NBER WORKING PAPER SERIES

MEASURING CONSUMER VALUATION OF LIMITED PROVIDER NETWORKS

Keith Marzilli Ericson
Amanda Starc

Working Paper 20812
http://www.nber.org/papers/w20812

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2014

Contact: kericson@bu.edu and astarc@wharton.upenn.edu. The authors thank Leila Agha, Cory Capps, Leemore Dafny, Jonathan Kolstad, Jim Rebitzer, Ashley Swanson, Bob Town, and seminar participants at Boston University and the NBER Health Insurance Exchange conference for helpful comments. We thank Kimberley Geissler for assistance with the data. Ericson thanks the Boston University School of Management for funding. Starc thanks the Wharton Center for Health Care Management and Economics for funding. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Measuring Consumer Valuation of Limited Provider Networks
Keith Marzilli Ericson and Amanda Starc
NBER Working Paper No. 20812
December 2014
JEL No. I10,I11,I13,L14

ABSTRACT

We measure provider coverage networks for plans on the Massachusetts health insurance exchange using a two measures: consumer surplus from a hospital demand system and the fraction of population hospital admissions that would be covered by the network. The two measures are highly correlated, and show a wide range of networks available to consumers. We then estimate consumer willingness-to-pay for network breadth, which varies by age. 60-year-olds value the broadest network approximately $1200-1400/year more than the narrowest network, while 30-year-olds value it about half as much. Consumers place additional value on star hospitals, and there is significant geographic heterogeneity in the value of network breadth.

Keith Marzilli Ericson
Boston University School of Management
595 Commonwealth Avenue
Boston, MA 02215
and NBER
kericson@bu.edu

Amanda Starc
The Wharton School
University of Pennsylvania
3641 Locust Walk
Room 303 CPC
Philadelphia, PA 19104
and NBER
astarc@wharton.upenn.edu

Introduction

Insurance plans that only allow coverage for a limited set of providers (often called "limited" or "narrow" network plans) are growing in popularity, especially in the new health insurance exchanges created by the 2010 Affordable Care Act. These networks, which can steer consumers to lower cost providers, have been proposed as a solution to rising health care costs.

Yet there is little evidence on how consumers value such provider coverage networks, since consumers (e.g. in employer-sponsored plans) have not typically chosen from among many different provider networks; this is changing with the creation of the exchanges. Variation in networks allows us to determine the value consumers place on plan attributes, including network breadth. There are at least two ways to examine consumer valuation of these networks. First, with the *provider demand system* method, consumers' value of a network is built up from a model of consumer demand for providers. Once the demand system for the providers has been estimated, the value of various provider networks can be simulated. That is, consumers' valuation for insurance networks can be derived from their demand for health care providers. Second, with the *insurance choice* method, we can measure consumers' demand for insurance networks directly from their choice of insurance plans that vary in network breadth.

We examine consumer valuation of provider coverage networks with both the provider demand system and insurance choice methods. We use data from the Massachusetts Health Insurance Exchange (HIX) and the Massachusetts All-Payer Claims Database (APCD). With the APCD, we develop a model of consumer demand for hospitals, and then use the model to simulate the value of provider coverage networks. We then use choices from the HIX to determine the value consumers place on provider coverage networks at the point of insurance choice.

Our results indicate that simple measures of network breadth can predict consumer choices. The consumer surplus of different networks estimated from our hospital demand system is highly correlated with a simple measure of fraction of population admissions that would be covered by the network. We find that WTP for network breadth varies by age, with 60-year olds valuing the broadest versus narrowest network at $102/month more using the consumer surplus measure and $123/month using the fraction of admissions measure.

While limited network plans have increased attention as a result of healthcare reform, they are not novel: managed care plans in the 1990s used limited provider choice as a method to reduce cost (Cutler, McClellan, and Newhouse 2000). Limited network insurance plans can reduce costs in a variety of ways: they can include only lower cost (per unit price) providers, they can include only lower utilization providers (i.e. variation in provider style), they can enable insurers to bargain more effectively with providers, and they can enable insurers to select a healthier pool of enrollees.[1] The focus of this paper, though, is not on how these plans lower costs but on how consumers value these plans.

Our analysis builds on previous literature. For employer-sponsored health insurance, Ho (2006) estimates a model of hospital demand, and then a model of insurance plan choice conditional on the hospital network offered. Her model of insurance plan choice represents a composite of employer choice and search as well as individual choice. In our paper, we directly examine consumer choice of insurance plans in an exchange setting, with posted prices. More recently, Gruber and McKnight (2014) examines financial incentives for Massachusetts state employees to choose plans with limited networks that led about 10% of eligible employees to change switch plans. They find that switching to limited networks reduced spending on medical care, with the reduction attributable to both a change in the quantity of services used as well as the price paid per service.

In addition to the impact on costs, narrow networks have the potential to shape insurance markets in a number of ways. First, narrow networks may allow carriers to differentiate their products, allowing them to charge a premium in the absence of strong brand preferences (Starc 2014). On the other hand, the ability to sell a narrow network product may lower barriers to entry, and additional entrants can lower premiums (Dafny, Gruber, and Ody 2014).

1. Data

We use data from the Massachusetts All-Payer Claims Database (APCD) and the Massachusetts HIX Commonwealth Choice program.[2]

1.a HIX Choices

The Massachusetts HIX was created by the 2006 health reform and was a model for the ACA HIXs. The HIX is described in detail in Ericson and Starc (2012a, 2012b). Our data is transaction-level data from Nov 2009 -Feb 2010 for individuals who purchase single coverage from the unsubsidized[3] market. This dataset captures only individuals who enroll in

[1] See Shepard (2014) for evidence of adverse selection on network breadth in the Massachusetts Commonwealth Care market. The Commonwealth Care market is distinct from the market we examine in our paper—Commonwealth Choice. Both are health insurance exchanges. Commonwealth Choice was the unsubsidized market that offered various tiers of plan quality (bronze, silver, gold). Commonwealth Care was the subsidized market that offered a single standardized benefit package but allowed variations in network breadth. Both were superseded by the ACA exchanges.

[2] We supplement this data with information from the American Hospital Association, CMS's National Plan and Provider Enumeration System, and hand collected data on provider network coverage.

[3] In this time period, subsidized insurance was offered in the separate Commonwealth Care market.

the HIX for the first time during this time period; it contains one observation per person, for the month in which they first enrolled.

Consumers pick a plan from the set of plans available to them at posted prices, which vary by age, zip code and family size. Plans were grouped into tiers of actuarial value (bronze, silver, and gold); the actuarial values of the tiers is slightly different from the ACA's tiers.[4] Six insurers (listed in Table 1) offer plans on the HIX during our time frame, and must offer a plan in each tier.[5]

To identify price sensitivity, we use the fact that preference are continuous in age but prices jump at round numbered ages (e.g. 30, 35, 40, etc.) We discuss, justify, and apply this identification strategy in detail in Ericson and Starc (forthcoming).

1.b Hospital Claims and Coverage

We examine provider coverage networks for acute-care hospitals for adults in Massachusetts. Using the 2012 American Hospital Association (AHA) database, we select the set of general medical and surgical hospitals, excluding long-term care, rehabilitation, children's, and Veterans Affairs hospitals. We are left with a list of 60 hospitals.

We then hand-collected data on whether each hospital was in network[6], for all six carriers in our HIX data from the HIX website. In addition, we separately coded Fallon Select and Fallon Direct plans—both offered by Fallon, but with different networks.

We then use the APCD data to construct "admission events" for six diagnosis categories: cardiac, cancer, neurological, digestive, labor, and newborn baby. We use the ICD-9 diagnosis codes in Ho (2006), reproduced in Table A.1. We use all commercial payers (e.g. excluding MassHealth, Medicare) and select all claims that have either and admitting diagnosis or primary diagnosis in one (or more) of these categories. We keep only claims with admission dates between Jan 1st, 2009 and Dec 31st, 2011. We link these claims to our list of acute care hospitals based on the National Provider Identifier (NPI) with further details in the appendix.

We aggregate claims into admission events. If an individual's first admission is on date *t,* we group all of their claims with admission dates between *t* and *t+30* into one admission event.

[4] In the 2009 the plans were simply grouped into tiers; beginning January 2010, the cost-sharing characteristics were standardized within seven product tiers: Gold, Silver-High, Medium and Low, and Bronze-High, Medium, and Low. Standardization unbundled the choice of plan into a choice of cost-sharing characteristics (tier), and a choice of insurer (with a provider coverage network and premium specific to that insurer). Standardization and its effect on choice are described in more detail in Ericson and Starc (2013).

[5] Health New England is omitted as it only covers part of the state.

[6] Circa 2013, the Connector had a web-based tool that allowed users to restrict search results to plans that included that hospital in network.

An individual can have multiple admission events: someone with 3 claims with admission dates *t, t+15, t+40* would have two admissions events: a *t* to *t+30* admission event and a *t+40* to *t+70* admission events. For each admission event, we assign the hospital based on the modal hospital over the claim lines; similarly we assign the modal admitting diagnosis and primary diagnosis.

We use data from all commercial payers. The HIX market we study is a small (but growing) part of the carriers' book of business, and our measures will not be contaminated by the choices of consumers choosing within the exchange.

2. Construction of Network Measures

2.a. Hospital Counts and Covered Fraction of Admission Events

We quantify the breadth of insurer-hospital networks in a number of ways. Our simplest measure simply takes the number of hospitals in network as a percentage of hospitals in Massachusetts. This measure ranges from nearly one-third (Tufts Select) to nearly all hospitals (BCBS). In order to account for differences in demand across hospitals, we utilize the APCD data. First, we construct a measure of the fraction of admissions that would be covered by a carrier network. The results are in Table 1, and confirm our priors. BCBS offers the most generous network, with 98% of hospitals in network. The Tufts Select network, an early narrow network, has the lowest coverage measure. Fallon Select's network is broader than Fallon Direct. We can further decompose the measures by individual diagnosis, but all of the measures are highly correlated. The second column constructs a similar measure that restricts to academic medical centers.

2.b Consumer Surplus from Hospital Choice Model

We can take the claims data even more seriously and construct measures of network total expected consumer surplus from a network, which we will call the "hospital choice measure" for simplicity. By utilizing methods from the hospital merger literature (see Capps, Dranove and Satterthwaite 2003 and Gowrisankaran, Nevo, and Town, forthcoming), we can infer consumer valuations of networks from their choice of hospitals. These measures will more accurately capture the nonlinearities generated by "star" hospitals or systems who may bargain together.

To estimate the hospital choice measure, we assume that an individual *i* with diagnosis category *d* has utility of hospital *h* given by:

$$v_{idh} = \pi_{dh} + \lambda_{1d} distance_{ih} + \lambda_{2d} distance_{ih}^2 + \epsilon_{idh},$$

where π_{dh} is a hospital-diagnosis specific fixed effect, and $distance_{ih}$ is the distance (in miles) from the individual's zipcode to the hospital's address (see Empirical Appendix).[7] The diagnosis category corresponds to one the six previously defined categories (cardiac, cancer, neurological, digestive, labor, and newborn baby). Given this model and the assumption that ϵ_{idh} takes on a type-I extreme value distribution we can estimate the parameters of this model from the data on hospital chosen, broken down by each diagnosis category, using a conditional logit model of choice.[8]

Having estimated the parameters from the hospital choice model, we can then generate the consumer surplus from a given hospital network. We construct these measures separately for each diagnosis category, as the perceived quality of a hospital may vary by diagnosis. The consumer surplus of a network *j* for a diagnosis category *d* for consumer *i*:

$$CS_{ijd} = \log\left(1 + \sum\nolimits_h \exp(\pi_{dh} + \lambda_{1d} distance_{ih} + \lambda_{2d} distance_{ih}^2)\mathbf{1}_{h\ in\ network\ j}\right),$$

where $\mathbf{1}_{h\ in\ network\ j}$ is an indicator for whether the hospital is in *j's* network. We z-score normalize these measures within each zipcode. We then average the 6 CS_{jd} measures into a single CS_{ij} measure using demographic (age and gender) specific diagnosis weights. Table 1 presents the average $\overline{CS_j}$ across all consumers. This variable is scaled differently than our % of admissions covered, but generates a similar ranking of network breadth.

This measure of consumer surplus that varies within insurer: for instance, some individuals live close to hospitals covered by Fallon while other individuals live further away. Our new measure will give a higher network valuation for Fallon to the first set of individuals. This measure will allow us to see whether consumers separately value this measure of plan network over and above the value they place on the insurer's overall network (including, for instance, other providers such as individual physicians). Our goal is to consider a variety of different network measures, rather than relying on a single measure. We will show that all of these measures have similar implications for consumer valuation of networks.

3. Estimating Insurance Demand

From individuals' insurance choices, we estimate multinomial logit models of the form:

$$u_{ij} = \alpha_i p_{ij} + f\left(age_i, p_{ij}\right) + \beta X_{ij} + \theta Network_j + \varepsilon_{ij}, \qquad \text{(Equation 1)}$$

[7] This model could be generalized in a number of ways: for instance, we could allow π to vary by more narrowly defined diagnosis categories (such as by ICD-9 code rather than by 6 groups).

[8] Individuals may have limited network insurance plans that do not cover certain hospitals, thereby removing it from the consumer's choice set, or tiered network plans that impose additional cost-sharing for certain hospitals. This likely biases down our estimate of the value of the highest utility-giving hospitals, since limited network plans typically exclude the hospitals for which there is higher demand. We believe the bias is relatively small, given that our time period of admissions predates the growth of limited network insurance plans and uses the commercially insured population (typically, employer-sponsored plans).

where the utility of plan *j* for person *i* is given by u_{ij}, the premium (which varies by age) is given by p_{ij}, and the network measure for plan *j* is given by $Network_j$. We include a vector of other plan characteristics (tier, actuarial value) as βX_{ij}. The error term ε_{ij} is assumed to take a Type-I extreme value distribution, giving a standard logit model of choice.

Following our previous work (Ericson and Starc, forthcoming), we identify α using discontinuities in pricing by age. Thus, we let price sensitivity vary continuously by age through the term $f(age_i, p_{ij})$; here we implement the interaction as a linear function; our previous work found this to be a reasonable choice.

We first estimate a version of Equation 1, in which in lieu of including a measure of the insurer's network in the utility model, we simply include an insurer-specific fixed effect γ_j. This measure is plotted on the y-axis of Figure 1, with Blue Cross/Blue Shield's network's utility normalized to zero. On the x-axis of Figure 1, we plot one of our measures of network breadth, the percent of hospital admission events that would be covered by the insurer's network. It is encouraging that there is a clear relationship between our estimated utility of plan networks and the percent of admission events covered. The graph plots a linear fit, which has an R^2 of 0.75; with just these six points, we reject the null hypothesis of no linear relationship between the two measures at $p<0.05$.

The results of our basic choice models are in Table 2, Panel A. The model in the first column measures the breadth of networks using the percentage of hospital admissions that would be covered by a given plan; it ranges from zero to one. We can interpret the coefficient by dividing by the price coefficient and multiplying by differences in the network measure. We can calculate a consumer's WTP for network A versus B as follows:

$$WTP_{A,B} = \frac{\theta}{\alpha_i}(Network_A - Network_B)$$

Note that price sensitivity α varies by age, so WTP for networks will also vary by age.

For example, take the % Admits Covered measure: BCBS covers 59 percentage points more hospital admissions in the APCD data than the Tufts Select network. If we divide θ by age-specific α and multiply by 0.59, we have a measure of WTP for the BCBS network relative to the Tufts Select network. For a 30-year-old consumer, we estimate a WTP of $68/month for the broader BCBS network; for the less price sensitive 60-year-olds, we estimate a WTP of $123/month. In Panel B of Table 2, mixed logit models— which estimate population heterogeneity in price sensitivity α_i— imply similar valuations.

The hedonic regressions in Table 4 imply that compared to Tufts, BCBS charges $51/month more for 30-year olds and $137/month more for 60 year-olds, which lines up closely with our estimates of the WTP per month.

We examine a coarse measure of hospital quality: in column 3, we use as our network measure % of admissions at academic medical centers that would be covered. This measure is nearly perfectly correlated with the measure based on all hospitals. Thus, our WTP for network breadth are virtually identical; while we estimate a smaller θ, this is offset by larger variation between networks in this measure (i.e. a difference of 81 percentage points for BCBS versus Tufts, compared to only 59 in the % of all admissions measure.)

Finally, we consider CS_{ij} , the consumer surplus measure from the hospital demand system, as our network measure. With this measure, the value of networks will vary across individuals. Using the average $\overline{CS_j}$ for BCBS and Tufts, this specification implies a valuation for the broader BCBS network of $57/month for 30-year-olds and $102/month for 60-year olds. This result is very similar to the % of admissions measure.

Table 3 explores heterogeneity, as well as additional measures of network breadth. Column 1 lets network valuation vary by age and gender. The interaction between % Covered and Female suggests that women value network generosity more, though it is imprecisely measured and not significantly different from zero. We do find an age-trend in valuation, with θ about 30% higher at age 60 than at age 30. (Note, α_i also varies by age).

Turning to geography, we interact our network measure with the hospital referral region (HRR) of the consumer purchasing insurance. Consumer valuation of networks is higher in the Boston HRR than in Worcester or Springfield. Given the set of hospitals in Boston, we think this is intuitive. It also has important implications for pricing across geographic regions.

One salient measure of network quality to consumers may be whether a large, prominent hospital is included in the network. In our setting, Massachusetts General Hospital (MGH), one of the core Partners Healthcare hospitals, is an obvious example. (The Massachusetts hospital market has been subject to increased antitrust scrutiny due to the potential market power wielded by Partners.) In Table 3, Column 3 we include an indicator variable for whether MGH is in network. The results imply that a 30-year old[9] will also pay $32/month more for a plan with MGH in network, even controlling for the breadth of the overall network. This is consistent with "star hospitals" being able to command a premium.

Distance is also an important determinant of hospital demand: consumers are most likely to go to the hospital closest to them. In Table 3, Column 3 we replace our network measure with a simple indicator for whether the nearest hospital is in network. Using this as a proxy for network quality, the results imply that a 30-year old is willing to pay $26 more/month for

[9] A 60-year old is roughly half as price sensitive, so these numbers can be multiplied by 2 to approximate a 60-year-old's WTP.

a plan with the closest hospital to their zipcode in network. However, the indicator is not statistically significant from zero when the percent of admissions covered is also included in the model.

Finally, we limit our analysis to individuals in the Boston HRR and estimate a hospital demand model from these individuals alone. Table 4 first replicates the final conditional logit specification from Table 2 for this Boston-only sample. Then, column 2 includes insurer-specific fixed effects γ_j. Once we do this, our estimate of the additional weight consumers place on network quality (CS_{ij}) becomes smaller in magnitude and is much more imprecisely estimated. The 95% confidence interval is consistent with consumers either placing zero weight on the measure, or placing similar weight (0.4) as estimated in column 2.

These results indicate it is difficult to separately identify the weight consumers place on this particular measure of network breadth from their valuation of an insurers' network more generally. We may not have enough geographic variation within the Boston HRR to capture the separate effect of networks. Moreover, insurer networks have more components than hospital coverage—such as which physicians are included in network. These are likely valued by consumers, correlated with the overall hospital network, but not well captured by our measure using distance from hospitals. Finally, the results are also consistent with consumers simply using brand as a proxy for network quality. (This would also be consistent with the similar valuations of the two Fallon networks seen in Figure 1.)

4. Discussion and Conclusion

The literature on insurance demand has largely focused on the financial features of plans, rather than their networks. By contrast, this paper highlights the importance of non-pecuniary features of plans. Determining how consumers value networks has important implications for the competitiveness of exchanges and network adequacy regulation. We measure the value consumers place on network breadth, and find that consumers value broader networks using a variety of measures. However, it is unclear whether consumers value—or even observe—geographic variation in network quality in the Greater Boston area. They may use brand name as a proxy for network quality.[10] Furthermore, "star" hospitals are valued by consumers above and beyond the overall network measure.

Consumer valuation of networks may vary by context. The enrollees in the unsubsidized HIX we study are all above 300% of the poverty line; willingness-to-pay-may be lower for lower-incomes. In order for consumers to value network breadth, they must be able to

[10] We know that consumers do not necessarily weight product characteristics as economic theory would predict (Abaluck and Gruber 2010). Similarly, they may not be able to evaluate network differences accurately because they do not have easy access to network information or cannot do the (complex) calculation.

observe it: in contexts where brands are unfamiliar and/or it is difficult to access network information, consumers may not appear to value networks.

References

Abaluck, Jason, and Jonathan Gruber. 2011. "Choice Inconsistencies among the Elderly: Evidence from Plan Choice in the Medicare Part D Program." *American Economic Review*, 101(4): 1180-1210.

Capps, Cory, David Dranove, and Mark Satterthwaite. 2003. "Competition and Market Power in Option Demand Markets." *RAND Journal of Economics*, Vol. 34, No. 4, pp. 737-763.

Cutler, David, Mark McClellan, and Joseph Newhouse. 2000. "How Does Managed Care Do It?" *RAND Journal of Economics,* Vol. 31, No. 3, pp. 526-548.

Dafny, Leemore, Jonathan Gruber, and Christopher Ody. 2014. "More Insurers Lower Premiums: Evidence from Initial Pricing in the Health Insurance Marketplaces." NBER Working Paper 20140.

Ericson, Keith and Amanda Starc. 2012a. "Heuristics and Heterogeneity in Health Insurance Exchanges." *American Economic Review*, Vol. 102, No. 3, pp. 493-97.

Ericson, Keith and Amanda Starc. 2012b. "Designing and Regulating Health Insurance Exchanges: Lessons from Massachusetts." *Inquiry*: Winter 2012/2013, Vol. 49, No. 4, pp. 327-338.

Ericson, Keith and Amanda Starc. 2013. "How Product Standardization Affects Choice: Evidence from the Massachusetts Health Insurance Exchange." NBER Working Paper 19527.

Ericson, Keith and Amanda Starc. Forthcoming. "Pricing Regulation and Imperfect Competition on the Massachusetts Health Insurance Exchange." *Review of Economics and Statistics.*

Gowrisankaran, Gautam, Aviv Nevo, and Robert Town. Forthcoming. "Mergers When Prices are Negotiated: Evidence from the Hospital Industry." *American Economic Review.*

Gruber, Jonathan and Robin McKnight. 2014. "Controlling Health Care Costs Through Limited Network Insurance Plans: Evidence from Massachusetts State Employees." NBER Working Paper 20462.

Ho, Katherine. 2006. "The Welfare Effects of Restricted Hospital Choice in the US Medical Care Market." *Journal of Applied Econometrics*, Vol. 21, No. 7, pp. 1039-1079.

Shepard, Mark. 2014. "Hospital Network Competition and Adverse Selection: Evidence from the Massachusetts Health Insurance Exchange." Working Paper, Harvard University.

Starc, Amanda. 2014. "Insurer Pricing and Consumer Welfare: Evidence from Medigap." *RAND Journal of Economics*. Vol. 1, No. 1, pp. 198-220.

Tables and Figures

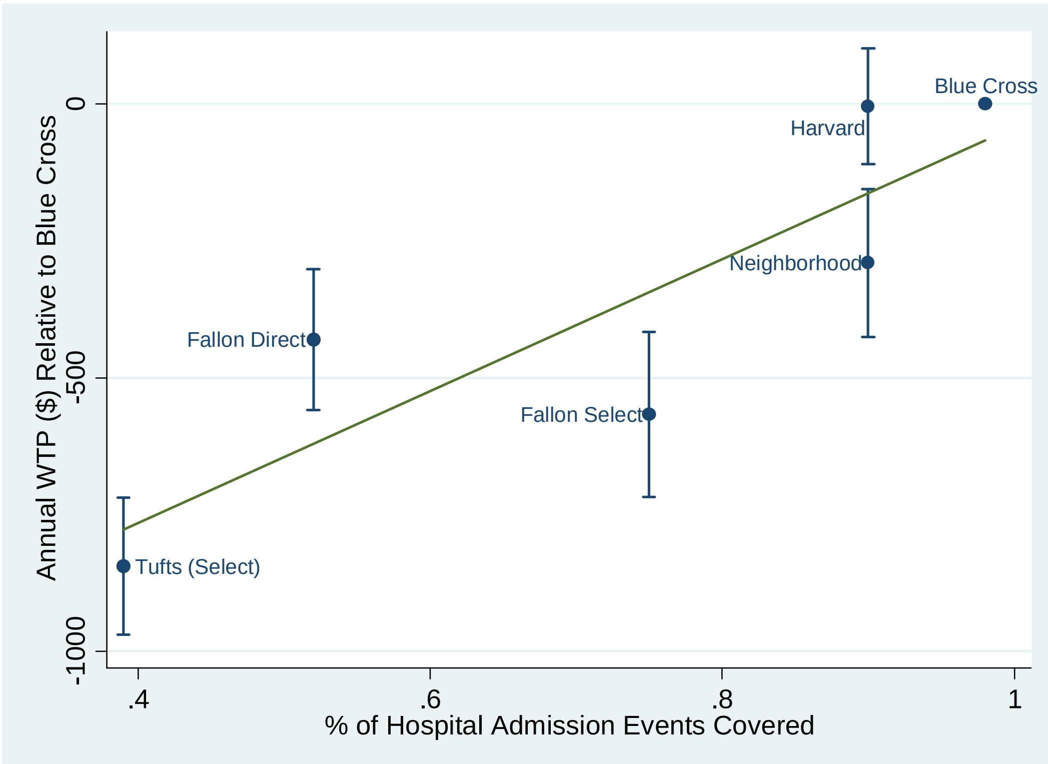

Figure 1. Network Breadth and Estimates of Plan-Specific WTP From Insurance Choice, for 30-year olds. Estimated from the following logit model: $u_{ij} = \alpha p_{ij} + \omega(age_i * p_{ij}) + \beta X_{ij} + \gamma_j + \varepsilon_{ij}$, where *X* includes actuarial value, tier, and year (2009 v 2010). "Annual WTP Relative to Blue Cross" for a 30-year old results from dividing the insurer-network fixed effect γ_j by $(\alpha + 30\omega)$. The graph includes 95% confidence interval bars, calculated by the delta method, around each WTP measure. The line shows a linear fit of the WTP measure to percent of hospital admission events covered.

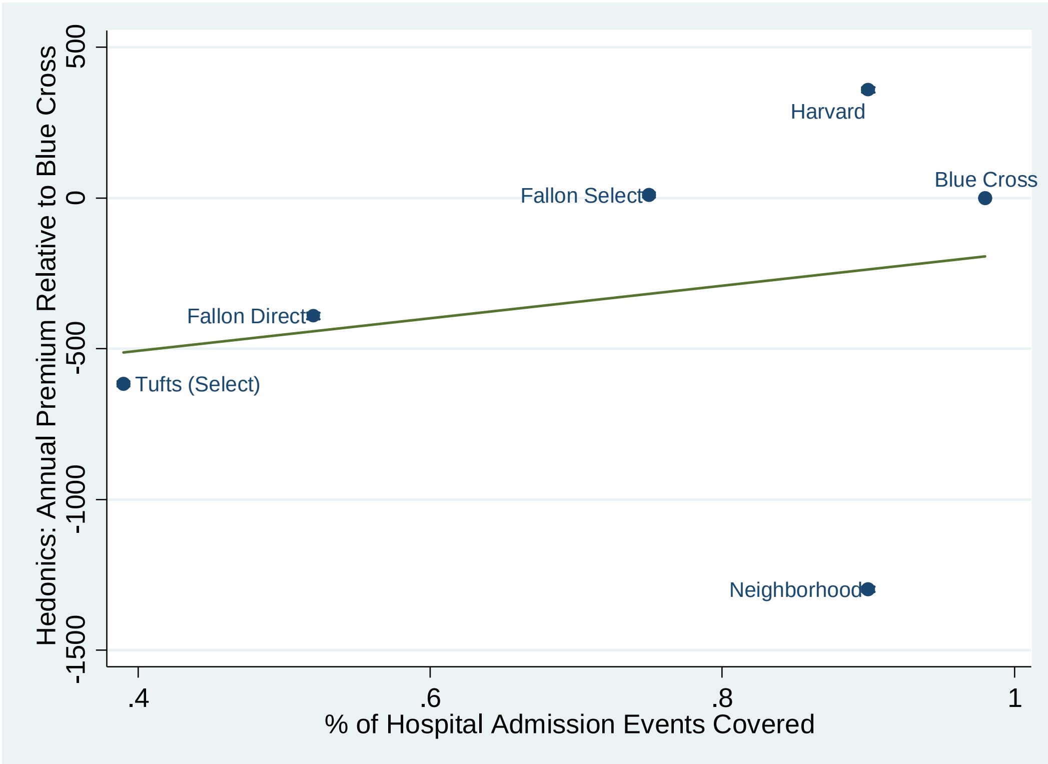

Figure 2. Network Breadth and Hedonic Pricing Regressions, Age 30 Prices. Vertical axis plots average premium differences (annualized) between insurer-networks from the hedonic regression estimated in Table 4 for 30-year olds. The graph includes 95% confidence interval bars, calculated by the delta method. The line shows a linear fit of the hedonic price differences measure to the percent of hospital admission events covered.

Table 1: Network Breadth Measures By Plan

	% of Hospitals In Network	% of Hospitals Admits Covered	% of AMC Admits Covered	Hospital Demand Model $\overline{CS_J}$
BCBS	0.981	0.983	1.00	0 .768
Fallon Direct	0.485	0.519	0.351	-0.480
Fallon Select	0.782	0.747	0.629	0 .128
Harvard	0.915	0.891	0.849	0 .529
Neighborhood	0.862	0.894	0.878	0 .589
Tufts (Select)	0.374	0.395	0.200	-1.536

Note: Provider coverage network information as described in text. Weighting comes from number of inpatient episodes captured in the MA APCD for six diagnostic categories, as described in text.

Table 2: Estimating Network Valuation from Insurance Choices

Panel A:	**Conditional Logits**			
	(1)	(2)	(3)	(4)
Premium	-0.0235***	-0.0225***	-0.0222***	-0.0220***
	(0.00112)	(0.00112)	(0.00112)	(0.00113)
Premium*Age	0.000241***	0.000231***	0.000227***	0.000226***
	(2.07e-05)	(2.06e-05)	(2.05e-05)	(2.07e-05)
Actuarial Value	2.366***	2.269***	2.220***	2.446***
	(0.250)	(0.251)	(0.251)	(0.251)
% Hospitals in Network	1.743***			
	(0.120)			
% Admits Covered		1.805***		
		(0.123)		
% of AMC Admits Covered			1.316***	
			(0.0889)	
Hospital Demand CS_{ij}				0.375***
				(0.0285)
Panel B:			**Mixed Logits**	
Mean $\ln[-\alpha_i]$	-3.771***	-3.810***	-3.825***	-3.828***
	(0.0671)	(0.0694)	(0.0703)	(0.0726)
Std. Dev. $\ln[-\alpha_i]$	0.420***	0.428***	0.433***	0.452***
	(0.0435)	(0.0455)	(0.0464)	(0.0489)
Premium*Age	0.000193***	0.000186***	0.000182***	0.000180***
	(2.90e-05)	(2.87e-05)	(2.86e-05)	(2.93e-05)
Actuarial Value	3.054***	2.976***	2.939***	3.140***
	(0.265)	(0.267)	(0.267)	(0.267)
% Hospitals in Network	1.541***			
	(0.125)			
% Admits Covered		1.563***		
		(0.127)		
% of AMC Admits Covered			1.134***	
			(0.0920)	
Hospital Demand CS_{ij}				0.322***
				(0.0295)
N (Plans*Individuals)	67,612	67,612	67,612	67,265

Note: Logit regressions as described in Equation 1. Also includes controls for tier (bronze, silver, gold). Mixed logits in Panel B allow for unobserved heterogeneity in price sensitivity by age. Sample: Choices of first-time enrollees on the Massachusetts HIX Nov. 2009 – Feb. 2010, one observation per person. Actuarial Value of plans measured from 0 to 1. N Person x Plan = 67,612 in all regressions.

Table 3: Additional Insurance Choice Specifications

	(1)	(2)	(3)	(4)
Premium	-0.0225***	-0.0220***	-0.0212***	-0.0239***
	(0.00112)	(0.00114)	(0.00117)	(0.00121)
Premium*Age	0.000231***	0.000226***	0.000217***	0.000246***
	(2.06e-05)	(2.08e-05)	(2.08e-05)	(2.21e-05)
Actuarial Value	2.276***	2.266***	2.187***	2.804***
	(0.251)	(0.255)	(0.251)	(0.257)
% Admits Covered	1.343***	2.018***	0.813***	
	(0.227)	(0.133)	(0.300)	
% Admits Covered*Age	0.0172*			
	(0.0103)			
% Admits Covered*Female	0.371			
	(0.244)			
% Admits Covered*HRR is Springfield		-1.627***		
		(0.333)		
% Admits Covered*HRR is Worchester		-2.689***		
		(0.227)		
1(MGH Covered)			0.468***	
			(0.130)	
1(Nearest Hospital Covered)				0.422***
				(0.0645)
N Person x Plan	67,612	65,955	67,612	62,140

Note: Logit regressions as described in Equation 1. Also includes controls for tier (bronze, silver, gold). Sample: Choices of first-time enrollees on the Massachusetts HIX Nov. 2009 – Feb. 2010, one observation per person. Actuarial Value of plans measured from 0 to 1. Sample sizes vary due to missing information on location.

Table 4: Within-Insurer Variation in Network Quality By Distance, Boston HRR

Conditional Logits	(1)	(2)
Premium	-0.0222***	-0.0237***
	(0.00121)	(0.00202)
Premium*Age	0.000225***	0.000240***
	(2.25e-05)	(2.83e-05)
Actuarial Value	2.336***	2.245***
	(0.281)	(0.296)
Hospital Demand CS_{ij}	0.466***	0.160
	(0.0333)	(0.134)
Brand FE	No	Yes

Note: Logit regressions as described in Equation 1. Also includes controls for tier (bronze, silver, gold). Sample: Choices of first-time enrollees on the Massachusetts HIX Nov. 2009 – Feb. 2010 in the Boston Hospital Referral Region, one observation per person. Actuarial Value of plans measured from 0 to 1. N Person x Plan 55,113 in all regressions.

Table 5: Hedonic Pricing Regressions

	Age 30 Prices		Age 60-65 Prices	
AV	105.9***	124.1***	214.7***	206.1***
	(2.720)	(1.431)	(4.493)	(2.418)
Silver	86.19***	83.87***	143.5***	145.7***
	(0.618)	(0.323)	(1.021)	(0.546)
Gold	191.7***	187.4***	321.1***	324.0***
	(0.898)	(0.471)	(1.483)	(0.796)
% of Admits Covered	52.63***		133.0***	
	(1.009)		(1.667)	
…Fallon Direct		-32.58***		-100.2***
		(0.470)		(0.793)
…Fallon Select		0.849**		-43.43***
		(0.356)		(0.602)
…Harvard		29.86***		-14.55***
		(0.334)		(0.564)
…Neighborhood		-108.2***		-218.8***
		(0.360)		(0.609)
…Tufts		-51.32***		-137.1***
		(0.361)		(0.610)
N Plan x Zipcode	61,744	61,744	61,744	61,744
R2	0.712	0.922	0.735	0.925

Note: Dependent Variable: Monthly Premium. Sample: Prices of plans on the Mass HIX, Nov. 2009 – Feb. 2010. Regressions include month fixed effects and zipcode fixed effects.

Empirical Appendix

CATEGORY	ICD-9 CODES (PRIMARY OR ADMITTING DIAGNOSIS)
CARDIAC	393-398; 401-405; 410-417; 420-429
CANCER	140-239
NEUROLOGICAL	320-326;330-337;340-359
DIGESTIVE	520-579
LABOR	644, 647, 648,650-677, V22-V24, V27
NEWBORN BABY	V29-V39

Table A.1. Definition of Diagnosis Categories From Ho (2006).

A1. Construction of Claims

From the APCD, we keep claims whose service provider is located in Massachusetts. We then merge each claim's Service Provider National Provider Identifier (NPI) with the CMS's National Plan and Provider Enumeration System Downloadable file (NPPES 2014-07-13 edition). To link these claims to hospitals, we keep matched APCD- NPPES records that have a National Uniform Claim Committee healthcare taxonomy code beginning in 282 (a broad category that includes General Acute Care Hospitals, but also other hospitals; see http://www.wpc-edi.com/reference/ for more details). We additionally hand select hospitals (Heywood, Marlborough, St Vincent, St. Anne's) based on the NPPES Provider Organization Name that were included in our AHA-identified hospital list but did not meet our taxonomy code criteria. Based on the NPI, Provider Organization Name, and Provider Business Practice Location fields, we hand link these records to our AHA-identified hospitals.