Industrial Organization of Health Care Markets

Empirical Industrial Organization II: Topics

Tanja Saxell
VATT and Helsinki GSE

Email: tanja.saxell@vatt.fi

Health Care and IO

- Introduction (Part 1)
  - What is IO of health care markets?
  - Why study health care?
- Markets for health insurance (Part 1)
- Hospital industry (Part 2)
  - Demand for hospitals
  - Connection with health insurance (hospital networks offered by plans)
  - Regulation
  - Allocation and performance in hospital markets

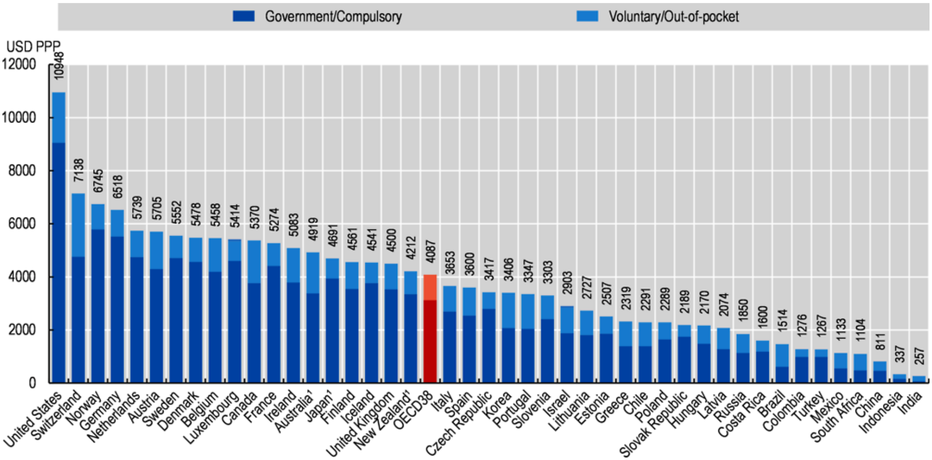
Health Care and IO: Review Articles

- Handel Ben, and Kate, Ho "Chapter 16: The industrial organization of health care markets". Handbook of Industrial Organization, 2021, Volume 5. (Part 1)
- Gaynor, Martin, Kate Ho, and Robert J. Town "The industrial organization of health-care markets." Journal of Economic Literature, 2015, 53 (2): 235-84. (Part 2)

Health Care and IO: Analyses of Markets for Health Care

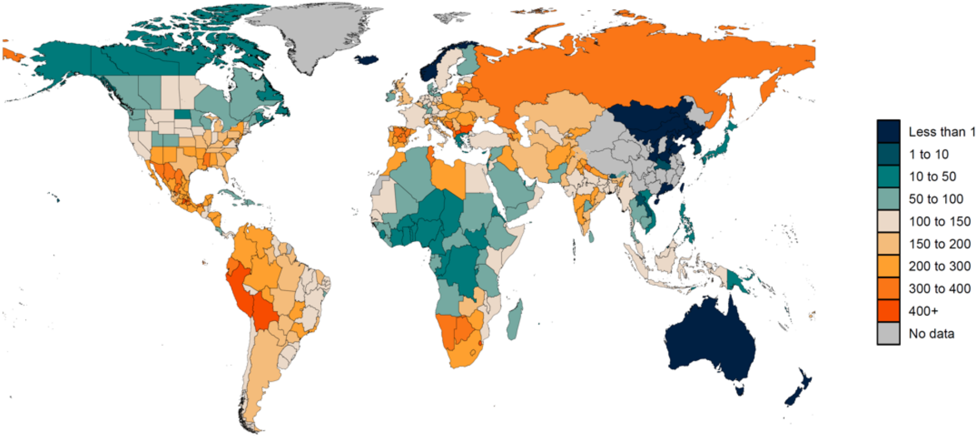
- How markets work from the point of view of patients (consumers), providers (public, private), government (regulator) etc.
- What type of market imperfections there are?
- How and why markets should be regulated?
- What determines the market power of hospitals? Should we allow hospital mergers to save costs?

Why Study Health Care (in 4 Slides)? It's Expensive



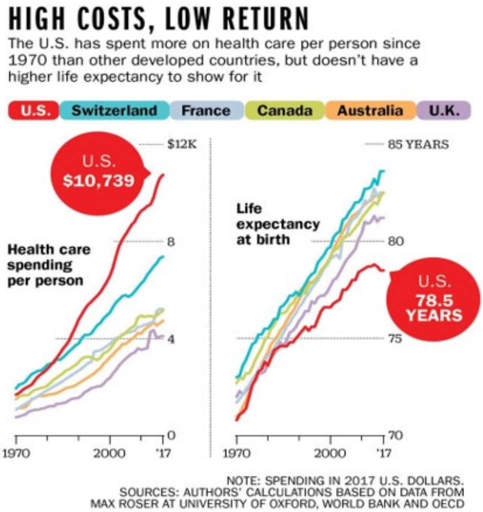
Health expenditure per capita, 2019 (or nearest year). Source: OECD

Why Study Health Care? Large Variation in Outcomes



Estimated excess mortality rate (deaths per 100,000) from March 1, 2020, to September 26, 2021. Source: Healthdata.org

Why Study Health Care? Potential For Inefficiency



Why Study Health Care? High-Quality Data!

- Examples of administrative patient-level data:
  - Hospital discharge data: hospital choices, treatment decisions, diagnoses
  - Data on private sector visits: treatment decisions, provider prices, reimbursements
  - Prescription data: prescribing decisions, pharmaceutical prices, and reimbursements
- Examples of publicly available data:
  - Regulatory decisions of medical agencies (e.g., market approval or entry of new drugs) and patent offices

Key Sources of Market Imperfections

- Uncertainty about health status, quality of care etc.
  - "Recovery from disease is as unpredictable as is its incidence"
- Asymmetric information between consumers, insurers, care providers
- Externalities: becoming sick affects others around you, especially in the case of contagious diseases

Consequences of Market Imperfections

- Scope for regulation: public provision, health insurance, entry restrictions
- Competition does not work as intended
- Often, there is very little or no competition (public monopolies)

Today's Topic and Papers

- Topic: markets for health insurance
- Papers:
  - Einav, Liran and Finkelstein, Amy "Selection in Insurance Markets: Theory and Empirics in Pictures". Journal of Economic Perspectives, 2011, 25(1): 115-138.
  - Einav, Liran, Finkelstein, Amy and Cullen, Mark. "Estimating Welfare in Insurance Markets Using Variation in Prices." The Quarterly Journal of Economics, 2010, 125(3): 877-921.

Today's First Paper

Einav, Liran and Finkelstein, Amy "Selection in Insurance Markets: Theory and Empirics in Pictures". Journal of Economic Perspectives, 2011, 25(1): 115-138.

Markets for Health Insurance

- Government interventions in insurance markets are common from the large-scale public insurance programs to the heavily regulated private insurance markets
- The fundamental theoretical reason for such intervention, based on classic work from the 1970s, is the problem of adverse selection
- Another one is moral hazard

Basic Definitions

- Adverse selection
  - A buyer had more information than the seller, for example, about the potential loss risk (e.g., becoming sick)
- Moral hazard
  - A person with insurance takes greater risks than they normally would without insurance

Adverse Selection: Textbook Example

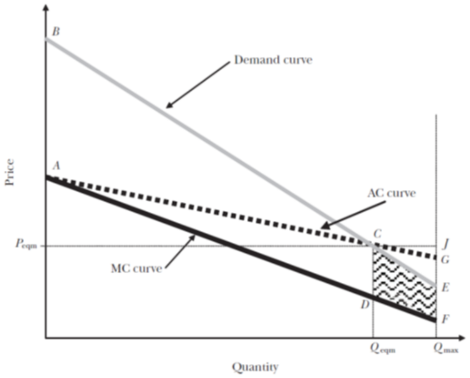
- Firms are perfectly competitive, risk-neutral, offer a single insurance contract that covers some probabilistic loss
- Risk-averse individuals differ only in their privately-known probability of incurring that loss (getting sick)
- No other frictions in providing insurance, such as administrative or claim-processing costs

Adverse Selection: Textbook Example

- Consumers make a binary choice of whether or not to purchase a contract
- Firms offer a single price for pools of observationally identical but in fact heterogeneous individuals

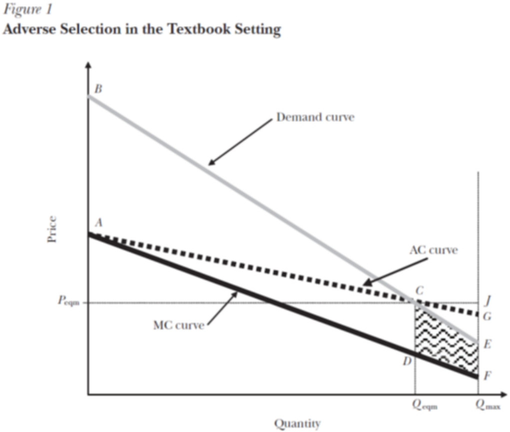
Adverse Selection

Figure 1
Adverse Selection in the Textbook Setting



- Willingness to pay (WTP) for insurance is increasing in risk type/expected cost
- The shape of the cost curve is driven by the demand-side customer selection

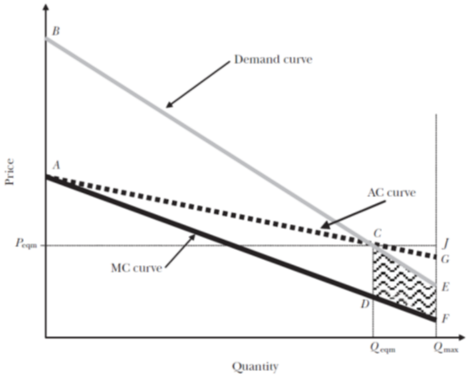
Adverse Selection



- The competitive equilibrium: P = AC
- AC > MC: the equilibrium quantity (price) of insurance will be less than the efficient quantity (price) ▸ Advantageous selection

Adverse Selection

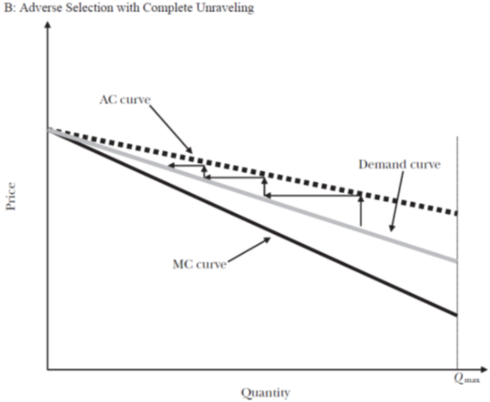
Figure 1
Adverse Selection in the Textbook Setting



- The welfare loss from adverse selection is the area of the deadweight loss trapezoid DCEF

Adverse Selection with Complete Unraveling

Figure 2 (continued)



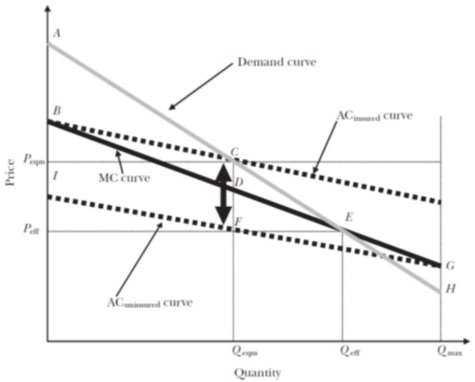
- The AC curve always lies above the demand curve and the MC curve is always below it
- The competitive equilibrium: no individual in the market is insured, while the efficient outcome is for everyone to have insurance

Empirical Work on Selection

- How we can test for whether the classic adverse selection models apply in real-world insurance markets?
- In other words, what would selection look like in the data, when or if it exists?
- Testing for adverse selection essentially requires us to test whether the MC curve is downward sloping.
- Making inferences about marginal individuals is difficult, however.
- Instead, compare the expected cost of those with insurance to the expected cost of those without (or compare those with more insurance coverage to those with less coverage).

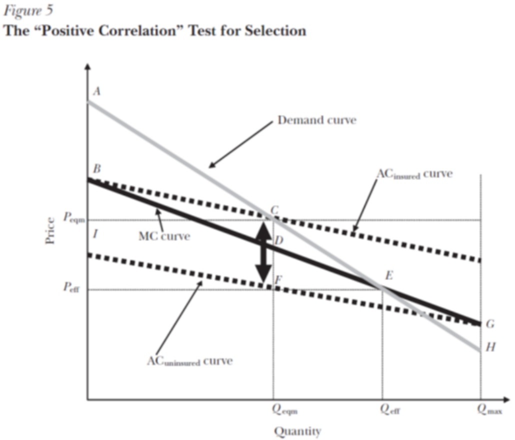
Positive Correlation Test

Figure 5
The "Positive Correlation" Test for Selection



- $AC_{insured}$: average over the expected costs of the insured (starting at $Q = 0$)
- $AC_{uninsured}$: average over the expected costs of the uninsured (starting at $Q = Q_{max}$)

Positive Correlation Test



- Adverse selection (downward sloping MC): $AC_{uninsured} > AC_{uninsured}$ at any given price, and in particular at the equilibrium price (points C and F)

Positive Correlation Test in Practice

- The test requires "only" that one observe the average expected costs of observationally identical individuals with different amounts of insurance coverage
- In practice, compare proxies for expected costs across individuals with different insurance coverage, controlling as needed for important confounding factors

Positive Correlation Test in Practice: Limitations

- The test has several limitation
- Comparing expected costs across individuals with and without insurance may confound unobserved consumer characteristics and moral hazard
- Measurement of costs is challenging

Limitations of Positive Correlation Test: Consumer Characteristics

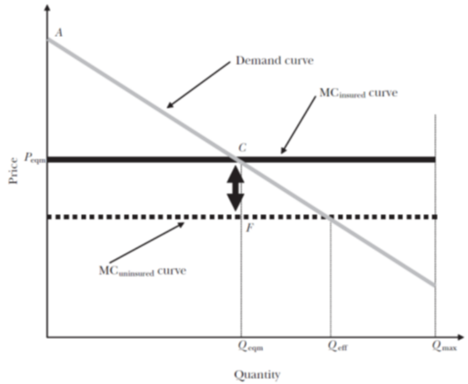
- One must condition on the consumer characteristics that determine the prices offered to each individual
- One could attempt to control for other observed variables that are not used by the firm (due to regulation or any other reason); less obvious if we should do this

Limitations of Positive Correlation Test: Moral Hazard

- With adverse selection, individuals who have private information that they are at higher risk (of accident or poor health outcome, for example), self-select into the insurance market, generating the positive correlation between insurance coverage and observed claims
- With moral hazard, individuals are identical before they purchase insurance, but have incentives to behave differently after
- Those with greater coverage have less incentive to take actions that reduce their expected costs (moral hazard), which will generate a relationship between insurance coverage and observed claims

Moral Hazard

Figure 6
The "Positive Correlation" Test for Moral Hazard



- Moral hazard can produce the same "positive correlation" property as adverse selection
- Lack of selection is captured by flat MC

Limitations of Positive Correlation Test: Measurement of Costs

- The theoretical object of interest: expected cost
- Most direct proxy: the average realized costs
  - With enough data, realized costs of the insured converge to the expected costs
- The "claims" (costs) of the uninsured are, however, unobserved
- One option is to use external data, for example, mortality data on life insurance or hospital discharges for health insurance
- **Key issue:** observed for the both insured and uninsured population

Beyond Testing

- Detecting selection is therefore only a first step
- If selection is empirically detected, new questions arise:
  - whether the welfare costs it generates are large or small
  - what might be the welfare consequences of specific government policies

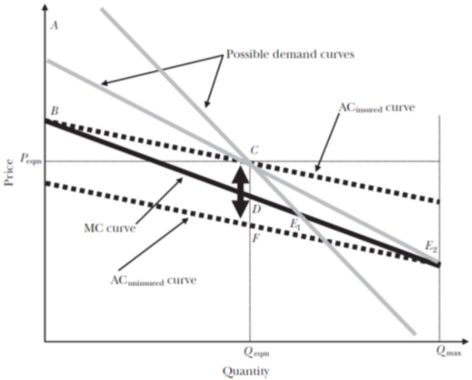
Beyond Testing: Welfare

- Can we say something about the welfare costs associated with selection based on the graphical analysis?
- Markets that appear more adversely selected (there is a larger difference between the expected costs of the insureds and uninsured) experience greater welfare loss associated with that selection?

Positive Correlation and Its (Non)relation to Welfare Costs of Selection

Figure 7

The "Positive Correlation" and Its (Non)relation to Welfare Costs of Selection



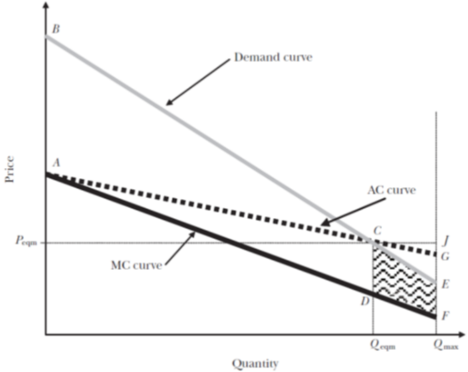
- The deadweight loss triangles of different sizes (CDE_1, CDE_2) can be generated by different demand curves even though the extent of adverse selection (the difference in average costs) is the same

Bounding Welfare Costs of Selection

- Upper bound of the welfare cost of selection: $P_{eqm} \times Q_{max}$
- Intuition: adverse selection leads to under-insurance, the worst possible scenario is when nobody is insured
- Since P_{eqm} must exceed the WTP for insurance by the uninsureds (otherwise they would have purchased insurance), the price provides an upper bound on the per-individual welfare loss
- Tighter upper bound: $P_{eqm} \times (Q_{max} - Q_{eqm})$

Bounding Welfare Costs of Selection

Figure 1
Adverse Selection in the Textbook Setting



- Can tighten the upper bound further: $(P_{eqm} - X) \times (Q_{max} - Q_{eqm})$, where X is the expected costs of the uninsureds (the average value of the MC curve between Q_{eqm} and Q_{max}).

Using Price Variation: Ideal Experiment

- Randomly vary the price at which insurance is offered to large pools of otherwise observationally identical individuals
- For each pool, observe the fraction of individuals who bought insurance and the average realized costs of insured individuals
- Can trace out the demand, AC and MC curves and the AC curve — the three essential curves behind all of the welfare analysis

Using Price Variation: Ideal Experiment

- Provides a direct test of both the existence and nature of selection based on the slope of the MC curve (downward sloping: adverse selection, upward sloping: advantageous selection)
- This "cost curve" test of selection is not affected by the existence of moral hazard
- Note that the cost curves are defined over a sample of individuals who all have the same insurance contract

Today's Second Paper

Einav, Liran, Finkelstein, Amy and Cullen, Mark (EFC). "Estimating Welfare in Insurance Markets Using Variation in Prices." The Quarterly Journal of Economics, 2010, 125(3): 877-921.

Motivation

- The welfare loss from selection in private insurance markets is a classic result in economic theory
- Provides the rationale for the government intervention in insurance markets
- Yet there has been relatively little empirical work devoted to quantifying the inefficiency that selection causes, or the welfare consequences of potential policy interventions in that market.

EFC (2010)

- Show how welfare loss from selection can be estimated empirically using identifying variation in the price of insurance
  - Can result from price regulation, tax policy, introduction of new goods, mandatory insurance coverage etc.
- Such variation, together with quantity data, allows us to estimate the demand for insurance
- The same variation, together with cost data, allows us to estimate how insurers' costs vary as market participants endogenously respond to price
- Demand and cost curves can be used to estimate welfare

EFC (2010)

- Minimal assumptions based on revealed preference
- The approach does not require assumptions about consumers' preferences or the nature of ex ante information
- Demand and cost curves serve as sufficient statistics for welfare analysis
- Relatively straightforward to implement
- The welfare analysis is, however limited to the cost associated with inefficient pricing, taking insurance contracts as given

EFC (2010)

- Theoretical framework
- Empirical model
- Empirical application

Theory

- A given population of individuals choose from two contracts: full insurance (contract H) and no insurance (contract L)
- The population is defined by a distribution $G(\zeta)$, where ζ is a vector of consumer characteristics
  - Do not need to specify ζ; could be risk factors, ex ante risk perceptions and/or preferences
- The (relative) price of contract H is p

Consumer Choice

Individual i chooses to buy insurance iff

$$v^H(\zeta_i, p) \geq v^L(\zeta_i),$$

where $v^H(\cdot)$ and $v^L(\cdot)$ are utilities from H and L, respectively

Aggregate Demand for Insurance

Aggregate demand for insurance is

$$D(p) = \int \mathbb{1}(\pi(\zeta) \geq p) dG(\zeta) = Pr(\pi(\zeta) \geq p),$$

where $\pi(\zeta_i) \equiv \max\{p : v^H(\zeta_i, p) \geq v^L(\zeta_i)\}$ is the highest price at which individual i is willing to buy insurance.

- assume that $D(p)$ is strictly decreasing, continuous, and differentiable

Supply and Equilibrium

- Consider N identical risk-neutral insurance providers, who set prices in a Nash equilibrium (Bertrand)
- Focus on perfect competition
  - Inefficiency is attributed to selection
  - Allowing for imperfect competition is, however, fairly straightforward
- Multiple firms set the same price, individuals choose a firm randomly
- The costs of providing contract H to individual i are the insurable costs, $c(\zeta_i)$

Supply and Equilibrium

The average (expected) cost curve is given by

$$AC(p) = \frac{1}{D(p)} \int c(\zeta)\mathbb{1}(\pi(\zeta) \geq p)dG(\zeta) = E(c(\zeta)|\pi(\zeta) \geq p).$$

Note that the average cost curve is determined by the costs of the sample of individuals who endogenously choose contract H

Supply and Equilibrium

The equilibrium is characterized by the following equation (zero profit condition)

$$p = AC(p)$$

assuming, for example, that it is profitable to provide insurance to those with the highest willingness to pay for it

- This is different from the efficient benchmark characterized by $p = MC(p)$

Measuring Welfare

It is easy to see that it is socially efficient for individual i to purchase insurance iff

$$\pi(\zeta_i) \geq c(\zeta_i)$$

In a first-best allocation individual i purchases insurance iff their WTP ($\pi(\zeta_i)$) is at least as great as the expected social cost of providing the insurance to them ($c(\zeta_i)$)

▸ Measuring welfare

Graphical Illustration: Evaluating Welfare

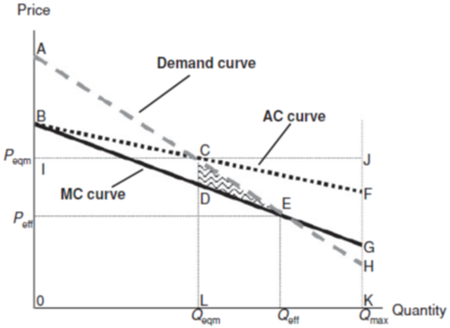


FIGURE I
Efficiency Cost of Adverse Selection

- The demand curve denotes the relative demand for contract H
- Welfare evaltions: efficient allocation (ABE), competitive equilibrium (ABE minus CDE), the welfare loss due to adverse selection (CDE), and welfare at mandating contract H (ABE minus EGH)

Sufficient Statistics for Welfare Analysis

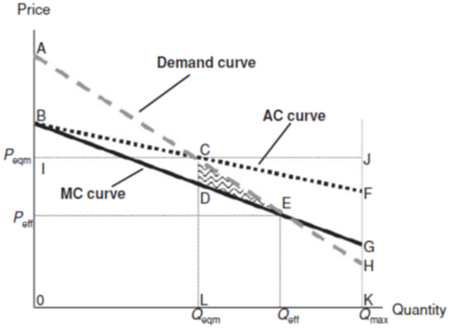


FIGURE I
Efficiency Cost of Adverse Selection

- The demand and cost curves are sufficient statistics for welfare analysis of pricing of existing contracts
- That is, different primitives (private info, preferences etc., as summarized by ζ) have the same welfare implications if they generate the same demand and cost curves

Estimation

- Estimating welfare in an insurance market requires data that allow estimation of the demand curve $D(p)$ and the average cost curve $AC(p)$
- The MC curve can be directly backed out from these two curves:

$$MC(p) = \frac{\partial TC(p)}{\partial D(p)} = \frac{\partial(AC(p)D(p))}{\partial D(p)} = \frac{\partial D(p)}{\partial p}^{-1} \frac{\partial(AC(p)D(p))}{\partial p}$$

- With $AC(p)$, $D(p)$ and $MC(p)$ can compute welfare under various allocations (see earlier Figure)

Estimation

- Estimating the $D(p)$ curve requires data on prices and quantities (coverage choices), as well as exogenous price variation
- To estimate the $AC(p)$ curve we need data on the expected costs of those with contract H, such as data on subsequent risk realization (e.g., accidents) and how it translates to insurer costs
- Can then use the same variation in prices to trace out the $AC(p)$ curve
  - Note that price variation that is exogenous to demand is also exogenous to insurable cost

Empirical Illustration: Employer-Provided Health Insurance

- Use individual-level data from 2004 on the U.S.-based employees at Alcoa, Inc.
- The data contain the menu of health insurance options available to each employee, the employee premium associated with each option, the employee's coverage choice, claim-level information on all the employee medical expenditures, and rich demographic information
- Observe virtually everything about the employee that the administrators setting insurance premiums can observe

Price Variation

- In 2004, company headquarters offered a set of seven different possible pricing menus for employee benefits
- The coverage options are the same across all the menus, but the prices (employee premiums) associated with these options vary
- Which price menu a given employee faces is determined by the president of his business unit (N=40 units)
  - The president may choose different price menus for employees within his unit based on their location (job site) and their employment type (e.g., salaried or hourly employee)

Exogeneity of Price Variation

TABLE I
ASSESSING THE EXOGENEITY OF THE PRICE VARIATION

	Faced lowest relative price (2,939 employees) (1)	Faced higher relative prices (840 employees) (2)	Difference (3)	Coefficient (4)	*p*-value (5)
Age (mean)	42.74	42.40	0.33	−0.245	.31
Tenure (mean)	13.02	11.63	1.39	−0.565	.08
Fraction male	0.862	0.852	0.009	1.268	.79
Fraction white	0.874	0.825	0.049	−6.998	.40
Log(annual salary) (mean)	11.16	11.05	0.11	−8.612	.17
Spouse age (mean)	41.37	41.05	0.32	−0.200	.41
Number of covered family members (mean)	4.14	4.07	0.07	−1.400	.36
Age of youngest covered child (mean)	9.81	9.41	0.40	−0.3	.26
2003 medical spending (in US$)[a]					
All (mean)	7,027	5,922	1,105	−0.0001	.09
In most common 2003 plan (mean)	6,938	5,967	971	−0.0001	.10

Notes. The table reports average differences in covariates (shown in the left column) across employees who face different relative prices for the higher-coverage option in the baseline sample. The employee characteristics in the left column represent contemporaneous 2004 characteristics (except where noted). Note that everyone with family coverage has a covered spouse and at least one covered child. Columns (1) and (2) present, respectively, average characteristics for the approximately three-fourths of employees who faced the lowest relative price ($384; see Table II) and the remaining one-fourth who face one of the five higher relative prices ($466 to $659; see Table II). Column (3) shows the difference between columns (1) and (2). Columns (4) and (5) report, respectively, the coefficient and *p*-value from a regression of the (continuous) relative price variable (in US$) on the characteristic given in the left column; we adjust the standard errors for an arbitrary variance covariance matrix within each state.

[a]In the bottom two rows we look at 2003 medical spending for all employees in the sample who were in the data in 2003 (2,600 and 658 employees in columns (1) and (2), respectively), and for all employees who were in the data in 2003 in the most common 2003 health insurance plan (2,282 and 523 employees in columns (1) and (2), respectively). The latter attempts to avoid potential differences in spending arising from moral hazard effects of different 2003 coverages.

Raw Data Patterns for Key Variables

TABLE II
THE EFFECT OF PRICE ON DEMAND AND COSTS

(Relative) price ($) (1)	Number of employees (2)	Fraction chose contract H (3)	Average incremental cost ($) for those covered under: Contract H (4)	Contract L (5)
384	2,939	0.67	451.40	425.48
466	67	0.66	499.32	423.30
489	7	0.43	661.27	517.00
495	526	0.64	458.60	421.42
570	199	0.46	492.59	438.83
659	41	0.49	489.05	448.50

Notes. The table presents the raw data underlying our baseline estimates. All individuals face one of six different (relative) prices, each represented by a row in the table. Column (2) reports the number of employees facing each price, and column (3) reports the fraction of them who chose contract H. Columns (4) and (5) report (for individuals covered by contracts H and L, respectively) the average incremental costs to the insurer of covering these individuals with contract H rather than with contract L, taking the family's medical expenditures as given. The graphical analog to this table is presented by the circles shown in Figure V.

Baseline Estimating Equations

Estimate the following demand and average cost functions:

$$\begin{aligned} D_i &= \alpha + \beta p_i + \epsilon_i \\ c_i &= \gamma + \delta p_i + u_i, \end{aligned}$$

where

- D_i is a dummy variable that is equal to 1 if employee i chose contract H and equal to 0 if i chose contract L
- $c_i \equiv c(m_i) = c(m_i; H) - c(m_i, L)$ is the realized incremental cost to the insurer from covering individual i medical expenditure m_i with contract H rather than contract L
- p_i is the incremental annual premium that employee i is required to pay to purchase contract H (rather than contract L)

Baseline Estimating Equations

Estimate the following demand and average cost functions:

$$
\begin{aligned}
D_i &= \alpha + \beta p_i + \epsilon_i \\
c_i &= \gamma + \delta p_i + u_i,
\end{aligned}
$$

where

- The demand equation is estimated on the entire sample
- The (average) cost equation is estimated on the sample of individuals who (endogenously) choose contract H
- The *AC* curve is in turn computed by calculating the average c_i for all individuals who choose contract H at a given relative price p

MC Curve

The MC curve is

$$MC(p) = \frac{\partial D(p)}{\partial p}^{-1} \frac{\partial (AC(p)D(p))}{\partial p} = \frac{1}{\beta}\left(\frac{\partial(\alpha + \beta p)(\gamma + \delta p)}{\partial p}\right) = \frac{1}{\beta}(\alpha\delta + \gamma\beta + 2\beta\delta p).$$

Equilibrium and Efficiency

- The equilibrium price and quantity are given by equating $AC(p) = D(p)$: $P_{eq} = \gamma/(1-\delta)$ and $Q_{eq} = \alpha + \beta(\gamma/(1-\delta))$
- The efficient price and quantity are given by equating $MC(p) = D(p)$: $P_{eff} = 1/(1-2\delta)(\frac{\alpha\delta}{\beta} + \gamma)$

Efficiency Costs

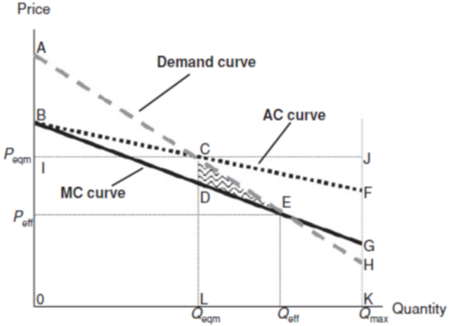


FIGURE I
Efficiency Cost of Adverse Selection

- The efficiency cost associated with competitive pricing (CDE) is given by:

$$\frac{1}{2}(Q_{eff} - Q_{eq})(P_{eq} - MC(P_{eq})) = \frac{-\delta^2}{2(1-2\delta)\beta\left(\alpha + \frac{\beta\gamma}{1-\delta}\right)^2}$$

Estimation Results

TABLE III
ESTIMATION RESULTS

Dependent variable (sample)	1 if chose High (both High and Low) (1)	Incremental cost (only High) (2)
Panel A: Estimation results		
Relative price of High (US$)	−0.00070	0.15524
	(0.00032)	(0.06388)
	[.034]	[.021]
Constant	0.940	391.690
	(0.123)	(26.789)
	[.000]	[.000]
Mean dependent variable	0.652	455.341
Number of observations	3,779	2,465
R^2	.008	.005
Panel B: Implied quantities of interest		
Competitive outcome (point C in Figure I)		$Q = 0.617$, $P = 463.5$
Efficient outcome (point E in Figure I)		$Q = 0.756$, $P = 263.9$
Efficiency cost from selection (triangle CDE)		9.55
Total surplus from efficient allocation (triangle ABE)		283.39
Efficiency cost from mandating contract H (triangle EGH)		29.46

Notes. The table reports the results from our baseline specification. Sample is limited to salaried employees with family coverage. Column (1) of Panel A reports the results from estimating the linear demand $D = \alpha + \beta p$ (equation (11)) on the sample of employees who choose contract H or contract L; D is an indicator variable for whether the employee chose contract H (as opposed to contract L). Column (2) reports the results from estimating the linear cost equation $c = \gamma + \delta p$ (equation (12)) on the sample of individuals who choose contract H; c is the incremental cost to the insurer of covering a given employee's (and covered dependents') medical expenditures with contract H rather than contract L. The price variable (p) is the incremental premium to the employee for contract H (as opposed to contract L). There are no other covariates in the regression besides those shown in the table. All estimates are generated by OLS. Standard errors (in parentheses) allow for an arbitrary variance covariance matrix within each state; p values are in square brackets. Results from alternative specifications are reported in the Online Appendix. Panel B reports the point estimates of several quantities of interest that are derived from the baseline specification and the estimates reported in Panel A.

Efficiency Costs of Adverse Selection

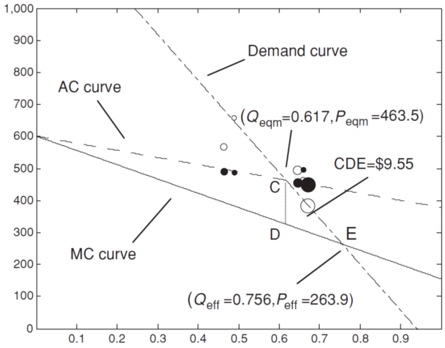


FIGURE V

Efficiency Cost of Adverse Selection—Empirical Analog

This figure is the empirical analog of the theoretical Figure I. The demand curve and AC curve are graphed using the point estimates of our baseline specification (see Table III). The MC curve is implied by the other two curves, as in equation (13). The circles represent the actual data points (see Table II, columns (3) and (4)) for demand (empty circles) and cost (filled circles). The size of each circle is proportional to the number of individuals associated with it. For readability we omit the one data point from Table II with only seven observations (although it is included in the estimation). We label points C, D, and E, which correspond to the theoretical analogs in Figure I, and report some important implied point estimates (of the equilibrium and efficient points, as well as the welfare cost of adverse selection).

Summary

- Data on quantity and costs, together with price exogenous price variation, can be used to test the presence of adverse selection and draw conclusions about the welfare loss associated with inefficient pricing in insurance markets with selection
- Analyses have, however, some important limitations that must be addressed
  - For examples, unobserved consumer characteristics and moral hazard may confound the cost estimates
- The approach is based on minimal assumptions
- Performing counterfactual policy experiments requires putting more structure to the model (assuming certain preferences, the nature of uncertainty etc.)

Part 2: Hospital Industry

Hospital Industry

Gaynor, Martin, Kate Ho, and Robert J. Town (GHT) "The industrial organization of health-care markets." Journal of Economic Literature, 2015, 53 (2): 235-84.

Motivation (GHT 2015)

- Health care sector is large and growing in many developed countries
  - For example, in the U.S., health care spending in 2011 amounted to $2.7 trillion and 18% of GDP (Hartman et al., 2013)
- The industries that constitute the major components of this sector: hospital services, physician services, and health insurance, are each large in their own right
  - The hospital sector represents 5.6% of US GDP, physician services constitute 3.6%, and health insurance is 1%
- This makes the hospital and physician sectors some of the largest industries in the US economy, larger than construction (3.6% of GDP), agriculture (1.37%), computer and electronic products (1.29%), for example

Motivation (GHT 2015)

- The significance of the health care sector is not only its size
- The functioning of health care markets has large implications for the well being of the population

Functioning of Health Care Markets

- Markets play a large role in the delivery of health care in many countries
  - For example, the English National Health Service (NHS), the Netherlands in 2006, Belgium, Sweden and Finland have introduced reforms designed to increase choice and competition for hospital care
  - The Netherlands also relies on private markets for health insurance and has been gradually deregulating markets for health care
- As a consequence, the performance of markets can have large impacts on the overall performance of the health care sectors in many countries

Key Issues in Health Care Markets (GHT 2015)

- Quality determination in provider markets
- Price and network determination in provider markets
- Premium determination in insurance markets
- Consumer choice in insurance markets
- Incentives and provider/consumer decisions

Most research focuses on one of the stages, even though they are all related

Today's Topics

- This lecture focuses on the functioning of hospital markets from three perspectives
  - Consumer choice in hospital markets
  - Connection with health insurance (hospital networks offered by plans)
  - Performance and allocation in the hospital industry

Today's Papers

- Ho, Katherine. "The Welfare Effects of Restricted Hospital Choice in the US Medical Care Market." Journal of Applied Econometrics, 2006, 21(7): 1039-1079.
- Chandra, Amitabh, Amy Finkelstein, Adam Sacarny, and Chad Syverson (CFSS). "Health Care Exceptionalism? Performance and Allocation in the US Health Care Sector." The American Economic Review, 2016, vol. 106(8): 2110–44.

Motivation

- Health care markets restrict patients' hospital choice
  - Choice of public hospitals is not free (at least before patient choice reforms)
  - In the U.S., managed care health insurers restrict their enrollees to visiting hospitals within specific networks
- Big question: what is the effect of restricted hospital choice on consumer welfare?
  - Or the other way round, what is the effect of removing restrictions on patient choice, as done in patient choice reforms (e.g., Moscelli et al. 2021)

Ho (2006)

- Estimating the effects of restricted choice requires deriving an estimate of consumer demand for health plans conditional on the network of hospitals they offer
- The analysis has three steps:
  - Demand for hospitals
  - Recover expected utility from each plan's hospital network
  - Demand for health plans conditional on the hospital network offered

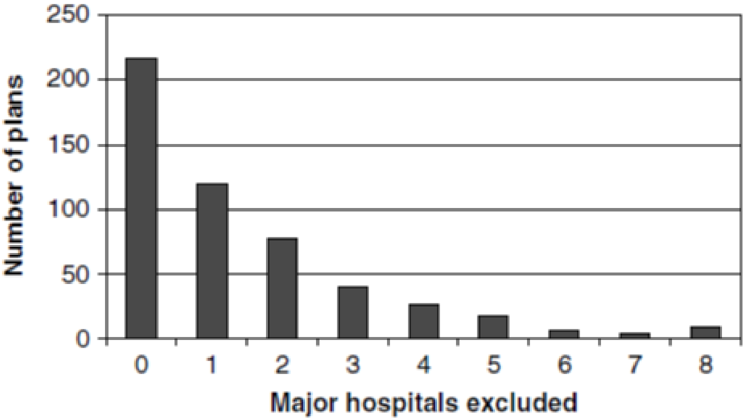
Industry Background

- Each year, every privately insured consumer chooses a health plan, generally from a menu offered by his employer and pays that plan a monthly premium in return for insurance coverage
- The insurer contracts with hospitals and physicians to provide any care needed during the year
- When the consumer requires medical care, he may visit any of the providers listed by the health plan (at zero or small out-of-pocket payment)

Industry Background

- Managed care plans are a type of health insurance, which have contracts with health care providers and medical facilities
- These providers make up the plan's network
- The focus of this paper is on two types of plans (Health Maintanance Organizations, **HMOs**, and Point of Service, **POS**, plans) that have most restrictions on the network and consumer choice

Variation in Size of Hospital Networks



Graph 1. Number of major hospitals excluded by each plan

Data Source: Hospital Demand

- Dataset for hospital demand the MEDSTAT MarketScan Research Database for 1997–98
- Includes hospital admissions of the privately ensured enrollees
- For each admission, the data includes the patient diagnosis and characteristics, the identity of the hospital and the type of plan
- Patient income is approximated using the median income of families in the Zip Code Tabulation Area (ZCTA), taken from Census 2000 data

Data Source: Hospital Demand

- Ideally would like to investigate consumers' choice of managed care (HMO, POS) plans
- Hospital choice set of managed care enrollees is unobserved in MEDSTAT
- Instead, examine the choices made by indemnity (fee-for-service) and Preferred Provider Organization (PPO) enrollees, whose hospital choice sets are **unrestricted**
- Assume:
  - Indemnity plan/PPO enrollees have the same preferences over hospitals as HMO/POS enrollees conditional on their diagnosis, income and location
  - Zero out-of-pocket costs (prices are unobserved in the data)

Estimation Steps and Data Sources

Step of estimation	Data inputs	Outputs
1. Hospital demand	MEDSTAT: encounter-level data on indemnity and PPO patients' characteristics and choice of hospital in 11markets, 1997–8 AHA: hospital characteristics	Estimated effect of hospital characteristics on consumer utility given age, gender, diagnosis and location
2. Expected utility	New dataset listing network of each HMO/POS plan in 43 markets, Q1 2003 Estimated parameters from Step 1	Expected utility of every consumer type in the market from every plan's network of hospitals
3. Plan demand	AIS: market share and characteristics of HMO/POS plans in 43 markets, 2002 NCQA: clinical quality and consumer assessment data, 2000 Weiss: characteristics of HMO/POS plans, 2002 Expected utility from Step 2	Estimated parameters of plan demand equation

Descriptive Statistics: Hospitals

Table I. Descriptive statistics for hospitals, MEDSTAT dataset

	Mean	SD
Number of beds	286	193
Teaching status	0.20	0.40
For-profit	0.06	0.25
Registered nurses per bed	1.24	0.46
Cardiac services	0.72	0.37
Imaging services	0.42	0.26
Cancer services	0.60	0.41
Birth services	0.82	0.38

Notes: $N = 434$ hospital-years. Cardiac, imaging, cancer and birth services refer to four summary variables defined in Appendix A. Each hospital is rated on a scale from 0 to 1, where 0 indicates that no procedures in this category are provided by the hospital and a higher rating indicates that a less common service is provided.

Descriptive Statistics: Patients

Table II. Patient descriptive statistics, MEDSTAT dataset

	Mean	SD
Diagnosis		
Neurological	0.01	0.10
Cardiac	0.11	0.32
Labor	0.17	0.38
Baby	0.07	0.26
Digestive	0.09	0.28
Cancer	0.08	0.27
Age		
0–17	0.13	0.34
18–34	0.22	0.42
35–44	0.13	0.33
45–54	0.19	0.39
55–64	0.29	0.45
Over 64	0.03	0.17
Industry		
Manufacturing (durable)	0.31	0.46
Manufacturing (nondurable)	0.06	0.24
Transport, Communications, Utilities	0.02	0.14
Finance, Insurance, Real Estate	0.01	0.08
Services	0.46	0.50
State and Local Government	0.03	0.17
Working status		
Full time	0.74	0.44
Part time	0.002	0.05
Early retiree	0.19	0.39
Retiree	0.04	0.19
Female	0.63	0.48
PPO enrollee	0.51	0.50
Emergency admission	0.05	0.21
Distance to chosen hospital (miles)	12.40	9.67
Distance to all hospitals (miles)	22.78	11.85

$N = 28\,666$ encounters.

Descriptive Statistics: Plans

Table III. Descriptive statistics for HMO/POS plans

Variable	Definition	N	Mean	SD
Market share	Plan share of non-elderly market	516	0.03	0.04
Enrollment	Number of enrollees (thousands)	516	66.22	110.1
Premium pmpm ($)	Premiums earned per member per month	478	140.75	44.27
Physicians per 1000 population	Number of physician contracts per 1000 pop. in markets covered by plan	418	1.56	1.51
Breast cancer screening	% of women aged 52–69 who received a mammogram within last 2 years	352	0.73	0.05
Cervical cancer screening	% of adult women who received pap smear within last 3 years	352	0.72	0.07
Check-ups after delivery	% of new mothers receiving a check-up within 8 weeks of delivery	351	0.72	0.11
Diabetic eye exam	% of adult diabetics receiving eye exam within last year	350	0.45	0.11
Adolescent immunization 1	% of children receiving all required doses of MMR and hep. B vaccines before 13th birthday	346	0.31	0.16
Adolescent immunization 2	% of children receiving all required doses of MMR, hep. B and VZV vaccines before 13th birthday	313	0.15	0.11
Advice on smoking	% of adult smokers advised by physician to quit	213	0.63	0.07
Mental illness check-up	% of members seen as outpatient within 30 days of discharge after hospitalization for mental illness	307	0.68	0.15
Care quickly	Composite measure of member satisfaction re: getting care as soon as wanted	304	0.75	0.05
Care needed	Composite measure of member satisfaction re: getting authorizations for needed/desired care	304	0.72	0.06
Age 0–2	Dummy for plans aged 0–2 years	516	0.01	0.08
Age 3–5	Dummy for plans aged 3–5 years	516	0.06	0.23
Age 6–9	Dummy for plans aged 6–9 years	516	0.17	0.37
Aetna	Plan fixed effect	516	0.15	0.36
CIGNA	Plan fixed effect	516	0.10	0.31
Kaiser	Plan fixed effect	516	0.03	0.16
Blue Cross Blue Shield	Dummy for ownership by BCBS	516	0.16	0.36
POS plan	Dummy for POS plan	516	0.35	0.49

Empirical Approach

- Hospital choice for each individual i based on utility maximization
- Predict individual i's expected utility from the set of hospitals offered by plan j in market m, EU_{ijm}
- Construct the utility of individual i from enrolling in plan j in market m as a function of EU_{ijm} and observed plan and individual characteristics
- Construct market shares for plan j and market m, s_{jm}

Demand for Hospitals

The utility function of enrollee/consumer i for visiting hospital h with diagnosis l is

$$u_{ihl} = \delta_h + x_h \nu_{il} \beta + \epsilon_{ihl},$$

where

- x_h are observed hospital characteristics
- ν_{il} are observed characteristics of the consumer such as diagnosis and location
- ϵ_{ihl} is the Type 1 extreme value and iid distributed error term

Demand for Hospitals

Consumer i with diagnosis l chooses hospital h from the set of hospitals H to maximize their utility

$$u_{ihl} \geq u_{ih'l}, \ \forall h' \neq h, h,' \in H$$

Demand for Hospitals

With the Type 1 extreme value distributed error term, the market share for hospital h is given by

$$s_h = \sum_{i,l} \frac{N_{il}}{N} \left(\frac{\exp(\delta_h + x_h \nu_{il} \beta)}{\sum_{p \in H} \exp(\delta_p + x_p \nu_{il} \beta)} \right)$$

where

- N_{il} is the number of individuals in consumer-type i who are hospitalized with diagnosis l
- N is the number of individuals admitted to hospital in the market

Demand for Hospitals

- Assume that the hospital-specific variable (mean utility) is $\delta_h = \eta_h + x_h\alpha$ where
  - η_h is the unobserved hospital quality
  - x_h are observed hospital characteristics
- Since the next step is to use the estimated coefficients in markets and years outside the sample, we need to predict the value of $\hat{\delta}_h$ using variables included in the plan dataset

Demand for Hospitals

- Estimate the following equation

$$\hat{\delta}_h = \delta_h + \mu_h = x_h\alpha + \eta_h + \mu_h$$

with sampling error μ_h

  - Regress the estimated hospital dummy coefficients on hospital characteristic variables (from the AHA datasets) and market fe's
  - Account for heteroscedasticity introduced by μ_h in standard error estimates

Demand for Hospitals

- The predicted utility used in the subsequent analysis is given by (with zero sampling error in the mean utility)

$$\hat{u}_{ihl} = \eta_h + x_h \hat{\alpha} + x_h \nu_{il} \hat{\beta} + \epsilon_{ihl}$$

where $\hat{\alpha}$ and $\hat{\beta}$ are estimated using the earlier two-stage process

Expected Utility from Each Plan's Hospital Network

Individual i's expected utility from the hospitals offered by plan j in market m is

$$EU_{ijm} = \sum_{l} p_{il} E(\max_{h \in H_{jm}}(\hat{u}_{ihl})) = \sum_{l} p_{il} \log\left(\sum_{h \in H_{jm}} \exp(\eta_h + x_h\hat{\alpha} + x_h \nu_{il}\hat{\beta})\right)$$

where p_{il} is the probability that individual i will be hospitalized with diagnosis l and H_{jm} captures **the plan's hospital network**

Expected Utility from Each Plan's Hospital Network

Individual i's expected utility from the hospitals offered by plan j in market m is

$$EU_{ijm} = \sum_{l} p_{il} E(\max_{h \in H_{jm}}(\hat{u}_{ihl})) = \sum_{l} p_{il} \log \left(\sum_{h \in H_{jm}} \exp(\eta_h + x_h \hat{\alpha} + x_h \nu_{il} \hat{\beta}) \right)$$

where p_{il} is the probability that individual i will be hospitalized with diagnosis l and H_{jm} captures **the plan's hospital network**

- Hospital quality η_h is still unobserved
- Assume $\eta_h = 0$
  - Develop a test for: use the EU with $\eta_h = 0$ as an IV for the EU with $\eta_h + \mu_h$ using residuals from eq. for $\hat{\delta}_h = x_h \alpha + \eta_h + \mu_h$ and assuming $\mu_h = 0$
  - Find similar findings with this approach

Demand for Health Plans Conditional on the Hospital Network Offered

Final steps:

- Take the predicted expected utility from the hospital network of each plan, for each type of individual
- Include it as an input to the plan demand equation

Demand for Health Plans Conditional on the Hospital Network Offered

The plan-level expected utility of the representative agent for plan j in the relevant market m over diagnoses l is (assuming $\eta_h = 0$)

$$EUrep_{jm} = \sum_{l} p_l^{rep} \log \left(\sum_{h \in H_{jm}} \exp(x_h \hat{\alpha} + x_h \nu_l^{rep} \hat{\beta}) \right)$$

where

- p_l^{rep} is the weighted average probability of diagnoses of individuals in the most populated zip code
- ν_l^{rep} is the vector of other characteristics of an individual (income, location) in the most populated zip code

Demand for Health Plans Conditional on the Hospital Network Offered

The plan-level expected utility of the representative agent for plan j in the relevant market m over diagnoses l is (assuming $\eta_h = 0$)

$$EUrep_{jm} = \sum_{l} p_l^{rep} \log\left(\sum_{h \in H_{jm}} \exp(x_h \hat{\alpha} + x_h \nu_l^{rep} \hat{\beta})\right)$$

where

- p_l^{rep} is the weighted average probability of diagnoses of individuals in the most populated zip code
- ν_l^{rep} is the vector of other characteristics of an individual (income, location) in the most populated zip code

An extension: a richer specification in terms of individual locations, income and demographics within each market

Demand for Health Plans Conditional on the Hospital Network Offered

- The utility for consumer i in choosing plan j in market m:

$$w_{jm} = \xi_{jm} + z_{jm}\vartheta + \gamma_1 EUrep_{jm} + \omega_{ijm}$$

where

- z_{jm} are observed plan characteristics (e.g., premium per month)
- ω_{ijm} is Type 1 extreme value distrib. error term

Demand for Health Plans Conditional on the Hospital Network Offered

The estimation eq. is then

$$log(s_{jm}) - log(s_{om}) = \xi_{jm} + z_{jm}\vartheta + \gamma_1 EUrep_{jm}$$

where

- s_{om} is the share of the outside good (choosing to be uninsured) in market m
- ν_l^{rep} is the vector of other characteristics of an individual (income, location) in the most populated zip code

Demand for Health Plans Conditional on the Hospital Network Offered

- Estimation with two-stage least squares
- The IVs for the premium variable: to the usual set of plan characteristics (the z's), the average hourly hospital wage and the average weekly nurse wage across the markets in which each health plan is observed to be active
- Note that standard errors need to be adjusted for the three-stage procedure

Hospital Demand Results

Table IV. Hospital demand results, ML estimation

Interaction Terms	Variable	Estimated coefficient
	Distance (miles)	−0.215** (0.004)
	Distance squared	0.001** (0.000)
	Emergency* distance	−0.008** (0.004)
Interactions: Teaching	Cardiac	0.090 (0.060)
	Cancer	0.192** (0.069)
	Neurological	0.546** (0.175)
	Digestive	−0.145** (0.062)
	Labor	0.157** (0.048)
	Newborn baby	0.038 (0.075)
	Income ($000)	0.007** (0.001)
	PPO enrollee	−0.067 (0.050)
Interactions: Nurses per bed	Cardiac	−0.096 (0.070)
	Cancer	0.445** (0.079)
	Neurological	0.130 (0.200)
	Digestive	−0.028 (0.076)
	Labor	−0.002 (0.063)
	Newborn baby	0.071 (0.087)
	Income ($000)	0.005** (0.001)
	PPO enrollee	−0.099* (0.056)
Interactions: For-profit	Cardiac	−0.164 (0.181)
	Cancer	−0.197 (0.202)
	Neurological	0.229 (0.379)
	Digestive	0.195 (0.150)
	Labor	0.300** (0.107)
	Newborn baby	0.194* (0.122)
	Income ($000)	−0.001 (0.003)
	PPO enrollee	−0.036 (0.090)
Interactions: Cardiac services	Cardiac	1.222** (0.134)
	Income ($000)	0.001 (0.001)
	PPO enrollee	0.080 (0.088)
Interactions: Imaging services	Cardiac	−0.188** (0.094)
	Cancer	−0.052 (0.107)
	Neurological	−0.084 (0.287)
	Digestive	−0.182* (0.105)
	Labor	−0.071 (0.084)
	Newborn baby	0.398** (0.129)
	Income ($000)	0.004** (0.001)
	PPO enrollee	−0.061 (0.072)
Interactions: Cancer services	Cancer	0.073 (0.082)
	Income ($000)	−0.005** (0.001)
	PPO enrollee	0.087 (0.056)
Interactions: Labor services	Labor	3.544** (0.391)
	Newborn baby	3.116** (0.487)
	Income ($000)	−0.003* (0.002)
	PPO enrollee	0.045 (0.077)
	Hospital fixed effects	Yes
	Pseudo-R^2	0.43

Notes: Maximum likelihood estimation of demand for hospitals using a multinomial logit model. Specification includes hospital fixed effects. $N = 28666$ encounters. Standard errors are reported in parentheses. ** Significant at $p = 0.05$; * Significant at $p = 0.1$.

- If a hospital moves an additional mile away from a patient's home, this reduces the probability that the patient will choose it by 21% (coef. -0.215)
- Patients with the most complex conditions (neurological diagnoses) attach the highest positive weight to teaching hospitals
- Additional results of the regression of the predicted hospital dummy coefficients (from the this model) on hospital characteristics ▸ Results

Plan Demand Results

Table VI. Plan demand results, logit specification

	No fixed effects	Large plan fixed effects	Large plan and market fixed effects
Premium ($00 pmpm)	−1.26 (3.15)	−1.09 (1.67)	−0.92 (1.10)
Expected utility from hospital network ($EUrep_{jm}$)	0.14 (0.14)	0.22* (0.11)	0.55** (0.14)
Physicians per 1000 population	0.30** (0.13)	0.23** (0.08)	0.21** (0.07)
Breast cancer screening	4.77 (4.66)	−1.71 (3.21)	−0.36 (2.48)
Cervical cancer screening	4.66** (1.83)	4.19** (1.69)	4.46** (1.75)
Check-ups after delivery	−0.53 (1.64)	0.26 (1.07)	0.14 (1.03)
Diabetic eye exams	0.39 (1.68)	−0.83 (1.19)	−1.20 (1.08)
Adolescent immunization 1	−0.77 (1.29)	−2.19* (1.08)	−4.11** (1.16)
Adolescent immunization 2	−1.74 (1.83)	2.19* (1.47)	3.16** (1.40)
Advice on smoking	−7.07** (2.76)	2.75* (1.90)	6.20** (1.80)
Mental illness check-ups	−0.34 (2.46)	2.02 (1.79)	2.67** (1.25)
Care quickly	6.64 (6.10)	4.55 (4.47)	0.75 (3.93)
Care needed	3.77 (6.58)	−1.85 (4.30)	0.81 (3.60)
Plan age: 0–2 years	−1.30 (0.98)	0.52 (1.17)	1.33 (0.94)
Plan age: 3–5 years	−2.31* (1.43)	−0.97* (0.53)	−0.63 (0.42)
Plan age: 6–9 years	−1.63* (0.83)	−0.26 (0.24)	−0.25 (0.22)
POS plan	−1.35** (0.22)	−1.10** (0.13)	−1.11** (0.13)
Constant	−9.38 (7.47)	−6.75* (3.78)	−10.94** (2.89)
Large plan fixed effects	No	Yes	Yes
Market fixed effects	No	No	Yes
R^2	0.362	0.592	0.671

Notes: Logit estimates of demand for health plans. $EUrep_{jm}$ is as defined in Section 5.3.1. Large plan fixed effects are included for insurers active in at least 10 of the markets considered. $N = 559$ insurers (516 HMO/POS plans and 1 indemnity/PPO option for each of the 43 markets). Standard errors (adjusted for the three-stage estimation process as described in Section 5.3.1) are reported in parentheses. ** Significant at $p = 0.05$; * significant at $p = 0.1$.

- The coef. of $EUrep_{jm}$ is positive: a plan's market share would be predicted to decrease if it excluded hospitals (lower $EUrep_{jm}$)

Consumer Welfare

- Quantify the welfare benefits attached to an increase in network size
- Consider the welfare impact of a move, holding prices fixed, from the observed set of networks in each market to a hypothesized equilibrium in which every plan offers every hospital

Consumer Welfare

A dollar-valued measure of consumer i's expected welfare gain from a change in a plan's hospital network is:

$$EV_{it} = \frac{1}{\alpha_i}(u_i^t - u_i^{t-1})$$

where α_i is the **negative** price coef. and $u_i^t = E\max_j(V_{ijm}^t + \omega_{ijm})$

- V_{ijm}^t depends on EU_{ijm}^t
- EU_{ijm}^t takes the value already calculated using the observed networks
- EU_{ijm}^{t-1} is calculated considering a network that includes all hospitals in the market

Consumer Welfare

Integrating analytically over the extreme value distribution of ω and summing over types of individual implies

$$EV_m = \sum_i \frac{n_i}{\alpha_i} \left(\ln \sum_{j \in m} \exp(V_{ijm}^t) - \exp(V_{ijm}^{t-1}) \right)$$

where n_i is the population in zip code–age–sex cell i and the difference between V_{ijm}^t and V_{ijm}^{t-1} comes solely from the change in the hospital network offered by each plan

Produce Welfare

The total producer surplus to be divided between plan j in market m and the hospitals in its network is

$$PS_{jm} = \sum_i n_i s_{ijm}(\text{prem}_{jm} - cost_i)$$

where $cost_i$ is the cost of treating a person of type i

Produce Welfare

The change in producer surplus when the plan switches from the observed contracts to offering a free choice of hospitals (all plans in the market contract with all hospitals):

$$PS_{jm}^{change} = PS_{jm}^{choice} - PS_{jm}^{observed}$$

where $cost_i$ is the cost of treating a person of type i

Total Welfare

Welfare effect	Predicted change per year from move to unselective networks
Consumer surplus	\$1.04 billion
Producer surplus	−\$0.80 million
Total	\$1.04 billion

Total Welfare

- Significant welfare effects of a move, at fixed prices, from plans' observed networks to a hypothesized equilibrium where every plan offers access to every hospital in its market ($1.04 billion in total)
- Similarly, introducing a free/unrestricted choice of public hospitals could benefit consumers in other settings
- Does not take into account producer or insurer responses such as changes in quality of care or prices (premiums)

Today's Second Paper

Chandra, Amitabh, Amy Finkelstein, Adam Sacarny, and Chad Syverson (CFSS). "Health Care Exceptionalism? Performance and Allocation in the US Health Care Sector." The American Economic Review, 2016, vol. 106(8): 2110–44.

Motivation

- The conventional wisdom for the health care sector is that there is little scope for market forces to allocate consumers to higher performance producers
  - Consumers lack knowledge or time to respond to the quality and price differences across providers
  - Consumers have little direct financial consequences of their health care decisions for example, due to generous health insurance
  - Public sector reimbursement provides little incentive for providers to achieve productive efficiency etc.

Motivation

- CFSS (2016) investigate empirically whether and to what extent higher performing hospitals tend to attract greater market share
- Look at allocation of Medicare patients for several different health conditions (heart attacks called acute myocardial infarction, or AMI, congestive heart failure, and pneumonia) and a common pair of surgical procedures (hip and knee replacements)
- Hospital quality includes, for example, the ability of the hospital to generate good health outcomes and patient satisfaction with the hospital experience

Static and Dynamic Allocation

- Examine the correlation between producer (hospital) performance and market share at a point in time, and the correlation between producer performance and growth in market share over time
  - This relationship has been analyzed extensively as a proxy for the role of competition (e.g., Olley and Pakes 1996; Collard-Wexler and De Loecker 2015)
- Competitive forces exert pressure on lower productivity firms, causing them to either become more efficient, shrink, or exit

Static and Dynamic Allocation

For the static allocation analysis, use the following regression framework:

$$ln(N_h) = \beta_0^s + \beta_1^s q_h + \gamma_M^s + \epsilon_h^2$$

where

- N_h is a measure of the market size of hospital h (the number of Medicare patients with the given condition)
- q_h is a measure of the quality of hospital h
- γ_M^s are market fe's

Within-market estimate of β_1^s reflects the static relationship between a hospitals quality and its market share

Static and Dynamic Allocation

For the static allocation analysis, use the following regression framework:

$$\ln(N_h) = \beta_0^s + \beta_1^s q_h + \gamma_M^s + \epsilon_h^2.$$

- If $\beta_1^s > 0$, as has been found with respect to productivity in many US manufacturing industries (e.g., Olley and Pakes 1996; Hortaçsu and Syverson 2007; Bartelsman, Haltiwanger, and Scarpetta 2013), it indicates that higher performance producers have a greater share of activity at a point in time
- If $\beta_1^s \leq 0$, lower quality facilities are the same size or larger than their high-quality counterparts and suggests that forces beyond quality competition are driving the allocation of market activity

Static and Dynamic Allocation

For the dynamic allocation analysis, use the following regression framework:

$$\Delta_h = \beta_0^d + \beta_1^d q_h + \gamma_M^d + \epsilon_d^2.$$

where $\Delta_h = \frac{N_{h,2010} - N_{h,2008}}{\frac{1}{2}(N_{h,2010} + N_{h,2008})}$ is a measure of the hospital's growth rate in patient counts (from 2008 to 2010)

- If $\beta_1^d > 0$, higher productivity producers experience growth in market shares, as commonly found in developed country manufacturing and retail (e.g., Scarpetta et al. 2002; Disney, Haskel, and Heden 2003; and Foster, Haltiwanger, and Krizan 2006)

Summary Statistics

Table 1—Static and Dynamic Allocation Metrics across Conditions

Condition:	AMI (1)	Heart failure (2)	Pneumonia (3)	Hip/knee (4)
Panel A. Composition of all Medicare discharges in 2008				
Number of patients in 2008	263,485	545,363	475,756	350,536
Share through emergency dept.	0.71	0.76	0.76	0.02
Share of all Medicare discharges	0.03	0.06	0.05	0.04
Share of Medicare hospital spending	0.04	0.05	0.04	0.05
Number of hospitals in 2008	4,257	4,547	4,607	3,297
Panel B. Static allocation: patients in 2008				
Patients (index events)	190,189	308,122	354,319	267,557
Average number of patients per hospital	65.8	76.6	81.9	101.7
SD of patients per hospital	67.6	78.2	70.8	118.0
Hospitals	2,890	4,023	4,325	2,632
Average number of hospitals per market	9.4	13.1	14.1	8.6
Panel C. Dynamic allocation: growth in patients from 2008 to 2010				
Average growth rate across hospitals	−0.17	−0.10	−0.13	−0.03
SD across hospitals	0.42	0.38	0.36	0.46
Hospitals	2,890	4,023	4,325	2,632

Notes: Panel A is calculated on a 100 percent sample of age 65 and older fee-for-service Medicare patients in 2008 and counts all patients with the condition, not just the index events that are the subject of the remainder of this study and panels B and C. The sample in panels B and C is all hospitals that had at least 1 index admission in 2008 for the condition shown in the column heading and had a valid risk-adjusted survival rate for that condition (risk-adjusted readmission for hip/knee replacement). There are 306 hospital markets, called Hospital Referral Regions (HRRs). Growth is calculated based on the formula in equation (3) that restricts values to between −2 and 2.

Summary Statistics

TABLE 2—SUMMARY STATISTICS ON QUALITY METRICS ACROSS CONDITIONS

Condition:	AMI (1)	Heart failure (2)	Pneumonia (3)	Hip/knee (4)
Panel A. Risk-adjusted survival rates (30 days): patients in 2006–2008				
Average 30-day survival rate	0.82	0.89	0.88	
SD of risk-adjusted measure	(0.03)	(0.02)	(0.02)	
Hospitals in risk-adjusted measure	2,890	4,023	4,325	
Panel B. Risk-adjusted readmission rates (30 days): patients in 2006–2008				
Average 30-day readmission rate	0.21	0.21	0.16	0.06
SD of risk-adjusted measure	(0.03)	(0.02)	(0.02)	(0.02)
Hospitals in risk-adjusted measure	2,322	3,904	4,264	2,632
Panel C. Processes of care: shares of patients receiving appropriate treatments in 2006–2008				
Average score	0.93	0.83	0.88	
SD	(0.05)	(0.14)	(0.07)	
Hospitals	2,398	3,666	3,920	
Average number of processes reported	4.40	3.30	6.22	
Panel D. Patient survey: survey covers all patients in 2008 (not limited to particular condition)				
Average overall rating (1–3, higher is better)	2.53	2.53	2.53	2.53
SD	(0.14)	(0.14)	(0.14)	(0.14)
Hospitals	3,498	3,598	3,610	3,061

Notes: Sample restrictions are specific to the condition and quality metric; see text for more details of the metric definitions and sample restrictions. Summary statistics are reported across hospitals. In panels A and B, the standard deviations are of the risk-adjusted measures and are empirical-Bayes-adjusted to account for measurement error (see online Appendix Section C.3.1). In panel D, the number of hospitals differs across conditions even though the patient survey metric is not condition-specific because we calculate the ratings on the subset of hospitals that reported at least one patient with the condition in 2008.

Allocation Results

Table 4—Allocation across Conditions

Measure/condition	Static allocation AMI (1)	Static allocation HF (2)	Static allocation Pneu (3)	Static allocation Hip/knee (4)	Dynamic allocation AMI (5)	Dynamic allocation HF (6)	Dynamic allocation Pneu (7)	Dynamic allocation Hip/knee (8)
Risk-adjusted survival								
Coef. on survival rate	17.496	15.360	5.140		1.533	0.774	1.220	
	(0.995)	(1.320)	(0.777)		(0.379)	(0.501)	(0.354)	
Hospitals	2,890	4,023	4,325		2,890	4,023	4,325	
Risk-adjusted readmission								
Coef. on readmission rate	−9.162	−10.346	0.499	−21.037	−1.428	−2.300	−1.138	−1.112
	(1.621)	(1.782)	(1.575)	(2.027)	(0.611)	(0.651)	(0.679)	(0.836)
Hospitals	2,322	3,904	4,264	2,632	2,322	3,904	4,264	2,632
Process of care Z-score								
Coef. on process Z-score	0.319	0.332	0.211		0.048	0.043	0.026	
	(0.026)	(0.016)	(0.015)		(0.010)	(0.009)	(0.009)	
Hospitals	2,398	3,666	3,920		2,398	3,666	3,920	
Patient survey Z-score								
Coef. on survey Z-score	−0.321	−0.252	−0.210	0.057	−0.065	−0.003	0.007	0.037
	(0.052)	(0.038)	(0.030)	(0.051)	(0.015)	(0.011)	(0.011)	(0.022)
Hospitals	3,498	3,598	3,610	3,061	3,498	3,598	3,610	3,061

Notes: The static allocation results are estimated using equation (1), a hospital-level regression of log-patients in 2008 on market fixed effects and the quality measure named in the row. The dynamic allocation results are estimated using equation (2), which is an identical regression except for the dependent variable, which is now growth in patients from 2008 to 2010. Growth is defined as in equation (3). Standard errors are bootstrapped with 300 replications and are clustered at the market level. Risk-adjusted survival and readmission are reported in percentage points (e.g., a value of 0.1 is 10 percentage points); process of care and patient survey metrics are reported in standard deviation units (e.g., a value of 1 is one standard deviation).

Benchmarking the Magnitude of Reallocation

- Compare the reallocation of market share associated with higher quality to the reallocation associated with shorter distance between patient and hospital
  - Distance-to-hospital has been extensively analyzed as a measure of hospital "price," with the general finding that individuals consider greater distance to the hospital as a disamenity (see, e.g., Luft et al. 1990; Town and Vistnes 2001; Gaynor and Vogt 2003; Tay 2003; Romley and Goldman 2011)
- To compare allocation on quality to that on distance, adapt the static allocation analysis in the spirit of the existing distance-to-hospital choice literature

Benchmarking the Magnitude of Reallocation

Specifically, specify the utility function of consumer p for hospital h as

$$U_{ph} = \rho_1 distance_{ph} + \rho_2 distance^2_{ph} + \theta q_h + \varphi_{ph}$$

where $distance_{ph}$ is the distance from the patient to the hospital, q_h is the quality metric and φ_{ph} is Type 1 extreme value distributed error term (conditional logit model)

Benchmarking the Magnitude of Reallocation

The probability of choosing hospital h is

$$P(C_p = h) = \frac{\exp(\rho_1 distance_{ph} + \rho_2 distance^2_{ph} + \theta q_h)}{\sum_{h' \in H_{M(p)}} \exp(\rho_1 distance_{ph'} + \rho_2 distance^2_{ph'} + \theta q'_h)}$$

where $H_{M(p)}$ is the patient's choice set of hospitals (all hospitals in the patient's hospital market)

Benchmarking the Magnitude of Reallocation

Report the marginal rate of substitution between quality and average distance ($\overline{distance}$)

$$MRS = \frac{\partial U_{ph}/\partial q_h}{\partial U_{ph}/\partial \overline{distance}} = \frac{\theta}{\rho_1 + 2\rho_2 \overline{distance}}$$

When the $MRS < 0$, it implies that the quality measure is a good, i.e., that patients are willing to travel farther to gain access to more quality

Benchmarking the Magnitude of Reallocation

Table 5—Choice Model of Patient Allocation across Conditions

Condition:	AMI (1)	HF (2)	Pneumonia (3)	Hip/knee (4)
Mean miles to chosen hospital	12.48	8.27	7.49	13.16
SD miles to chosen hospital 20.06	20.06	13.25	11.92	18.85
Risk-adjusted survival				
MRS(1 pp risk-adjusted survival, miles)	−1.793	−1.029	−0.378	
	(0.158)	(0.129)	(0.057)	
Patients	165,005	275,671	317,904	
Risk-adjusted readmission				
MRS(1 pp risk-adjusted readmission, miles)	1.138	1.040	0.451	2.385
	(0.173)	(0.122)	(0.109)	(0.268)
Patients	158,086	274,667	317,374	222,673
Process of care Z-score				
MRS(1 SD process of care, miles)	−4.418	−2.238	−1.325	
	(0.383)	(0.221)	(0.110)	
Patients	158,032	270,773	309,623	
Patient survey Z-score				
MRS(1 SD patient survey, miles)	0.324	−0.093	0.036	−1.604
	(0.388)	(0.205)	(0.151)	(0.382)
Patients	167,429	266,915	298,185	224,451

Notes: This table reports the marginal rates of substitution (MRS) of quality for distance derived from the conditional logit model (see equation (6)). For the survival and readmission rates, the MRS given by equation (6) is divided by 100 to put it into percentage point terms. Only one quality measure is used at a time in each logit model. Standard errors are analytic and clustered at the market level. The sample is all patients with the condition in 2008 who stayed in their market of residence for treatment. The choice set for a patient is all hospitals in his market with the quality measure available that treated at least one patient in 2008. The mean and SD miles statistics are taken from the patients in the column's risk-adjusted survival sample (risk-adjusted readmission for hip/knee replacement). All MRSs in a column are evaluated at this mean.

Evidence of Demand-Based Mechanism: More Scope for Choice For Transfer Patients

Table 8—Travel Distance for ED and Non-ED Transfer Patients across Conditions

Condition:	AMI		Heart failure		Pneumonia		Hip/knee	
Source of admission	ED (1)	Transfer (2)	ED (3)	Transfer (4)	ED (5)	Transfer (6)	ED (7)	Transfer (8)
Share of patients in 2008	0.76	0.16	0.75	0.03	0.77	0.01	0.02	0.00
Median miles traveled	5.43	33.77	5.06	30.15	5.12	25.20	5.88	29.18
Mean miles traveled	40.89	66.45	34.27	61.38	37.65	52.21	44.24	61.01
Share treated at nearest hospital	0.52	0.03	0.53	0.07	0.54	0.12	0.50	0.14

Notes: This analysis considers 2008 patients who were treated at hospitals in the baseline allocation sample (i.e., hospitals with at least one patient in 2008). ED patients were admitted through the hospital's emergency department (see footnote 29). Non-ED transfer patients were admitted directly after a stay at another hospital (see footnote 30). Distances are from the zip code centroid of the patient to the zip code centroid of the hospital.

Larger Effects When More Scope for Choice For Transfer Patients

TABLE 9—ALLOCATION FOR ED AND NON-ED TRANSFER PATIENTS ACROSS CONDITIONS

Condition:	AMI		Heart Failure		Pneumonia	
Source of admission	ED (1)	Transfer (2)	ED (3)	Transfer (4)	ED (5)	Transfer (6)
Share of patients in 2008	0.76	0.16	0.75	0.03	0.77	0.01
Risk-adjusted survival						
Static allocation	14.489	42.532	15.727	50.673	7.168	14.049
	(1.022)	(2.609)	(1.586)	(4.664)	(0.983)	(2.941)
p-value of test for equality	0.000		0.000		0.009	
Hospitals	2,881	2,881	4,023	4,011	4,325	4,275
Dynamic allocation	0.572	7.258	2.300	13.935	3.423	4.454
	(0.496)	(1.260)	(0.799)	(2.635)	(1.006)	(1.793)
p-value of test for equality	0.000		0.000		0.562	
Hospitals	1,384	1,384	1,438	1,438	1,451	1,451
Risk-adjusted readmission						
Static allocation	−8.128	−25.550	−11.265	−37.988	−1.647	1.089
	(1.730)	(5.921)	(2.329)	(6.744)	(2.021)	(6.252)
p-value of test for equality	0.001		0.000		0.653	
Hospitals	2,304	2,304	3,903	3,892	4,264	4,214
Dynamic allocation	0.148	−1.837	−1.812	−11.381	−0.439	−2.517
	(0.704)	(2.034)	(0.994)	(2.727)	(1.419)	(2.965)
p-value of test for equality	0.285		0.001		0.500	
Hospitals	1,342	1,342	1,434	1,434	1,445	1,445
Process of care Z-score						
Static allocation	0.326	1.179	0.377	0.754	0.262	0.214
	(0.021)	(0.090)	(0.025)	(0.058)	(0.018)	(0.043)
p-value of test for equality	0.000		0.000		0.261	
Hospitals	2,379	2,379	3,665	3,653	3,920	3,869
Dynamic allocation	0.008	0.216	0.063	0.295	0.079	0.098
	(0.021)	(0.045)	(0.027)	(0.053)	(0.024)	(0.042)
p-value of test for equality	0.000		0.000		0.638	
Hospitals	1,360	1,360	1,433	1,433	1,428	1,428
Patient survey Z-score						
Static allocation	−0.157	−0.034	−0.141	−0.090	−0.137	−0.203
	(0.035)	(0.072)	(0.032)	(0.060)	(0.028)	(0.057)
p-value of test for equality	0.051		0.349		0.170	
Hospitals	3,498	3,498	3,598	3,586	3,610	3,559
Dynamic allocation	0.019	0.052	0.038	0.012	−0.002	0.008
	(0.020)	(0.037)	(0.018)	(0.052)	(0.023)	(0.051)
p-value of test for equality	0.430		0.600		0.851	
Hospitals	1,397	1,397	1,423	1,423	1,396	1,396

Notes: This table repeats the analysis of Table 4, but the left-hand side of these regressions considers hospital size and growth counting only ED patients in the odd-numbered columns and only non-ED transferred patients in the even-numbered columns. We use a fixed effects Poisson model for static allocation to avoid differential truncation between the two patient groups. To make the Poisson model analogous to our baseline static allocation model, its regressand is the count of patients, not the logarithm. The static allocation sample is the baseline analysis sample from Table 4. Poisson sample sizes may differ from baseline sample sizes because markets with one hospital or markets with all zero patient counts are excluded. The dynamic allocation sample is the subset of baseline hospitals with at least one ED patient and non-ED transfer patient in 2008. Standard errors are bootstrapped with 300 replications and are clustered at the market level.

Summary

- Find robust evidence across several different conditions and performance measures that higher quality hospitals have higher market shares and grow more over time
- The relationship between performance and allocation is stronger among patients who have greater scope for hospital choice, suggesting that patient demand plays an important role in allocation
- Health care may thus have more in common with "traditional" sectors subject to market forces than often assumed

Literature: Review Articles and Health Insurance

- Gaynor, Martin, Kate Ho, and Robert J. Town "The industrial organization of health-care markets." Journal of Economic Literature, 2015, 53 (2): 235-84.
- Handel Ben, and Kate, Ho "Chapter 16: The industrial organization of health care markets". Handbook of Industrial Organization, 2021, Volume 5.
- Einav, Liran and Finkelstein, Amy "Selection in Insurance Markets: Theory and Empirics in Pictures" Journal of Economic Perspectives, 2011, 25(1): 115-138.
- Einav, Liran, Finkelstein, Amy and Cullen, Mark. "Estimating Welfare in Insurance Markets Using Variation in Prices." The Quarterly Journal of Economics, 2010, 125(3): 877-921

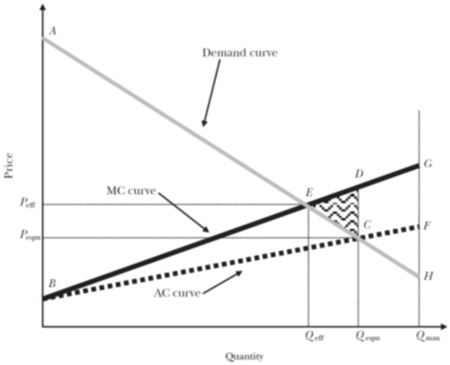
Literature: Hospital Industry and Performance

- Ho, Katherine. "The Welfare Effects of Restricted Hospital Choice in the US Medical Care Market." Journal of Applied Econometrics, 2006, 21(7): 1039-1079
- Moscelli, Giuseppe, Gravelle, Hugh, Siciliani, Luigi. Hospital Competition and Quality for Non-emergency Patients in the English NHS. The RAND Journal of Economics, 2021; 00: 1- 33.
- Chandra, Amitabh, et al. "Health Care Exceptionalism? Performance and Allocation in the US Health Care Sector." The American Economic Review, 2016, vol. 106(8): 2110–44.
- Chandra, Amitabh, and Douglas O Staiger, "Identifying sources of inefficiency in healthcare." The Quarterly Journal of Economics, 2020, 135(2): 785-843.

Additional Results

Advantageous Selection ▸ Back

Figure 4
Advantageous Selection



Source: Einav, Finkelstein, and Cullen (2010), figure 2.

- The individuals who are willing to pay the most for insurance are those who are the most risk averse (and so have the lowest average cost)

Measuring Welfare

- Measure consumer surplus by the certainty equivalent (CE)
- The CE of an uncertain outcome is the amount that would make an individual indifferent between obtaining this amount for sure and obtaining the uncertain outcome (expressed as $v(CE) = E(v(\zeta))$
- An outcome with a higher CE therefore provides higher utility to the individual
- Total surplus in the market is the sum of CEs for consumers and profits of firms

Measuring Welfare

- Denote by $e^H(\zeta_i)$ and $e^L(\zeta_i)$ CEs for consumer i of an allocation of contract H and L
- Under the assumption of risk aversion, the WTP for insurance is $\pi(\zeta_i) = e^H(\zeta_i) - e^L(\zeta_i) > 0$

Measuring Welfare

Consumer welfare is

$$CS = \int [(e^H(\zeta) - p)\mathbb{1}(\pi(\zeta) \geq p) + (e^L(\zeta))\mathbb{1}(\pi(\zeta) < p)] dG(\zeta)$$

Measuring Welfare

Producer welfare is

$$PS = \int (p - c(\zeta))] \mathbb{1}(\pi(\zeta) \geq p) dG(\zeta)$$

Measuring Welfare

▸ Back Total welfare is thus

$$TS = CS + PS = \int [(e^H(\zeta) - c(\zeta))\mathbb{1}(\pi(\zeta) \geq p) + (e^L(\zeta))\mathbb{1}(\pi(\zeta) < p)]dG(\zeta)$$

Hospital Demand Results

▸ Back

Table V. Results from regression of hospital dummy coefficients on characteristics

Variable	Coefficient estimate
Neonatal intensive care	−1.79 (1.46)
Angioplasty	−1.51 (1.61)
Cardiac catheterization laboratory	5.90** (1.82)
Computed tomography scanner	6.53* (3.88)
Positron emission tomography	4.55** (1.57)
Single-photon emission computerized tomography	−3.23** (1.09)
Oncology services	2.90 (2.08)
Obstetric services	−1.93 (1.69)
Emergency department	−4.29* (2.20)
Breast cancer screening/mammograms	−4.44* (2.49)
Burn care	2.10 (1.88)
Alcohol/drug abuse inpatient care	0.51 (1.24)
Number of beds	0.01** (0.004)
Distance from City Hall	0.63** (0.19)
Distance from City Hall squared	−0.02** (0.01)
Registered nurses per bed	28.18** (4.97)
Nurses per bed squared	−9.74** (1.76)
Doctors per bed	3.78** (1.79)
JCAHO accreditation	6.83* (3.45)
Cancer program approved by ACS	4.32** (1.72)
Residency training program	−4.46** (1.46)
Medical school	4.72** (1.36)
Member of Council of Teaching Hospitals of the Association of American Medical Colleges	−0.29 (1.86)
Independent Practice Association—hospital	5.27** (1.15)
Foundation	−6.79** (2.04)
Indemnity Fee for Service Plan—hospital	2.56 (2.27)
Primarily osteopathic hospital	1.56 (3.72)
Operates subsidiary corporations	2.24** (1.05)
Controlled/owned by county	−9.51** (3.80)
Controlled/owned by church	−4.49** (1.41)
Controlled/owned by for-profit partnership	19.69** (5.06)
Constant	−32.10** (5.57)
Market fixed effects	Yes
R^2	0.44

Notes: Regression of estimated hospital fixed effect coefficients from multinomial logit model on hospital characteristics. $N = 434$ hospital-years. Robust standard errors are reported in parentheses; ** significant at $p = 0.05$; * significant at $p = 0.1$.

- Shows the results of the regression of the predicted hospital dummy coefficients on hospital characteristics
- Consumers place a positive value on the number of nurses per bed, the number of doctors per bed, and overall on hospital accreditation
- Many of the characteristics are correlated with each other, making some of the results difficult to interpret