative to status quo ($+$ means cost increases from disintegration)

PCP Org.	Effect on Expected Costs: No Integration	No Efficiencies	No Steering
All PCPs	+6.0%	+5.0%	+1.0%
Partners (high-cost)	-2.2%	+2.0%	-4.2%
Atrius (medium-cost)	+19.9%	+14.0%	+5.9%
Steward (low-cost)	+7.3%	+3.0%	+4.3%

▸ Full Table

Counterfactuals

- Wide variation in sign of steering effect even without efficiencies
- Why? **No demand sensitivity to costs**
  - Absent steering, patients not sorting to low-cost orthopedists
  - Low-average-cost systems' steering reduces expected costs
  - Zero steering effect requires β to be -0.8 (40x higher)
  - High bar: Demand-side policies have close to 0 impact on β (Sood et al 2013, Brot-Goldberg et al 2017)
  - Supply-side incentives: Estimated effect of global capitation contracts on β is -0.56
- Omitted: GE price effects ▸ Literature review

Counterfactuals

Costs

- Counterfactuals when we add supply-side incentives in β:

	Effect on Expected Costs		
PCP Org.	No Integration	No Efficiencies	No Steering
All PCPs	+5.7%	+5.2%	+0.6%
Partners (high-cost)	-2.4%	+1.9%	-4.3%
Atrius (medium-cost)	+19.9%	+15.0%	+4.9%
Steward (low-cost)	+6.7%	+3.2%	+3.5%

▸ Full Table

- Better outside options $\rightarrow$ steering less beneficial
- Increased self-dealing by low-cost systems $\rightarrow$ efficiencies more beneficial

Implications for Antitrust Policy

- Ex ante evaluation of vertical mergers requires estimation of both market structure and post-merger conduct
- Our estimates suggest substantial heterogeneity in conduct
- No singular ‘effect of VI’: Data from other organizations would produce a biased estimate of impact of VI
- Need better models and data for intra-firm contracts to make predictions

- Evidence of foreclosure not per se evidence of harm

Discussion

- Vertical relationships in health care drive industry productivity
  - Substantial positive and negative static effects
  - Potential effects intertwined with both underlying market structure and vertical conduct
  - Increasing horizontal cost competition can be complement *or* substitute for vertical action

- Worries about dynamics: No cost competition means dynamic efficiency driven by dynamics of integration
- Policy towards mergers may shape productivity dynamics

Thank you!

THE WALL STREET JOURNAL.

The Hidden System That Explains How Your Doctor Makes Referrals

- *If the share of in-house business wasn't viewed as adequate, administrators [at Phoebe Putney Health System] would press them to improve, doctors said.*
- *...hospital executives would talk in meetings with doctors about the need to maximize the system's market share.*
- *"We do not use our referral tracking data to put pressure on our physicians to refer to their partners within our system. However, if an employed physician routinely refers patients outside of our group without good reasons to do so, then that physician is not demonstrating commitment to the best interest of the patients and may not fit well within our team of outstanding health-care professionals."*

Back

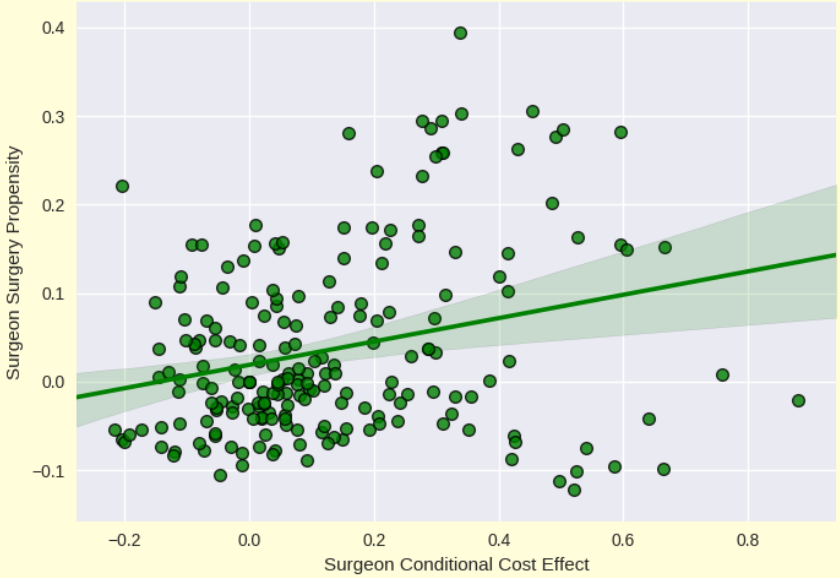
Explaining Orthopedist Variations

- Why are orthopedists expensive?
  1. Do many surgeries
  2. Incur many costs otherwise
- Decomposition of surgeon variation across these channels
- Run two regressions:

$$
\begin{aligned}
surg_i &= \delta^{surg} X_i + \gamma^{surg}_{k(i)} + \eta^{surg} V_{j(i)k(i)} + v^{surg}_i \\
\log Y_i &= \delta^{other} X_i + \gamma^{other}_{k(i)} + \eta^{other} V_{j(i)k(i)} + \theta surg_i + v^{other}_i
\end{aligned}
$$

- 1 s.d.:
  - γ^{surg}_k: 0.103
  - γ^{other}_k: 0.206
- Surgery increases costs by 1.56 log points (θ)

Explaining Orthopedist Variations



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Explaining Orthopedist Variations

- Note that $\gamma_k = \theta\gamma_k^{surg} + \gamma_k^{other}$
- We decompose the variation in γ_k:

	Unshrunken	Shrunken
Variance Component of Surgery Costs	28.7%	30.0%
Variance Component of Other Costs	59.0%	49.6%
2x Covariance Component	12.6%	20.4%

- Reducing surgeries has ambiguous welfare consequences, reducing other costs generally positive

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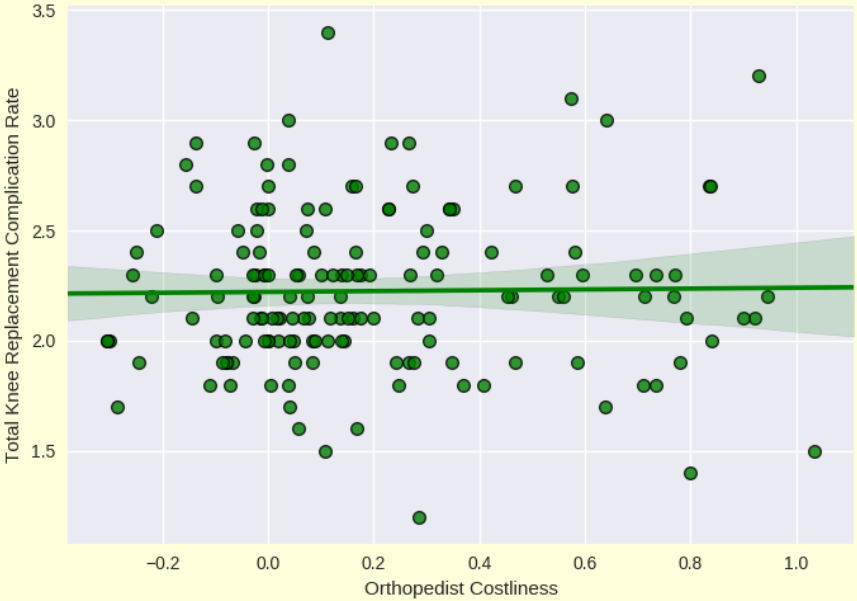
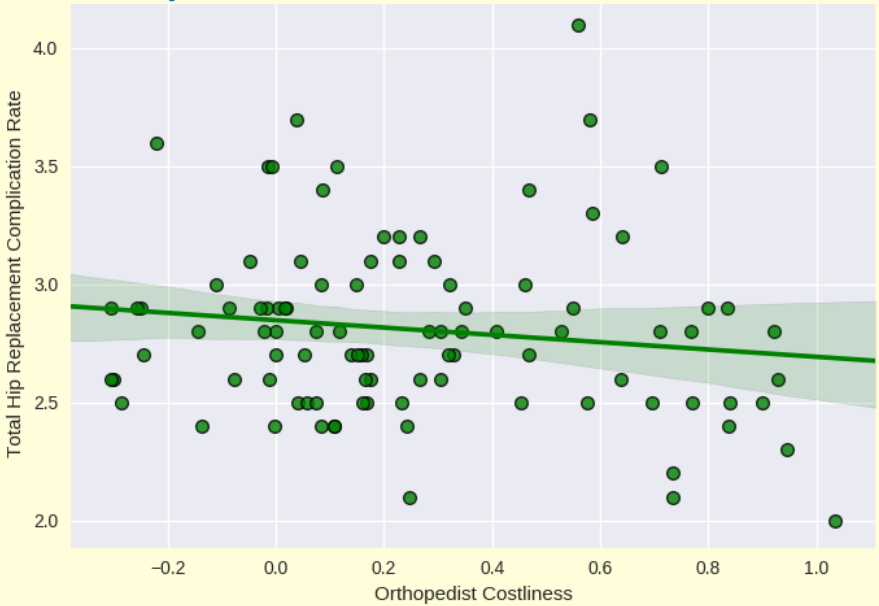
Cost vs. Quality

- Are our cost measures reflecting vertical differentiation by quality?
- Quality is hard to measure outside of surgical settings
- Use total joint replacement quality measures reported by ProPublica
- Measured using Medicare data from 2009-2013
  - Same time period, but different data
  - Purged of causal relation between quality/cost

Cost vs. Quality



Cost vs. Quality



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Variation by Type of Spending

- Recreate cost model estimates for spending subtypes:

	Orthopedics Only	Orthopedist Only	Imaging
Standard Deviation of γ_k^{Type}	0.613	0.554	0.428
η (Vertical Efficiencies)	-0.033	0.001	-0.074
	(0.014)	(0.007)	(0.014)

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Sorting

- Exercise inspired by Altonji et al. 2005: Examine sorting on observable sickness
- If patients do not sort to orthopedists on observable costliness, hard to believe they will sort on unobservable costliness
- Measure observable costliness in two ways:
  1. Elixhauser Comorbidity Index
  2. Patient contribution to costs δX_i
- Take bins of costliness, measure average:
  1. Expected cost of orthopedist $\gamma_{k(i)}$
  2. Share referred internally

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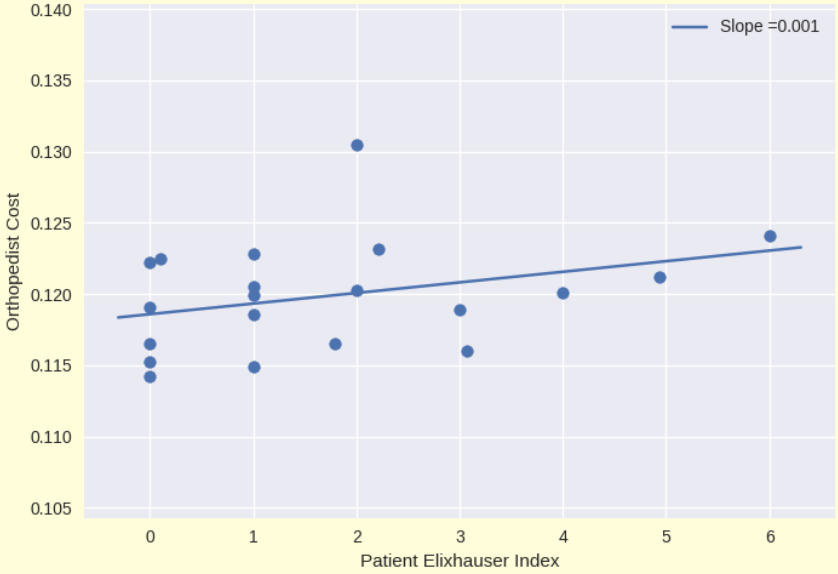
Sorting



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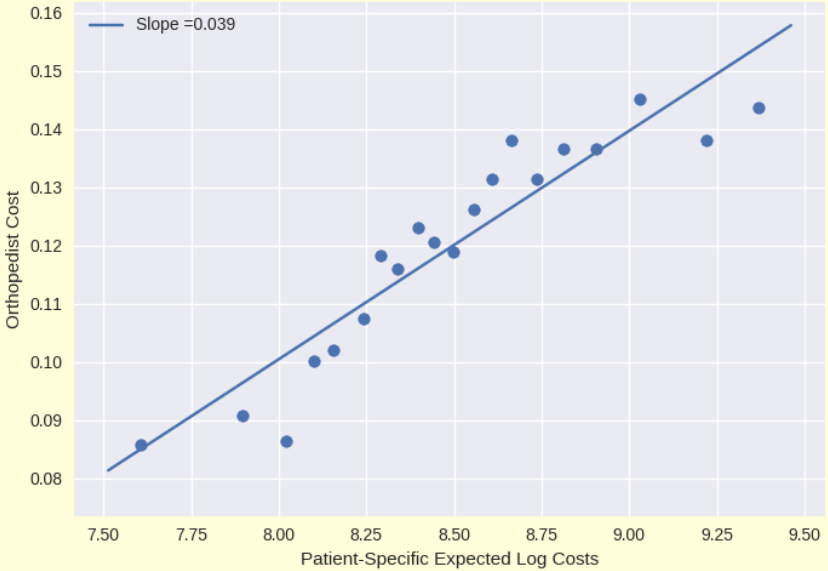

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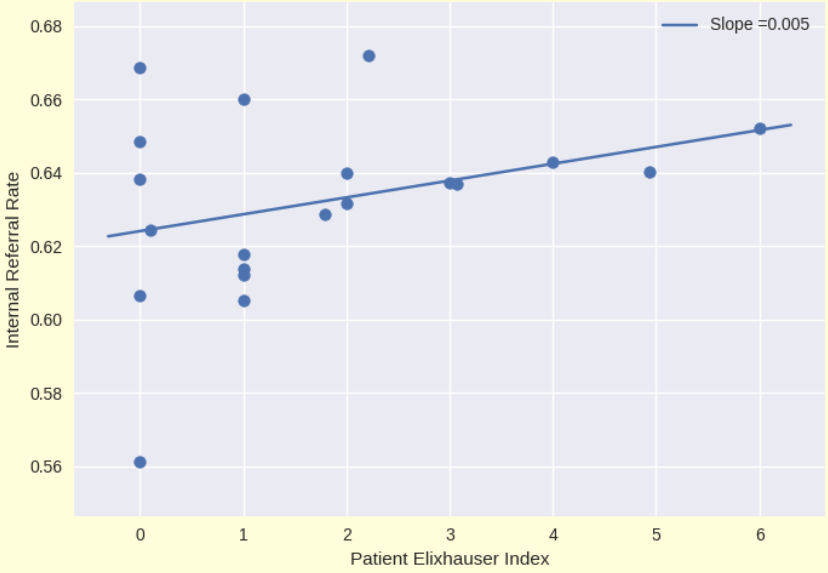

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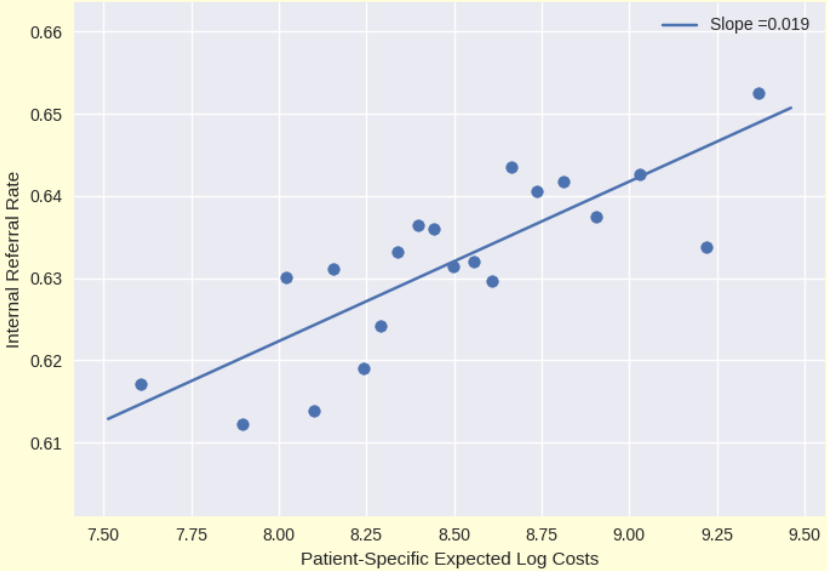

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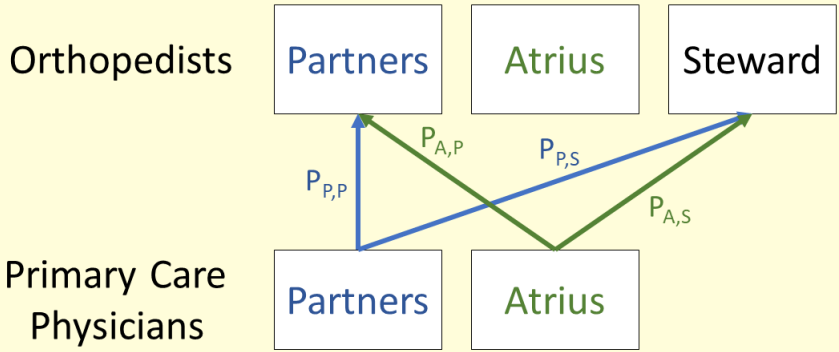
Identification of T



$$T_P \approx \log\left(\frac{P_{P,P}}{P_{P,P} + P_{P,S}}\right) - \log\left(\frac{P_{A,P}}{P_{A,P} + P_{A,S}}\right)$$

Back

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Steward	67.2%	66.8%	42.3%
UMass	56.6%	56.2%	34.9%

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Steward	+6.7%	+3.2%	+3.5%
UMass	-3.0%	+1.6%	-4.7%

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Price Effects

Paper	Estimate	Unit
Ciliberto & Dranove 2006	-9% – -1%	Hospitals
Cuellar & Gertler 2006	-$25 – +$93	Hospitals (per patient-day)
Baker, Bundorf, and Kessler 2014	0% – +3.4%	Hospitals
Neprash et al 2015	+$1,182	Outpatient (per patient)
Neprash et al 2015	+$240	Inpatient Hosp (per patient)
Capps, Dranove, and Ody 2018	+14%	Physicians

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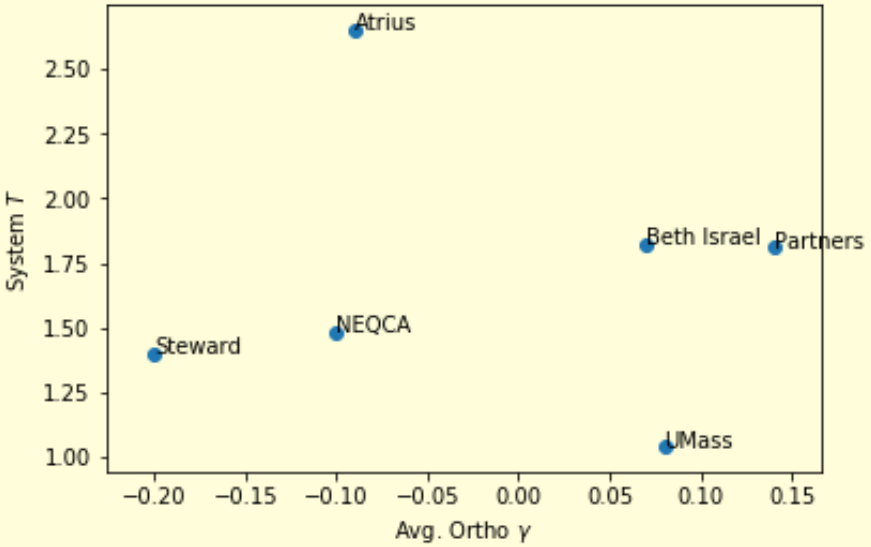
A Rent-Seeking Theory of the Firm?



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