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UNIVERSITY OF CALIFORNIA,  
IRVINE

Essays in the Economics of Health and Religion

DISSERTATION

submitted in partial satisfaction of the requirements  
for the degree of

DOCTOR OF PHILOSOPHY

in Economics

by

Jerrod F. Anderson

Dissertation Committee:  
Professor Michael McBride, Chair  
Professor Ami Glazer  
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2016



# DEDICATION

To Meredith and Orrick

# TABLE OF CONTENTS

	Page
<b>LIST OF FIGURES</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>vi</b>
<b>ACKNOWLEDGMENTS</b>	<b>vii</b>
<b>CURRICULUM VITAE</b>	<b>viii</b>
<b>ABSTRACT OF THE DISSERTATION</b>	<b>ix</b>
<b>1 The Effect of Volume and Medicare Payment on Quality and Concentration in the Liver Transplant Market</b>	<b>1</b>
1.1 Introduction . . . . .	1
1.2 Literature . . . . .	2
1.3 Institutional Details . . . . .	5
1.4 Data . . . . .	6
1.5 Results . . . . .	8
1.5.1 Volume and Quality . . . . .	8
1.5.2 IV and Robustness Results . . . . .	11
1.5.3 Medicare Approval and Market Share . . . . .	15
1.6 Conclusion and Discussion . . . . .	17
<b>2 Club Splitting</b>	<b>20</b>
2.1 Introduction . . . . .	20
2.2 Theory of Group Splitting . . . . .	22
2.3 Affiliation Game . . . . .	26
2.3.1 Model . . . . .	26
2.3.2 Equilibrium of the Affiliation Game . . . . .	27
2.4 Splitting Game . . . . .	28
2.4.1 Model . . . . .	28
2.4.2 Splitting Equilibrium . . . . .	29
2.5 Application to Religious Schisms . . . . .	33
2.6 Conclusion . . . . .	40

<b>3</b>	<b>The Market Process in Health Care</b>	<b>42</b>
3.1	Introduction . . . . .	42
3.2	Health Care and Consumer Shopping . . . . .	44
3.3	Asymmetric Information and Health Care . . . . .	49
3.4	Lodge Doctors . . . . .	51
3.5	Medical Tourism . . . . .	56
3.6	Conclusion . . . . .	62
	<b>Bibliography</b>	<b>64</b>
<b>A</b>	<b>Chapter 2 Proofs</b>	<b>69</b>

# LIST OF FIGURES

	Page
1.1 Wait List Additions and Transplants Over Age 64 . . . . .	6
2.1 Affiliation Game . . . . .	26
2.2 Split with $s_1 > s_2$ . . . . .	30
2.3 Split with $s_1 < s_2$ . . . . .	31
2.4 Number of Schisms by Year . . . . .	35
2.5 Ownership Type by Denominational Family . . . . .	36
2.6 Schisms by Family . . . . .	37
2.7 Schisms by Ownership Type . . . . .	37

# LIST OF TABLES

	Page
1.1 Liver Transplant Center Characteristics by volume Tercile . . . . .	7
1.2 Liver Recipient Characteristics by volume Tercile . . . . .	7
1.3 Effect on 1 Year Patient Mortality of Volume by Tercile . . . . .	9
1.4 Effect on 1 Year Patient Mortality of Volume by 6 Month Increments . . . . .	10
1.5 Marginal Effects on 1 Year Patient Mortality of Volume by 1-Year Increments	11
1.6 Marginal Effects of Volume on 1 Year Patient Mortality IV Results . . . . .	12
1.7 Effect on 1 Year Patient Mortality of Previous Year Volume by Tercile . . . . .	14
1.8 Effect of Approval on Waitlist Share . . . . .	16
1.9 Effect of Approval on Transplant Share . . . . .	17
2.1 Regression results . . . . .	38
2.2 Direction of Schisms . . . . .	39



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# ABSTRACT OF THE DISSERTATION

Essays in the Economics of Health and Religion

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Doctor of Philosophy in Economics

University of California, Irvine, 2016

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The first chapter considers returns-to-scale in the liver transplant market. This chapter improves on the measurement of the learning effects by correlating mortality rates with only measures of previous volume, rather than with measures of current year volume. This chapter also investigates the impact of Medicare certification of liver transplant centers on those centers' market shares of the transplant market. I find no statistically significant relationship between previous transplant volume and the 1-year mortality rate.

Chapter 2 considers the affects of returns-to-scale in group formation. I develop a model of club competition in which the competitor arises from within the group. Clubs overcome the free-rider problem by restricting members' activity outside the group, and groups compete by choosing how restrictive they are. I find that club good production decreases (relative to no competition) if the competitor chooses a lower restriction level, and production increases if the competitor chooses a restriction higher than the incumbent. In each case members are worse off. The main determinant of a split being successful is the fixed cost of breaking away. If this cost is high, the likelihood of splitting decreases.

Chapter 3 explores how returns-to-scale can affect solutions to problems of asymmetric information. I use the examples of mutual aid societies and medical tourism to illustrate the implications in the health care market.

# Chapter 1

## The Effect of Volume and Medicare Payment on Quality and Concentration in the Liver Transplant Market

### 1.1 Introduction

There is evidence to suggest that increased volumes at transplant centers increases the quality of patient outcomes (see Axelrod et al. (2004)). But it is difficult to know whether center volume increases because outcomes are good or if outcomes are good because center volume increases. In 1991, Medicare began paying for liver transplants. This can be thought of as a shock to demand for liver transplants. Medicare would only pay for the transplant if the patient went to an approved transplant center (19 out of 84 were approved in 1991). This paper uses this change in policy to isolate the effect of center volume on patient outcomes

(as measured by patient mortality rates). This paper also improves on the measurement of the relationship between volume and quality by correlating previous transplant center experience with patient outcomes, rather than correlating current year volume with patient outcomes. I find that volume, as measured by previous transplants, does not have a statistically significant effect on patient mortality.

Given previous estimates of the relationship between volume and quality, the competitive environment may impact patient outcomes due to learning-by-doing (see Barnett and Kaserman (1995) and below for discussion). Government regulation or government certification in the market for transplants may effect patient outcomes if that regulation changes the competitive environment. Using government certification as a proxy for an entry barrier, this paper also measures the effect of Medicare certification of transplant centers on those centers' market share of transplants performed and on demand (as measured by wait list additions) faced by those transplant centers. I find that Medicare certification only increases a center's share of transplants and wait list additions of patients over age 64 but not the total share of transplants or wait list additions.

## 1.2 Literature

There has been much debate on the effects of market concentration in the hospital care market. As noted by Propper et al. (2004), the literature can be characterized by those papers that used data prior to the mid-1980s and those papers that use more recent data. The former finds that competition increases excess capacity, costs, and prices, evidence which supports the hypothesis that competition leads to a medical arms race. The papers that use more recent data tend to find lower excess capacity, cost, and prices are associated with increased competition in the hospital care market (for example, see Dranove et al. (1992)). Dranove et al. (1993) note that the effects of concentration will depend on whether

the competition is patient-driven or payer-driven. They find payer-driven competition (e.g. HMOs) reduces price. Dalmau-Matarrodona and Puig-Junoy (1998) find that increased competition increases hospital productive efficiency.

Less work has been done on the effect of market concentration on patient health outcomes. Ho and Hamilton (2000) find some evidence that mergers and acquisitions, in some cases, lead to increases in readmission rates for heart attack patients and early discharges of newborns, suggesting the decreased competition may cause quality degradation in hospital services. Gowrisankaran and Town (2003) find that, as with the effects on price, the effects of competition on health outcomes may depend on who pays; they find competition leads to better outcomes (as measured by hospital mortality rates) for patients with HMOs but worse for Medicare patients. Propper et al. (2004) find that quality decreases with higher competition in the UK, though Propper et al. (2008) find that quality increases as competition increases in the UK.

The issue of competition and quality in transplant market arises due to concerns about learning effects. Axelrod et al. (2004) note that there is a strong correlation between high volume and low mortality. These authors measured volume by tercile. If the data is ordered by the number of transplants a center performs during the study period, the lowest tercile is found by adding the number of total transplants of the lowest volume centers until one-third of transplants are accounted for; likewise for the second and third tercile. These authors estimate that, holding all else constant, having a liver transplant at a transplant center in the lowest volume tercile, rather than in the highest volume tercile, increases risk of death in the following year by 30 percent. There are issues with this kind of study. These studies correlate patient outcome with the current year's volume rather than the previous year's volume. Not only does this assume that transplant centers forget what they learn each year, but also that the transplant at the end of the year affects the transplant at the beginning of the year. I improve on these analyses by only including measures of previous volume to

capture the learning effects. This will also allow me to distinguish the effect of relatively recent volume on quality and the effect of more temporally remote experience on current quality. Volume may also be endogenous to quality, so estimates that do not control for this endogeneity may not reflect the true relationship between volume and quality.

Due to possible learning effects, competition in the transplant market may be detrimental to patient health. Barnett and Kaserman (1995) note that because of the relative stability in the number of transplants available, increasing the number of transplant centers can lead to doctors getting less practice in transplanting organs, leading to increased mortality rates. The authors only consider total transplants and the total number of transplant centers in the country. It should be noted that increased competition (for example, adding one transplant center where there was previously a monopoly) in a transplant market with 500 transplants a year will have different effects on mortality rates than a transplant market with only 10 transplants a year.

Based on the concerns of learning effects and competition, Barnett and Kaserman (1995) advocate a free market in organs to increase supply, which they hypothesize will increase supply of organs. One could, however, have the same concerns about competition and learning, but advocate a reduction of competitors rather than an increase in supply. This can occur with outright restrictions on entry into the market or by more subtle means. Government quality certification based on center volume and patient survival can be seen as a barrier to entry. A hospital would have to invest a large fixed cost to achieve the necessary volume and quality to become certified. This is less of a barrier if the certification only applies to a subset of patients or if the certification only precludes receiving payments from certain entities (e.g. Medicare). In this way, Medicare certification may act as a barrier to entry (and an increased incentive of non-certified centers to exit), though perhaps not a strong one.

### 1.3 Institutional Details

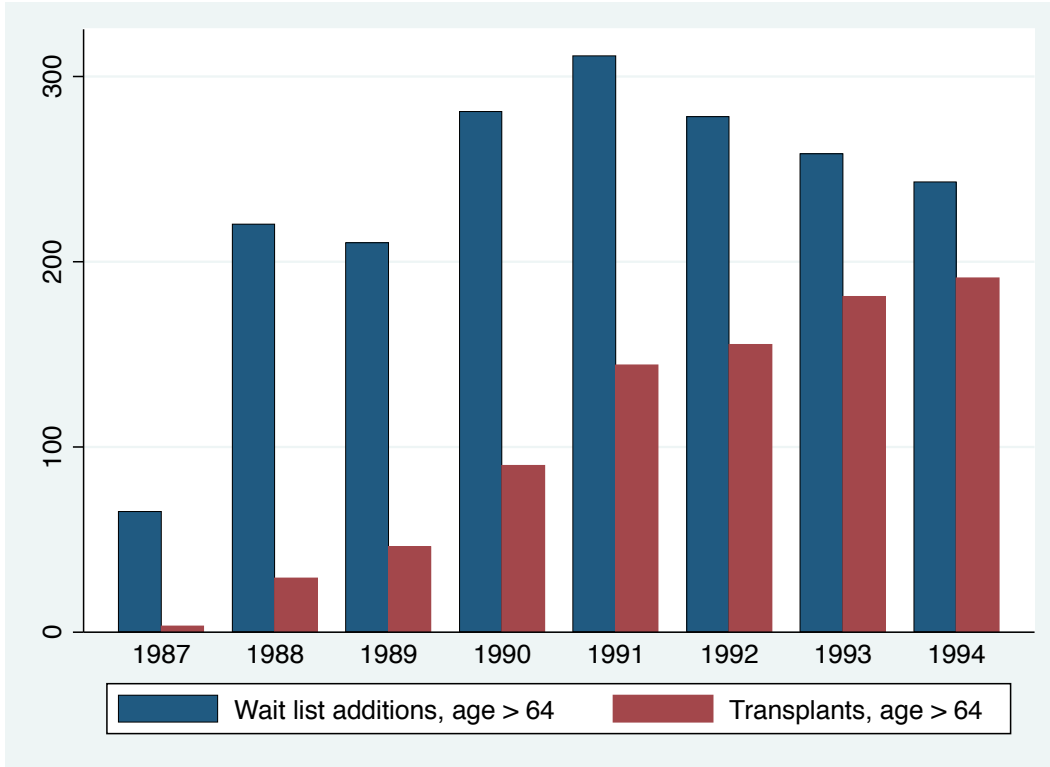
The liver transplant system is broken into three levels: the organ procurement organization (OPO), the region, and the nation. Patients enroll on a waiting list at a transplant center, which is associated with an OPO. There are 1 to 4 OPOs per state, with most states having one OPO. The nation is broken up into 11 regions. The allocation algorithm for the livers gives priority to patients within an OPO based on a certain cut-off score. If there is not a patient that meets that cut-off score, then the algorithm searches for a match within the region, etc.

In 1991, Medicare change its policy to allow payment for liver transplants. Medicare patients would only be covered if they received the transplant at an approved transplant center. The data for the sample period are displayed in Figure 1.1. Out of 84 liver transplant centers in 1991, only 19 were Medicare approved. By 1994, those numbers increase to 102 and 21, respectively. Taken together, the centers that were approved in 1991 increase their share of transplants for patients 65 or older by 11 percentage points between 1991 and 1992. This rise comes after the share of patients age 65 or older had been falling since 1988. In 1991, Medicare approved 19 liver transplants for eligibility to receive funds from Medicare. To be approved, transplant center must have performed 12 transplants in each of the two preceding 12-month periods and must have a 77 percent one-year survival rate and a 60 percent two-year survival rate of the adult patients.

The mean (median) center volume for approved programs is 157 (126), while for unapproved programs it is 30 (27). There are 26 transplants centers that met the volume requirement in 1991 but were not approved. There are 8 transplant centers that met the volume and survival rate requirements in 1991 but were not approved. The total number of livers transplanted into patients 65 or older increased from 90 in 1990 to 144 in 1991 to 155 in 1992. The raw survival rate is 73 percent over the sample period.



Figure 1.1: Wait List Additions and Transplants Over Age 64



## 1.4 Data

The data come from the Scientific Registry of Transplant Recipients (SRTR). These data are at the individual patient level. They include patient and donor demographics (age, race, etc.), patient and donor medical information (cirrhosis status, creatinine levels, death date, listing date, transplant date). These data are compiled from regular follow-up files. I use data covering 1987 to 1994. Most of the transplant centers that were approved were approved in 1991, so the time frame provides plenty of data both before and after approval. Summary statistics for the data provided by volume tercile in Table 1.1 and Table 1.2. It should be noted that the unadjusted 1-year mortality rate for the different volume categories is similar. The high volume hospitals have higher rates of patients with high creatinine levels, in the ICU before transplant, and on life support than low volume centers.

Table 1.1: Liver Transplant Center Characteristics by volume Tercile

	Volume Tercile		
	Low	Medium	High
Number of Liver Transplants (1987 - 1994)	6721	6590	6724
Number of Centers	81	16	5
Median Annual Volume per Center	24	71	208
Unadjusted Death Rate at 1 Year	24.3	22.6	23.5

Table 1.2: Liver Recipient Characteristics by volume Tercile

	Volume Tercile		
	Low	Medium	High
Age 18-34 (%)	11.8	10.4	12.8
Age 35-49 (%)	36.3	32.1	33.5
Age 50-64 (%)	29.9	31.8	36.1
Age > 64 (%)	2.3	3.5	6.7
Asian (%)	1.6	3.4	3.8
African-American (%)	10.2	8.1	6.5
In ICU before Transplant (%)	21.8	27.0	32.4
Creatinine > 2.0 (%)	12.0	14.1	18.1
Cholestatic Liver Disease / Cirrhosis (%)	13.4	8.6	8.7
On Life Support (%)	13.7	18.6	21.0

The mean (median) center volume for approved programs is 157 (126), while for unapproved programs it is 30 (27). There are 26 transplant centers that met the volume requirement in 1991 but were not approved. There are 8 transplant centers that met the volume and survival rate requirements in 1991 but were not approved. The raw survival rate is 73 percent over the sample period. If we divide the centers into volume terciles, the median (maximum) volume is 23 (43) for the first tercile, 71 (137) for the second tercile, and 219 (471) for the third tercile. Due to anonymization of center identifiers, the data is lacking in characteristics such as population, area demographic variables, and other location specific factors (such as the extent of liver transplant insurance coverage in the age 65 and older population) that could influence demand for liver transplants. Where possible of try to control for these variables via fixed effects.

## 1.5 Results

### 1.5.1 Volume and Quality

I begin with replicating the results from Axelrod et al. (2004). Table 1.3 presents these results in log-odds form. We see that those liver transplant centers that are in the lowest tercile for annual transplants have a much higher one-year mortality rate than those centers in the second or third tercile. Because some transplant centers may serve a healthier population or a wealthier population that can afford more supplemental care or have different technology, I include hospital fixed effects to control from these unobservables. This model also includes controls for time trends. The coefficient for low volume centers is much larger than in Axelrod et al. (2004) (1.48 vs. 1.30). This could be because the data in table are from an earlier time period. It could also be because Axelrod et al. (2004) do not control for time trends and hospital fixed effects in their analysis. As mentioned above, the volume - patient

Table 1.3: Effect on 1 Year Patient Mortality of Volume by Tercile

Low volume center	1.48**	[1.11,1.96]
Medium volume center	0.97	[0.78,1.21]
Recipient age 18-34	0.78***	[0.68,0.89]
Recipient age 50-64	1.38***	[1.26,1.51]
Recipient age > 64	1.70***	[1.41,2.05]
In hospital ICU	1.47***	[1.29,1.67]
On life support	1.83***	[1.59,2.11]
Previous liver transplant	2.32***	[2.06,2.60]
Cholestatic liver disease/cirrhosis	0.98	[0.83,1.15]
Serum creatinine > 2	1.66***	[1.49,1.84]
Living donor	1.17	[0.57,2.40]
Donor age 18-34	0.97	[0.87,1.07]
Donor age 35-49	1.21**	[1.08,1.36]
Donor age 50-64	1.45***	[1.26,1.66]
Donor age > 64	1.73***	[1.31,2.28]
Donor Asian	1.20	[0.85,1.68]
Donor African-American	1.36***	[1.21,1.54]
Cold ischemia time (per hour > 8.25h)	1.01**	[1.00,1.02]
Observations	17130	

Exponentiated coefficients; 95% confidence intervals in brackets

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

outcome analyses treat transplant centers as if they were opened anew each year and forgot anything they learned in the previous years. Also, by correlating annual volume with all the transplants in a particular year, the model assumes that the centers first transplant of the year benefits from the learning effects and practice that may come from the last transplant of the year. Table 1.4 presents results for cumulative transplants over a center’s lifetime broken into 6 month increments. We would assume that more recent surgeries are more valuable than more temporally remote surgeries, so the number of surgeries in the six months previous to the current operation should have a more pronounced negative impact on mortality than the number of surgeries between 18 months to 2 years before the current operation.

Table 1.4: Effect on 1 Year Patient Mortality of Volume by 6 Month Increments

Transplants in previous 6 months	1.002	[0.998,1.006]
Transplants in previous 6-12months	0.998	[0.995,1.002]
Transplants in previous 12-18 months	0.997	[0.993,1.000]
Transplants in previous 18-24 months	1.003*	[1.000,1.007]
Transplants in previous 24-30 months	1.003	[1.000,1.007]
Transplants in previous 30-36 months	0.996*	[0.992,1.000]
Transplants in previous 36-42 months	1.002	[0.998,1.007]
Transplants in previous 42-48 months	0.997	[0.993,1.001]
Transplants in previous 48-54 months	1.000	[0.995,1.005]
Transplants in previous 54-60 months	1.001	[0.996,1.006]
Transplants in previous 60-66 months	1.002	[0.997,1.008]
Transplants in previous 66-72 months	0.996	[0.989,1.002]
Transplants in previous 72-78 months	1.004	[0.997,1.012]
Transplants in previous 78-84 months	1.000	[0.992,1.008]
Transplants in previous 84-90 months	0.992	[0.972,1.014]
Observations	17130	

Exponentiated coefficients; 95% confidence intervals in brackets

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

What we see is a weak relationship between recent activity and patient mortality, and the only statistically significant relationship is with the number of transplants performed between 1.5 and 2 years (with a positive impact on patient mortality) and between 2.5 and 3 years (with a negative impact on patient mortality) previous to a particular transplant. The coefficients for the surgeries done between 6 months and year and between a year and 18

months previous to the current operation are jointly significant, though the coefficient for the number of transplant performed in the previous 6 months is not jointly significant with either of those variables. Running the regression on only the transplant centers in the second and third tercile and only on the third tercile centers also reveals the same pattern. Using one-year increments also reveals the same pattern. Table 1.5 presents the marginal effects for the previous volume (measured in one-year increments) coefficients.

Table 1.5: Marginal Effects on 1 Year Patient Mortality of Volume by 1-Year Increments

Transplants in the previous 12 months	-0.0009	[-0.00,0.00]
Transplants in the previous 12-24 months	0.0008	[-0.00,0.00]
Transplants in the previous 24-36 months	0.0006	[-0.00,0.00]
Transplants in the previous 36-48 months	-0.0017***	[-0.00,-0.00]
Transplants in the previous 48-60 months	0.0010*	[0.00,0.00]
Transplants in the previous 60-72 months	-0.0003	[-0.00,0.00]
Transplants in the previous 72-84 months	0.0005	[-0.00,0.00]
Observations	17130	

95% confidence intervals in brackets

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## 1.5.2 IV and Robustness Results

The number of transplants a center performs may be endogenous to hospital quality, so any excluded variables captured by the error term may be correlated with hospital volume as well. To control for this endogeneity, I instrument transplant volume in the previous year with a dummy for a change in Medicare approval status and organ procurement organization fixed effects (which capture population size and health of the population). We would not, however, think that this change in status would lead to an immediate increase in transplants in the previous year, so I lag the approval by one year to reflect this consideration. I cannot run this regression on the whole sample.

Because Medicare approval is correlated with patient survival rates, the error in the first

Table 1.6: Marginal Effects of Volume on 1 Year Patient Mortality IV Results

Transplants in the previous 12 months	-0.0002	[-0.00,0.00]
Transplants in the previous 12-24 months	0.0000	[-0.00,0.00]
Transplants in the previous 24-36 months	0.0001	[-0.00,0.00]
Transplants in the previous 36-48 months	-0.0009*	[-0.00,-0.00]
Transplants in the previous 48-60 months	0.0003	[-0.00,0.00]
Transplants in the previous 60-72 months	-0.0001	[-0.00,0.00]
Transplants in the previous 72-84 months	0.0001	[-0.00,0.00]
Recipient age 18-34	-0.0942*	[-0.18,-0.01]
Recipient age 50-64	0.1770***	[0.12,0.24]
Recipient age > 64	0.2804***	[0.17,0.39]
In hospital ICU	0.2610***	[0.18,0.35]
On life support	0.3202***	[0.22,0.42]
Previous liver transplant	0.5162***	[0.44,0.60]
Cholestatic liver disease/cirrhosis	-0.1355**	[-0.24,-0.04]
Serum creatinine > 2	0.2798***	[0.21,0.35]
Living donor	-0.2767	[-0.77,0.22]
Donor age 18-34	-0.0024	[-0.07,0.07]
Donor age 35-49	0.1118**	[0.04,0.19]
Donor age 50-64	0.2075***	[0.12,0.30]
Donor age > 64	0.2327**	[0.06,0.41]
Donor Asian	0.0559	[-0.16,0.27]
Donor African-American	0.1357**	[0.05,0.22]
Cold ischemia time (per hour > 8.25h)	0.0067**	[0.00,0.01]
Observations	12695	

95% confidence intervals in brackets

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

stage regression would be correlated with error in the second stage regression if I included centers that were not approved. To control for this, I only use those transplant centers that were approved during the sample period. Thus, the Medicare approval variable and the OPO fixed effects should capture those factors correlated with quality that would have otherwise been included in the first stage error term. I use an IV probit to estimate the two-step regression. The marginal effects are presented in Table 1.6. The first-stage regression coefficient for the approval variable is 11.7 and is significant at the 0.01 percent level. So Medicare approval appears to have a positive and significant impact on volume. We do not, however, see a significant impact on one-year patient mortality. These are similar to the marginal effects given in Table 1.3. The Wald test for exogeneity gives a test statistic of 0.34, so I do not reject the null hypothesis that the regressors are exogenous. Using an IV estimate is, therefore, unnecessary. This suggests that patients are unresponsive to the quality of the hospital. This may be the case if patients do not know the 1- or 2-year survival rates for the transplant centers they visit, or it may be the case that access to the higher quality hospitals is limited for geographic reasons.

It may be that by disaggregating the data in the raw transplant count in previous periods, the analysis may not be powerful enough to pick up the effect of being a high volume center. Another way of measuring volume (and providing a closer comparison to the base results in Table 1.3) is to categorize transplant centers into volume terciles based on their previous year's volume. To do this I sort the centers within a given quarter into terciles based on the number of transplants performed in the previous year. This classification correlates with the classification used in Table 1.3 with a covariance of 0.91. The results for this analysis are presented in Table 1.7 in log-odds form. For a particular transplant, if a center's previous year's volume falls within the first tercile, this has no statistically significant effect on the patient's survival relative to having a previous year's volume within the third tercile.



Table 1.7: Effect on 1 Year Patient Mortality of Previous Year Volume by Tercile

Previous year low volume	1.17	[0.90,1.52]
Previous year medium volume	0.90	[0.73,1.10]
Recipient age 18-34	0.78***	[0.68,0.89]
Recipient age 50-64	1.38***	[1.26,1.51]
Recipient age > 64	1.70***	[1.41,2.05]
In hospital ICU	1.47***	[1.29,1.66]
On life support	1.83***	[1.59,2.11]
Previous liver transplant	2.32***	[2.07,2.61]
Cholestatic liver disease/cirrhosis	0.97	[0.83,1.15]
Serum creatinine > 2	1.66***	[1.49,1.84]
Living donor	1.16	[0.56,2.39]
Donor age 18-34	0.97	[0.87,1.07]
Donor age 35-49	1.21**	[1.08,1.36]
Donor age 50-64	1.44***	[1.26,1.66]
Donor age > 64	1.73***	[1.31,2.28]
Donor Asian	1.19	[0.85,1.67]
Donor African-American	1.36***	[1.21,1.54]
Cold ischemia time (per hour > 8.25h)	1.01**	[1.00,1.02]
Observations	17130	

Exponentiated coefficients; 95% confidence intervals in brackets

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

### 1.5.3 Medicare Approval and Market Share

Even though we do not see a significant relationship between volume and patient mortality using the above measures of volume, based on prior evidence, we may still believe that quality is determined to some extent by the number of transplants a center performs. The first stage of the IV probit regression (and simple linear regressions) suggests that being approved by Medicare to receive payment from Medicare patients increases the number of transplants a transplant center performs. As noted above, the effect of competition in the transplant market (especially if the number of transplants available stagnates), so knowing the impact of Medicare certification on competition in the transplant market is a great importance.

To examine the question of competition in the transplant market, I will first look at the changes in demand for livers at particular transplant centers, and then I will examine the effect of Medicare approval on the share of transplant performed. We would certainly expect those centers that are Medicare approved to see a larger share of demand and a larger share of transplants performed for those over age 64. But we may also expect that Medicare approval would have an overall effect because this could be seen as a signal of quality from an independent certifying organization. Given the result from the Wald test in the two stage regression above, we may have weaker priors that this quality signal would effect total market share.

We can interpret additions to a transplant center's wait list as the quantity demanded a particular transplant center faces in a given time period. We expect that if a hospital is approved by Medicare, that hospital would see an increase in patients aged 65 and over added to the wait list, and this should have an immediate effect. We may also expect (due to forward looking behavior) that older patients not yet 65 years old (for example, over 60) may also seek to be listed on the wait list of a Medicare-approved center. To determine the effect of Medicare approval on the competitive environment, I measure the impact of

Medicare approval on the quarterly market share of an individual transplant center’s wait list additions relative to the total additions to all the wait list within an organ procurement organization. I control for time trends, OPO fixed effects, center one-year mortality, and the number of centers within the OPO. Standard errors are clustered by transplant center. Table 1.8 presents the results of the regressions for the center’s total share of waitlist additions as well as the share over age 49, over age 59, and over age 64. The results show that being approved does not increase an individual transplant center’s total share of waitlist additions, but approval does have the expected effect of increasing the center’s share of wait list additions for those patients age 65 and older. Being approved by Medicare increases a center’s share of patients over age 64 by 12 percentage points. The insignificant coefficients on the one-year mortality rate underscores the finding from earlier that volume at a hospital is not determined by quality as measured by mortality.

Table 1.8: Effect of Approval on Waitlist Share

	OPO Share	Over 49 OPO Share	Over 59 OPO Share	Over 64 OPO Share
Approval	0.02 [-0.03,0.07]	-0.01 [-0.07,0.06]	0.04 [-0.06,0.14]	0.12** [0.03,0.20]
Mortality	0.01 [-0.05,0.07]	0.07 [-0.01,0.16]	0.03 [-0.08,0.14]	0.00 [-0.08,0.09]
Centers in OPO	-0.09*** [-0.13,-0.06]	-0.09*** [-0.14,-0.05]	-0.05** [-0.09,-0.02]	-0.05** [-0.08,-0.02]
Observations	1983	1983	1983	1983

95% confidence intervals in brackets

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Next, I examine the relationship between Medicare approval and a transplant center’s quarterly share of total transplants within an OPO. If Medicare approval does have an effect, we would expect the effect to be observed with a lag, so the dummy for Medicare approval equals 1 a year after a center is approved. As with the wait list, we expect the coefficient on the center’s share of transplants for those over age 64 to be positive. Given the insignif-

icant results from the wait list regressions for the other market share measures, we would not expect Medicare approval to have a significant effect on total transplant market share or on the over age 49 or over age 59 market share. As before, I control for time trends, OPO fixed effects, and the number of centers within the OPO. Standard errors are clustered by transplant center. Table 1.9 presents the results of the regressions for the center’s total share of transplants as well as the share over age 49, over age 59, and over age 64. The coefficient on Medicare approval’s effect is positive, and the results for approval are consistent with the wait list regressions. The coefficient on the number of centers within the OPO are as expected. From the regressions on the share of wait list additions and on the share of transplants, we see that Medicare approval does not have an effect on an individual transplant center’s overall market share but does increase the share of wait list additions and transplants of those patients over age 64.

Table 1.9: Effect of Approval on Transplant Share

	OPO Share	OPO Over 49 Share	OPO Over 59 Share	OPO Over 64 Share
Approval	0.02 [-0.03,0.07]	-0.02 [-0.09,0.05]	0.06 [-0.02,0.15]	0.12** [0.03,0.21]
Centers in OPO	-0.12*** [-0.16,-0.09]	-0.09*** [-0.13,-0.05]	-0.04* [-0.09,-0.00]	-0.01 [-0.04,0.01]
Observations	2015	2015	2015	2015

95% confidence intervals in brackets

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## 1.6 Conclusion and Discussion

This paper improves on the methodology of previous quality-volume correlation studies by regressing patient mortality on previous transplants rather than only current year volume. One objection could be that I only find no relationship because I am using the raw quantity rather than where the transplant center falls in the volume distribution, which is the method

used by (Axelrod et al., 2004). There are two responses. First, the method employed in the current paper seems more methodologically appealing if we think there are learning effects in surgery. If there are learning effects, with each surgery, a transplant center should get better. This is not captured if volume is measured by what quantile the transplant center falls in. Second, using the data in this paper, there is a significant and negative relationship between quantity of current year transplants and patient mortality. I also found that the regressors in the base regression of quality on volume are not endogenous. This is confirmed by the insignificant relationship between a transplant center's one-year patient mortality and wait list additions. This finding suggest that patients are unresponsive to quality measures. This could be because of lack of knowledge of the quality of the transplant center or that access to higher quality transplant centers is limited (possibly due to geographic reasons).

There are a few reasons why one might not expect to find a significant relationship between previous volume and quality. One reason may be that because these data are only at the hospital level rather than the doctor level, the learning effects may be hidden. Another reason may be that the variation in liver transplant surgeon quality is not very large. Doctors (especially transplant surgeons) have to go through years of rigorous training so that by the time doctor's are allowed to perform transplants, only the best surgeons are involved. It may also be the case that the learning curve is very steep and then plateaus (and there may be positive spillovers from other surgeries), and any variation above a certain quantity of transplants would not produce significant results because the effect is so small.

I also find a significant effect on a transplant center's share of wait list additions and transplants of patients over age 64 within an organ procurement organization. This suggest that soft government regulation (in the form of government certification) can have an effect on the competitive environment in the relevant market. If there are learning effects, increases in concentration in certain (i.e. low volume) markets can lead to better outcomes. Given that Medicare is a large provider of insurance to those getting kidney transplants (Medicare

covers people of any age with end-stage renal disease), a targeted use of certifications may lead to improved outcomes.

A weakness of this study is the lack of geographic and demographic data due to anonymization of center identifiers. While not discussed above, because transplant patient outcomes are characterized by team production (physician who transplants, nurses who monitor), data at the level of individual transplant teams could also provide finer results and may provide clues for optimal team composition.

Contrary to intuition, the positive correlation between quality and quantity does not appear to derive from learning-by-doing, nor do consumers seem to be sensitive to quality within the range analyzed, which means that quality does not drive quantity. In the case of liver transplants, it could be the case that there are improvements in the technology or method of transplantation being used at the larger hospitals that have not reached the smaller hospitals. So instead of a learning-by-doing story, the positive correlation between quality and quantity may be explained by technology diffusion. Further research is necessary to explore this hypothesis.

# Chapter 2

## Club Splitting

### 2.1 Introduction

Economists have said a great deal about the formation of organizations. Coase (1937) and Williamson (1973) study the formation of firms in light of transaction cost of carrying out exchange in the market. Alchian and Demsetz (1972) suggest that organizations form because output is a product of team production. Grossman and Hart (1986) provide a property rights theory of the firm that emphasizes control rights, and Van den Steen (2010) develops a model in which the firm organizes around the interpersonal authority of the owner. Iannaccone (1992) extends the analysis of group formation in light of imperfect monitoring to religious groups, while Skarbek (2014) addresses how prison gangs form and operate. Yet very little attention has been given to how groups may split apart and what the effects of splitting may be.

In this paper I provide a model in which groups produce a club good and overcome the free rider problem by placing restrictions on individuals' ability to engage in activity outside the group. Groups are defined by the level of restriction they place on members. Splitting occurs

when a rival leader proposes a different level of restriction and a subset of members join the rival leader. The non-rival nature of the good results in the splitting attempt being modeled as a coordination problem. The model allows for splitting to occur from leaders who propose lower restrictions and higher restrictions. In equilibrium, lower restriction splits result in a lower level of club good production relative to no split occurring, while higher restriction splits end in greater club good production. In each case members receive a lower utility. The main predictions of the model are that the likelihood of a split occurring decreases with the cost splitting and that higher restriction splits are more likely to occur. I apply this model to data on religious schisms and find that the model is broadly consistent with the data.

This paper fits into the literature on competition between clubs. Alesina and Spolaore (1997) and Casella (2001) provide models for the number of jurisdictions that will form when the public good is discrete and individuals have heterogeneous preferences. These models find that while the optimal number of jurisdictions increases with market size and preference heterogeneity, the number of jurisdictions is inefficiently large if compensating transfers cannot be used to prevent jurisdiction formation.

Alesina et al. (1999) and Alesina and La Ferrara (2000) find that participation and public goods provision decreases with heterogeneity, though this is mostly driven by individuals taste for homogeneity. Haimanko et al. (2004) and Jaramillo and Kempf (2003) provide models of how the core is partitioned when clubs produce congestible goods. The former finds that the partition that minimizes total cost is immune to splitting, while the latter shows that societal segmentation increases with income inequality. Polborn (2008) develops a model in which competition between clubs may lead to either inefficiently large production of the public good when clubs compete for recognition and old members receive increased utility just from new members joining the group.

While these papers mostly concern competition from outside the group, there has been some work done on competition from within the group. Austin (1995), in the context of local



public goods, finds that secessionist movements cannot be prevented via side payments when membership is not excludable. In the model provided below, I find that a secessionist movement may not be prevented even when the group can exclude members. Bueno de Mesquita (2008) provides a model of terrorist factions, finding that increases in economic opportunities lead to decreases in terror group membership but that the remaining terror factions may be more extreme. Bueno de Mesquita (2008) does not model the benefit from the group as non-rival. This may lead one to ignore the coordination aspects of the formation of break-off groups.

The paper is organized as follows. Section 2 gives an overview of group splitting. Section 3 goes through the affiliation game that will be a reference for the outcomes of the splitting game. Section 4 provides the description and equilibrium of the splitting game. Section 5 applies the model to the case of religious schisms.

## 2.2 Theory of Group Splitting

In this section, I provide a verbal model that addresses the question of how susceptible a club good producing organization is to splitting. I use the term club good in a broad sense to describe a good for which an individual shares the consumption of that good with others Buchanan (1965). If the good in question is characterized by a high degree of rivalry, the club leader must devise methods to restrict access to the good in order to avoid overconsumption by club members.<sup>1</sup> If the good is characterized by a low degree of rivalry, the club leader must come up with rules to overcome the free rider problem where club members do not contribute to the good's production.<sup>2</sup> Given this description, we can understand clubs to be at the center of much of economic and non-economic life, from small consulting partnerships

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<sup>1</sup>see Ostrom (1990) and Ostrom (2005) for descriptions of how groups overcome this issue for a variety of goods in diverse settings.

<sup>2</sup>See Cornes and Sandler (1996) for a general treatment of club goods. See Iannaccone (1992) and Berman (2000) for applications in a religious context.

(in which partners share office space, staff resources, and profit) to teams within firms (which often share responsibility for the success or failure of a project) to families and fraternities (which share financial resources and access to social networks).

The key problem for club leaders is to come up with ways to produce these club goods as efficiently as possible. This often comes in the form of restricting the types of behavior in which club members can engage. Specifically, this involves placing restrictions on members' ability to engage in activity outside of the organization. Firms place internet filters on company servers to prevent employees from substituting time spent working with time on Facebook. A firm might restrict in-house attorneys from taking on outside clients, or a consulting partnership may restrict the clients a partner can accept.

The individual must weigh the cost of these restrictions on her behavior with the benefit of being a member of the organization. The benefits often come in the form of increased productivity. An individual is much more able to produce with the aid of the resources of a group. As long as the addition to her utility of joining the group is greater the loss in utility caused by the restrictions, she will join the group. By optimally choosing the level of restriction, the club leader can ensure that those individuals who can contribute to the production of the club good (either by not free riding in contribution or by not over-consuming) are the individuals that do, in fact, join the club.

Up to this point, this has been a general description of the economics of groups formation a kin to the theory of the firm presented by Coase (1937). I now ask what can make these organizations fragment. In particular, what causes a group of members to break away, *en masse*, to either set up or join rival organizations, and why do we see some types of groups experience this type of fragmentation more than other types of groups?

Imagine a group that places some level of restriction on the members ability to participate in activities outside the group and individuals make their decisions of whether or not to join

the group. These restrictions are costly for group leader as well as the members, so over time, the leader's value of activities outside the group may change. If that value increases, the leader may decrease the number of restrictions; if the value of activities outside the group decreases, the leader may be more comfortable with increasing the restrictions. If the restrictions decrease, the quality of the club good may decrease because free-riders and over-consumers now join the group. If the restrictions increase, the current group members may come to resent being part of the group. These dissatisfied members may not drop out of the group because they may have accumulated some organization-specific capital, such as social network connections or job skills that are useful only in the organization, that make the cost of dropping out of the group too costly.

If this change in restriction occurs, a current member may find it beneficial to organize a group of members to break away and form a new group. Why might this new leader not just create a new group on her own? Analogous to the reasons for individuals not switching presented above, creating a new group may be more costly. If a subset of members breaks away to form a new group, they take much of the institutional knowledge with them: they know the routines and are familiar with each other and would be more readily productive than a group of strangers.<sup>3</sup>

The ability for a subset of members to break away will be determined not only by the cost of breaking away but also the attributes of the club good, i.e. how rivalrous the good is. Costs of breaking may include the purchase of a new building or office space, loss of social or professional connections, the use of the original group's resources, etc. The ease of splitting off may be higher if the good that is shared by the group is more rivalrous. Take a profit-sharing arrangement that gives partners equal shares by a partnership as an example. If the current leader of an consulting firm eases restrictions on consultants accepting independent

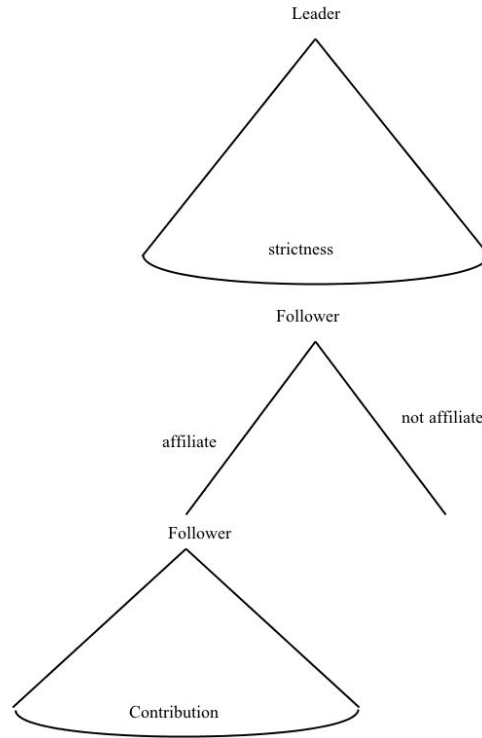
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<sup>3</sup>Take a pharmaceutical start-up as an example. If the group is working on a particular drug and there is some disagreement among the owners of how the research should be carried out, it would be much easier to start for an owner to start up a new company with employees of the original company because they are familiar with the research and the specific laboratory procedures.

contracts from outside the firm, the profit pool may shrink, leading to a smaller profit share for each partner. If the value of contracts outside the firm vary by partner but the productivity within the firm is the same for each partner, then partners with lower-valued outside contracts can create a new firm that does not allow outside contracts and increase their profit-shares. If the cost of setting up the new firm are relatively low, it does not matter how many partners join the new firm because the within firm productivity is the same for each partner, and the addition of another partner will not change the profit share. It would then be easier to coordinate a split

If the group produces a good that is non-rivalrous, then coordinating a split maybe more difficult. Take a professional business organization as an example. This group may provide such benefits as a professional social network and lobbying efforts for the members. These goods are non-rival in that one member's use of the social network does not diminish any other member's use of the network and the lobbying efforts (e.g. for more favorable tax rates for members) benefit each individual member. If the leader of this group decides to increase the restrictions on the ability of members to join outside organizations, current members may become dissatisfied with the group. If a subset of members want to split from the organization, the benefit now heavily depends on the number of members who join the break away group. This is because the benefits a social network and the lobbying efforts are increasing in the number of members. Each individual's decision to break away depends on the number of other individuals who decide to break away. If not enough individuals want to break away, then any attempt to split would not be successful.

Figure 2.1: Affiliation Game



## 2.3 Affiliation Game

### 2.3.1 Model

I will first describe the game without any splitting. The group leader chooses a level of restriction (what I will call the strictness level) to place on members' involvement in outside groups. Individuals then decide whether or not to join the group. Figure 2.1 provides a visual representation of the game. The leader's utility is

$$U_L(s) = \ln(G) - \ln\left(\frac{1}{1-s}\right). \tag{2.1}$$

$G$  is the total contributions to the group and  $s$  is the strictness level the leader chooses.

There are  $N$  individuals with an endowment of 1, which they can allocate between in-group and out-group activities. The individual's utility is

$$U_i(g_i) = a(1 - s)(1 - g_i) + r_i(g_i + G_{-i}). \quad (2.2)$$

The individual's utility of out-group activity is increasing only in her contribution, while the utility of in-group activity is increasing in all others activity, as well as her own.  $g_i$  is the individual's contribution to the group, and  $G_{-i}$  is the contribution of all other members.  $a$  and  $r_i$  are scalars that represent the productivity of the individual's consumption of the out-group good and the in-group good, respectively.  $s$  essentially acts as a tax on out-group activity. Note that the individual's utility function is similar to the utility from games that employ the standard voluntary contributions mechanism (VCM). In the model used in this paper, the individuals are heterogeneous along the in-group productivity margin,  $r_i \sim Uniform[0, a]$ .<sup>4</sup> I have placed these bounds on  $r_i$  to keep the affiliation decision from being non-trivial.

### 2.3.2 Equilibrium of the Affiliation Game

Starting with the individual's contribution decision, we see that if the individual contributes any amount of her endowment, she contributes all of it. Specifically, if  $r_i > a(1 - s)$ , the individual contributes. The fraction of individuals contributing to the group is

$$1 - \frac{a(1 - s)}{a} = s \quad (2.3)$$

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<sup>4</sup>Iannaccone (1992) represents strictness in the same way, but he uses productivity differences in individuals out-group activity to generate his results, while I use differences in in-group activity.

and total contributions are  $Ns$ . This is the share of contributors multiplied by the total number of individuals. Knowing that the total contributions will be  $Ns$ , individuals make their affiliation decision. Those who affiliate and do not contribute will receive a utility of  $U_i(s) = a(1 - s) + r_i(Ns)$ . If this is greater than  $a$ , those individuals find it worthwhile to incur the strictness tax on their consumption of out-group activities. Those who join are characterized by

$$a < a(1 - s) + r_i(Ns) \quad \implies \quad r_i > \frac{a}{N}. \quad (2.4)$$

Using inequalities (3) and (4), we see that there will be a non-zero number of free-riders if the strictness level is small enough, i.e. if

$$\frac{a}{N} < a(1 - s) \quad \implies \quad s < 1 - \frac{1}{N}. \quad (2.5)$$

Now we turn our attention to the leader's optimal choice of strictness. Knowing that total contributions will be  $Ns$ , the leader solves this utility maximization problem:

$$\operatorname{argmax}_s \quad \ln(Ns) - \ln\left(\frac{1}{1 - s}\right). \quad (2.6)$$

This yields an optimal  $s = \frac{1}{2}$ .

## 2.4 Splitting Game

### 2.4.1 Model

The setup in the splitting game is similar to the affiliation game above. I identify Leader 1 as the leader of the original group and Leader 2 as the leader of the break-off group. The

leaders have the same utility function as the leader in the affiliation game. The sequence of play is as follows: Leader 1 chooses the strictness level  $s_1$  for the group, individuals make their affiliation decision of whether to join the group or stay unaffiliated, Leader 2 chooses the strictness level  $s_2$  of the break-off group, individuals who affiliated with Leader 1 in the earlier stage now choose whether to affiliate with Leader 2 or stay with Leader 1, individuals choose their contribution level. If individuals stay with Leader 1, they receive the same utility as before. If individuals switch to Leader 2, they receive a utility of

$$U_i = a(1 - s_2)(1 - g_i) + r_i(g_i + G_{-i} - c), \quad (2.7)$$

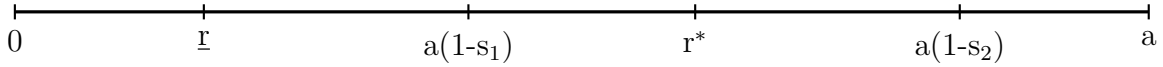
where  $c$  is a common switching cost. Note that this cost is multiplied by the individuals' in-group productivity parameter  $r_i$ . This means it is more costly to switch for individuals with higher productivity. I interpret this as meaning a high productivity individual is able to build up more group specific capital than a low productivity individual and will, therefore, incur a higher switching cost.

## 2.4.2 Splitting Equilibrium

I first consider the situation in which the split occurs to the left (i.e. leader 2 chooses  $s_2 < s_1$ .) Proofs are presented in the Appendix 1. In the original affiliation game, individuals joined the group and contributed as long as their in-group productivity was large relative to their productivity in the outside activity. In the splitting game the final affiliation decision represents a coordination game. The choice of which leader to affiliate depends on the size of the club goods each leader can provide. An individual will not want to switch from leader 1 to leader 2 if she expects that only a few others will also switch because the resulting club good will not be sufficiently large. Because any individual with  $r_i \geq (1 - s_2)a$  will contribute to either group 1 or group 2, there exist an infinite number of equilibria in the



Figure 2.2: Split with  $s_1 > s_2$



second affiliation decision subgame. To gain some traction, I find the individual with  $r_i = r^*$  who is indifferent to switching if all individuals with  $r_i > r^*$  switch.

**Result 1.** *If switching cost is sufficiently low relative to the population, leader 2 will be able to successfully lead a split. A successful split results in leader 1 choosing an  $s_1 > \frac{1}{2}$ . Leader 2 chooses  $s_2 < \frac{1}{2}$ .*

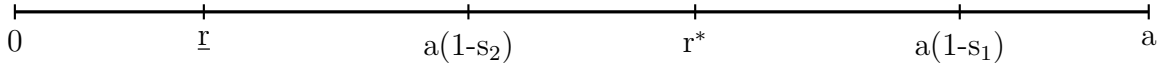
The first part of Result 1 is intuitive. Because the club good is a function of the size of population, a larger  $N$  leads to a larger club benefit, offsetting the cost of switching. The second part of Result 1 is less obvious. Given the similarity to the Hotelling model, one might expect the leaders to locate their strictness levels near one another. The reason why the leaders choose strictness levels far from each other is a function of the coordination equilibrium I chose to analyze.<sup>5</sup> In this equilibrium, all individuals with an in-group productivity greater than the indifferent individual will affiliate with leader 2. Keep in mind that leader 2's utility is increasing in contributions but decreasing in strictness. Because the maximum possible amount of contributions to leader 2 is  $(1 - \frac{r^*}{a})N$ , any  $s_2$  leader 2 chooses such that  $(1 - s_2)a < r^*$  comes at a cost to leader 2 without an offsetting benefit of increased contributions.<sup>6</sup>

Result 1 also says that leader 1's optimal strictness level increases with competition. This is a result of the non-rival nature of the club good. Provided that leader 1 expects the split to be successful, he chooses a higher strictness level than in the monopoly case to increase

<sup>5</sup>This is similar to findings by McBride (2008), who develops a model of competition between religious groups where religious groups choose a strictness level.

<sup>6</sup>This result of an entrant pushing the incumbent to be more extreme is similar to the result in the valence politics literature in which a candidate with the lower valence becomes more extreme than his opponent in the policy space. See (Groseclose, 2001) for an example.

Figure 2.3: Split with  $s_1 < s_2$



the size of the club in anticipation of a subset of club members switching to leader 2.

**Result 2.** *The total production of club goods is smaller when there is a split than in the monopoly case.*

**Result 3.** *There is a positive number of free riders in the break away group.*

The decrease in total club good production is driven by free-riding in the group that splits off. Remember that in this equilibrium, individuals with  $r_i \geq r^*$  affiliate with leader 2. Leader 2 chooses  $s_2$  such that  $(1 - s_2)a > r^*$ , and a subset of those who join group 2 will not contribute. Because a smaller amount of total club production is now being split between two groups, the benefit to being in the group is lower. The split is a net negative for the club members.<sup>7</sup>

Next, I consider a split from the right. In this case leader 2 chooses  $s_2 > s_1$ , which is represented in Figure 2.3. As noted above, second affiliation subgame represents a coordination game, and I focus on the equilibrium in which the individuals with  $r_i > r^*$  affiliate with the group with the lowest strictness.

**Result 4.** *With a right split, if the value of the outside option  $a$  is sufficiently low, leader chooses  $s_2$  such that there are no free-riders in group 2.*

**Result 5.** *Leader 1 chooses  $s_1 < \frac{1}{2}$  and leader 2 chooses  $s_2 > \frac{1}{2}$ , and total club production is greater than in the monopoly case.*

<sup>7</sup>This is different from (Iannaccone, 1992), where the formation of two groups leads to greater utility because, in that paper, the benefit of joining the group is represented by the average contribution to the group rather than the total contribution to the group.

By splitting to the right, leader 2 is able capture contributions from individuals who were previously free-riding. Because of this, leader 1 cannot set  $s_1$  too low because then the club good would not be large enough to compete with that provided by leader 2. If  $a$  is not too large, this induces leader 1 to set  $s_1$  such that  $(1 - s_1)a = r^*$ . So long as the benefits to consuming outside the group is small enough, leader chooses  $s_2$  such that all joiners contribute to group 2.

The welfare effects are uncertain without developing a full general equilibrium model and specifying how the club-produced good interacts with the production of other goods, but we can note a few things. Club members in a group that experiences a left split are worse off than under the cases of monopoly and a split to the right. There is less of the club good provided and it is split between two groups. The members in a club that experiences a right split are worse off than in the monopoly case. Recall that the club benefit of group 2 minus the switching cost must be equal to the club benefit of group 1. In the monopoly case, the club benefit was  $\frac{1}{2}N$ . In order to be as well off in the splitting case as in the monopoly case, the group 1's club good would have to equal  $\frac{1}{2}N$ . Due to the switching cost, group 2's club good would have to be greater than  $\frac{1}{2}N$ , but that is not possible as the total club production would be larger than the endowment of all individuals. So even though there is a greater production of club goods, because it is split between two groups, club members are worse off.

Some comments are in order. The welfare affects are due to two assumptions: the pure non-rival nature of the club good and the linearity of the utility of the club good. As is well known, linearity of the utility function often leads to corner solutions in maximization problems. In the model above, there are also no congestion effects. These could come in the form of either negative or positive participation externalities. For the negative participation externalities, we can think that if the group has a finite meeting space, adding more and more members to the group will eventually reduce the utility to existing members. For

congestion effects with positive participation externalities, we can think that rather than utility being a function of group size, utility is instead a function of the average contribution to the group. In this case, while each member benefits from other members' contributions, if the contribution is less than average, utility will be lower, as in Iannaccone (1992). In either of these cases, the optimal number of groups may be greater than one and at least some members would gain from splitting away from the group.

Two testable predictions come out of this model. First, right splits will be more common than left splits. This is due to the greater ability of the group splitting to the right to provide a larger club good than the group splitting to the left. Second, if there is a fixed cost to splitting<sup>8</sup>, we would expect to observe fewer groups splitting.

## 2.5 Application to Religious Schisms

There are many groups that form and then split, from consulting partnerships to political parties, but religious organizations appear to do this with some regularity, making them ideal for studying the dynamics of group splitting. There has been relatively little written on religious schisms in the economics literature. (Montgomery, 1996) provides a model that generates a process of doctrinal change driven by individuals joining those denominations that mostly closely match their desired strictness, so the model predicts changing affiliations but there is not the type of coordinated exit from a group that would constitute a schism. (Beard et al., 2014) provide a Hotelling model in which leaders of new groups start their own group by choosing a strictness level and then wait for individuals to affiliate with them. While presented as a model of schism, the model is more of a model of entry by an outside

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<sup>8</sup>For example, a minimum number of contributions.

competitor and abstracts away from the issues of coordination that are involved in the decision to split from a group.<sup>9</sup>

Sociologists of religion have provided more detailed accounts of religious schisms. (Niebuhr, 1929) and (Stark and Finke, 2003) present the sect-church-cycle in which religious groups start out strict and, through the incentives leaders face to grow the group or compete for status in society, become less strict. The reduction in strictness alienates the members of the group who prefer a stricter religion, and eventually these individuals break away to form their own group. At its core, the sect-to-church theory is about clashes of identity. This theory, however, only provides an explanation for schisms where a stricter group breaks away from a less strict group. This theory also leaves the coordination issues that characterize a schism unexplored.

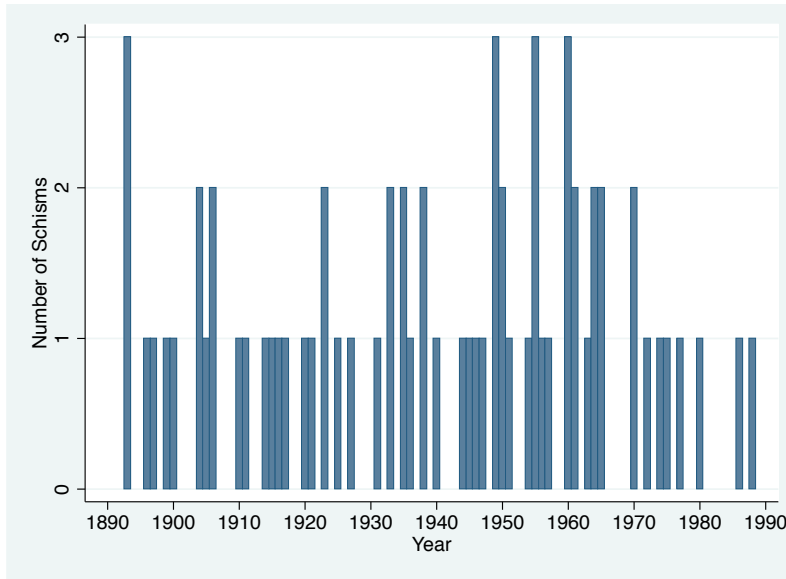
(Sutton and Chaves, 2004) provide a more detailed explanation of how schisms occur, emphasizing organization and resource mobilization over identity. These authors note that schisms occur "through the creation of a new nonlocal organization that successfully mobilizes the loyalty and the resources of a subset of existing congregations" (p. 172). These organizations are formed within the denomination. While the authors do not put it in these terms, these organizations act as the coordinating mechanisms needed to enable a schism. I see this model as complementary to the one I presented in the previous section. With the addition of viewing the groups as producers of non-rival goods, I am able to make predictions about the relative number of left schisms and the importance of the cost of breaking away.

The model is general to any group. Here, I apply the model to denominations with the church leaders as the analog of individuals in the model. The application abstracts from the conflicts that certainly arise within individual congregations, but given that the level of coordination

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<sup>9</sup>(Maloney et al., 2010) presents a model for schism relating to the early split in Islam, but given the importance of governmental actors in this schism, it bears less relevance to modern denominational schisms and to the understanding of the stability of groups. The same can be said of the study of the schism that split the Catholic from the Orthodox church in 1054 A.D. and the schisms of the Protestant Reformation in the 1500s A.D.

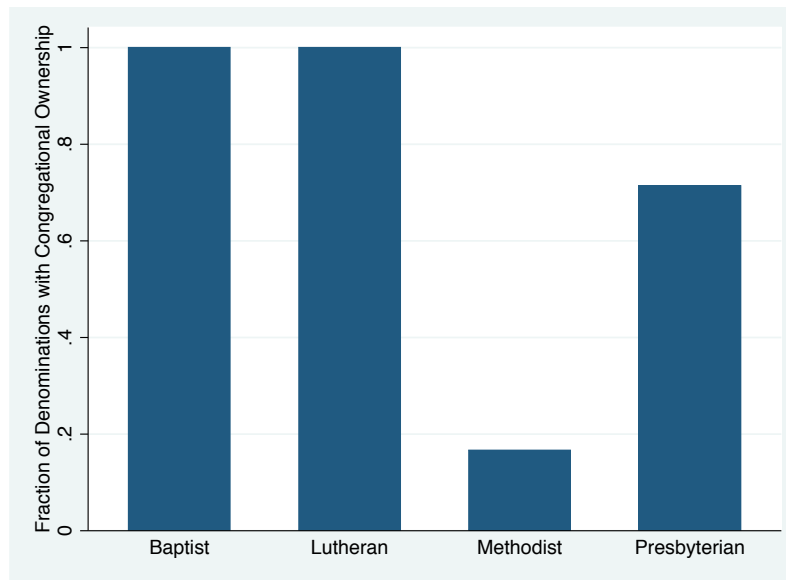
Figure 2.4: Number of Schisms by Year



that occurs in denominational schisms is usually between leaders of congregations (rather than the body of denomination members), I think the application fits well. The distribution of  $r_i$  in this case represents the distribution of  $r_i$  for each congregation's leader.

The data I use come from (Sutton and Chaves, 2004). Those authors gather data on 178 denominations in the Baptist, Lutheran, Methodist, and Presbyterian/Reformed traditions between 1890 and 1990. Figure 2.4 summarizes the data those authors provide on the number of schisms. They report data on membership, number of churches, nation-wide economic variables, measures of centralization and bureaucratization of the denominations. I augment this data set with data on ownership from 60 existing denominations. I obtained these data from email exchanges with denomination leadership and from denominational constitutions. Many of the denominations no longer exist due to past mergers. If I was unable to find any information about the property ownership structure of these denominations, I code the property ownership variable equal to the value of the denomination which was created by the merger.

Figure 2.5: Ownership Type by Denominational Family



There are two property ownership contracts I found that dominate the way churches organize themselves. In the first, the individual congregations within the denomination own the church buildings outright. All the Baptist and Lutheran denominations in my sample hold to this ownership structure. The autonomy of the congregation/pastor is a tenet of the Baptist faith, and this ownership structure provides safeguards for that autonomy.

The other variety of ownership that dominates in the data is that of the congregation holding the church property in trust for the benefit of the denomination. Under this ownership structure, churches are able to make decisions about the use of the property in an autonomous fashion, but trust structure allows the denomination to have final say. This is particularly important in relation to religious schisms. If the property is held in trust for the benefit of the denomination and the congregation decides to leave the denomination, the denomination has final say over whether the congregation can use the property they once met in. Figure 2.5 summarizes the ownership data by denominational family. As noted above, all of the Baptist and Lutheran denominations have congregations that own their church property. More than 80 percent of Methodist denominations require their congregations to hold property in trust. Approximately 30 percent of Presbyterian/Reformed denominations require a trust clause.

These are not the only types of ownership configurations. Many denominations have the capacity to act as seeding organizations for new congregations. In this process, the denomination will "plant" a church and act as a co-signer for a loan on the church property or will own the property outright with no addition of a trust clause. I was unable to obtain data on the number of congregations with this ownership structure, but my correspondence with denomination officials suggests that this type of ownership structure governs a tiny proportion of congregations. For those denominations (only one or two) had this data available to share, this type of ownership governed less than 5 percent of the congregations in the denomination.

Figure 2.6: Schisms by Family

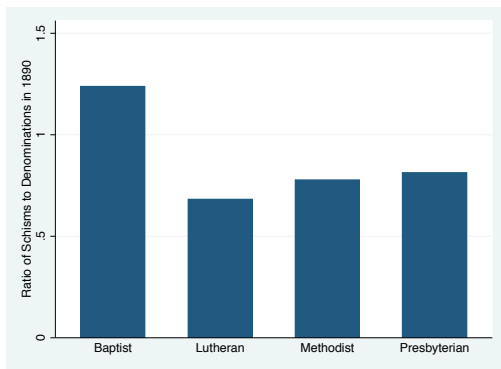


Figure 2.7: Schisms by Ownership Type

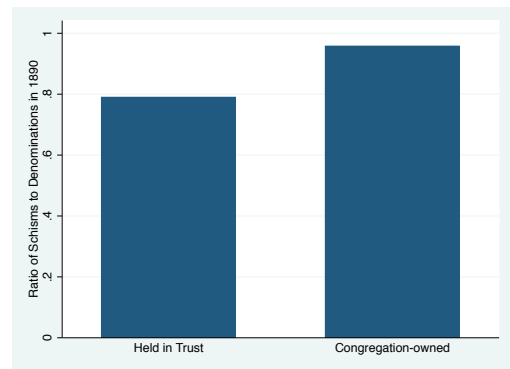


Figure 2.6 shows the number of schisms experienced by each family divided by the number of denominations in each family in 1890 (the start of the study period). What we see is that the Baptist family has been much more susceptible to schisms in the study period than any other denominational family, while Lutherans have been the least susceptible. This is due to the Lutherans not just experiencing fewer schisms but experiencing more mergers as well. The Lutheran family was the only family to see a decrease in the number of denominations throughout the study period. The model can explain the high rate of schism in the Baptist family relative to all Methodists and Presbyterians. It is probable that the variables that make the coordination easier for schism to occur also make it easier for mergers to occur.



Table 2.1: Regression results

	(1)	(2)
	Schism occurs	Number of Schisms
Churches (in hundreds)	0.00668*** (0.00144)	0.00565*** (0.00135)
Property	-0.777 (0.612)	-0.806 (0.609)
<i>N</i>	5749	119

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Another way of viewing this is to categorize the denominations by their ownership contracts. This is shown in Figure 2.7. Those denominations whose congregations owned their church buildings experience a higher rate of schisms. The ratio for the "Congregation-owned" and "Held in trust" categories are 0.95 and 0.8, respectively, and this difference is statistically significant. To further analyze the importance of property for the occurrence of a schism, I run a logit regression on the panel of denominations. An observation is a denomination in a given year. I control for denominational family, how many churches are in the denomination, national economic environment (unemployment and business failure rate), and how many schisms the denomination has experienced in the past. As I am most interested in how property and coordination affect the schisms, I report the coefficients on the property dummy variable (which equals 0 if the church property is held in trust) and the number of churches in the first column of Table 2.1. Recall from the model above, due to the non-rivalrous nature of the club good, larger groups will experience schism more often because size of the club good mitigates the individuals switching cost.

As shown in the Table 2.1, the type of property regime does not have a statistically significant impact on the probability of schism. We do see that the number of churches has an effect on the probability of schism. The overall probability of a denomination experiencing a schism in

Table 2.2: Direction of Schisms

Right Schism	34
Left Schism	6

a given year is 0.007. The coefficient on the number of churches suggests that if the average denomination increased the number of churches by 100, the probability of a schism occurring increases by 0.000044. This is a 0.6 percent increase in the overall probability for schism, so while the coefficient is statistically significant, it is not large.

The second column of Table 2.1 shows the results of a poisson regression on the total number of schisms for each denomination over the sample period. The results confirm those from the first regression, with the coefficient on the property variable not statistically significant. The coefficient on the the number of churches suggests that if the average denomination increased the number of churches by 100, the number of schisms that denomination would experience would increase by 0.002.

To address the prediction of right splits being more common than left splits, I code the schisms in the data either as resulting in groups that place more restrictions on members or fewer restrictions. A right schism may result in a break away group with stricter or more fundamentalist theology, not associating with other denominations, or refusing to join in movements outside of the church. If the schism was over leadership infighting, I did not include that occurrence in the sample because those schisms generally resulted in groups that had almost equivalent doctrinal and behavioral codes. Many splits, like the one that formed the Duck River Association of Baptist, came about because one group wanted to have formal connections with another. In the case of Duck River, the group split from the Elk River Association to pursue a theology of general atonement and to recognize other groups as being in communion with God.<sup>10</sup>

<sup>10</sup>This group experienced several splits throughout its history, but the resulting groups decided to keep the same name. As a result, there were four Duck River Associations as of 1978 - a nice example of trying to not locate close to your competition.

Table 2.2 summarizes the information on the direction of the schism. Right schisms are much more common than left schisms, which confirms the prediction of the model above. This difference in relative frequencies has been noted in the literature (see Stark and Finke (2003) for an example), yet I have not seen any empirical measures of the frequency of right schisms relative to left schisms. This paper contributes to the literature not only by providing a theoretical explanation of why we would observe more right schisms relative to left schisms, but also by providing a measurement of the observed frequencies.

## 2.6 Conclusion

This paper developed a model for understanding why groups split. The key to this problem is understanding the coordination problems that arise from the non-rivalrous nature of the goods groups provide. To overcome the free-riding induced by the non-rival characteristic, groups may put restrictions on group members ability to participate in activities outside the group, either through explicit contracts, organizational culture that encourages more time spent in the group, or strict behavioral codes that alienate the individual from others outside of the group. The superior ability of groups with more restrictions to overcome free-riding make the break away groups more likely to impose more restrictions on group members than the original group did.

The data on religious schisms is broadly consistent with the model I provide. Schisms are more likely to be led by stricter groups and the size of the original group increases the probability of schism (which suggest the assumption of increasing returns is warranted). This paper is the first to present theoretical foundations and empirical evidence for schisms being led mostly by stricter groups. As mentioned above, the model and the application are analogous up to a point. To understand religious schisms more fully, the incentives of the

leaders would have to be modeled more fully, rather than being reduced to the unidimensional strictness variable.

# Chapter 3

## The Market Process in Health Care

### 3.1 Introduction

Consumer shopping is a key ingredient to encouraging market competition. Markets in which consumers can effectively shop around incentivize producers to offer goods at lower prices, higher qualities, or both. This aspect of a competitive market is lacking for U.S. health care. That has not always been the case. I examine how private institutions can order exchange to support a well-functioning market. I use the historical example of the use of lodge doctors by mutual aid societies to highlight general principles of a well functioning health care market. I then use these principles to understand how modern insurance companies offering medical tourism could serve as institutional cornerstones for a well-functioning health care market today.

Where consumers cannot effectively shop, competition is diminished. The health care market in the US seems to be characterized by consumers that cannot effectively shop for health care. This could be for any number of reasons: consumers do not fully understand the

product they are consuming, prices are hidden behind layers of bureaucracy, restrictions exist on the type of competition providers and insurers can engage in, etc.

I explore the examples of the practice of the lodge doctor from the early 1900s and modern day medical tourism facilitated by insurance policies. Three general attributes characterize how these arrangements enhance consumer shopping and strengthen competitive forces. First, information about provider quality must be truthfully and publicly revealed. Mutual aid societies achieved this by hiring the doctor through election. Medical tourism can achieve this through data collection on outcomes by insurers in the course of normal business activity.

Second, health care providers must have the incentive to provide the service at a low cost. Both mutual aid societies and insurers providing medical tourism policies do this by contracting a fixed salary with the provider determined annually via a bidding process (in the case of the lodge doctor) and a fixed fee for a procedure decided before the procedure begins (in the case of medical tourism). By offering alternative means of obtaining health care, these practices also have the added benefit of putting downward pressure on prices other providers in the market.

Third, the payment arrangement must incentivize the provider to maintain quality. In the case of the lodge doctor, this was achieved through the fixed salary, which channeled the doctor's efforts towards effective prevention and early treatment, and through the yearly election, which kept the doctor's mind focused on providing high quality in order to keep his job. In the case of insured medical tourism, insurance companies have the incentive to contract with high quality providers because those insurers bear the cost of complications of postoperative care upon the patients return home.

Section 2 provides a review of the literature on consumer shopping in order to show that under most current arrangements, consumers cannot effectively shop for medical care. Section 3

describes lodge doctor practices and how they aided in increasing competition in the health care market. I discuss limitations of this model in the present day. Section 4 describes medical tourism, how it can enhance competition in the health care market, and what the impediments to increasing its use are.

## 3.2 Health Care and Consumer Shopping

Much of the rhetoric about the health care market today is about the soaring cost and health care's increasing share of GDP. Regarding the second point, we should not care about the share of GDP going to any particular product market. If consumers and producers are engaging in voluntary exchange and there are relatively few impediments to the types of contracting in which consumers can engage, then the amount of consumption in that product market reflects the fulfillment of consumers' desires, and there is no necessary share that one product market should have of GDP. A large body of research suggests, however, that the rapidly increasing cost of healthcare does not reflect an efficient allocation of resources. Here I provide an overview of empirical findings related to consumer shopping behavior in both health care and health insurance markets.

In analyzing consumer shopping behavior in the health care market, we must remember that consumers' incentives to shop may be attenuated, depending on the type of insurance coverage a consumer has. Many studies on consumer shopping utilize differences in the behavior of those with a high-deductible health plan (HDHP)<sup>1</sup> and those with traditional health plans. The idea is that high deductibles give consumers "skin in the game". In HDHPs, insurance does not begin to cover the costs of care as soon as traditional insurance plans, which increases the marginal cost a consumer faces each time she seeks medical attention. This should incentivize the consumer, at the margin, to consider shopping before deciding

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<sup>1</sup>\$1250 for individual and \$2500 for family. See Internal Revenue Service. High-Deductible Health Plan Definition for 2014. <http://www.irs.gov/pub/irs-drop/rp-13-25.pdf>.

on a particular health care provider. Sinaiko et al. (2016) report findings from a survey of approximately 2000 health care consumers. The consumers' demographics were broadly similar, with HDHP consumers having slightly higher incomes, and beliefs and attitudes towards health care were also similar. When consumers were asked whether they would use price information if it were available, there was no statistical difference in the percent of "very likely" and "likely" responses between the consumers with HDHPs (56 percent) and consumers with traditional health plans (50 percent). When asked about their most recent use of medical care, only 10 percent of traditional health plan consumers and 11 percent of HDHP consumers responded that they had considered other health care professionals, and only 4 percent of HDHP consumers and 3 percent of traditional health plan consumers responded that they considered other health professionals and compared costs of those health professionals.

From these findings, it does not appear that consumers who face higher marginal costs engage in different shopping behavior than those who face a lower marginal costs. Several factors could explain these findings. Search cost may be too great. Shopping on price requires calling different providers, asking whether they take a particular insurance, then waiting for the care provider to respond with pricing information, which depends on the negotiated contract between the insurer and the provider. Also, given that the consumers with HDHPs have higher incomes, the relative search cost for the HDHP group are somewhat higher. Though the fact that only half of each group would use price information if it were available suggests that there is a low level of interest in shopping around.

Brot-Goldberg et al. (2015) compare the behavior of health care consumers from a large employer that switched from a plan with no cost sharing to a HDHP. As would be expected, spending decreased substantially, approximately 12 percent over a two-year period. The authors decompose this spending reduction to measure the effect that comes from price shopping, quantity reduction, and quantity substitution. The price shopping effect is found



by comparing whether consumers shifted toward a lower cost provider conditional on a given procedure. The total quantity effect is measured as the total change in health care expenditure minus the change in expenditure caused by provider price inflation and consumer shopping. Quantity reduction is just the measured change in the number of procedures, and quantity substitution is the part of the total quantity effect not explained by quantity reduction. They find that 90 percent of the spending reduction in the first year after the switch comes from quantity reduction, with the remainder coming mostly from quantity substitutions. The mix of procedures chosen by consumers suggests that consumers, overall, chose higher priced providers after switching to the HDHP. The authors also estimate the potential reduction in medical expenditure if those consumers who chose providers with higher than median prices would have instead chosen providers with median prices.<sup>2</sup> This would reduce expenditure by approximately 20 percent.

These findings do not necessarily suggest that consumers are acting irrationally. The analysis does not account for the quality of the provider, and depending on the correlation between price and quality, reducing expenditures solely through quantity reductions may be optimal. That quantity reduction accounts for almost the entire reduction in expenditure may be a sign that moral hazard was driving previous health care consumption decisions. This analysis also only considers the effect of the decisions of a subset of consumers on provider prices. If the quantity reduction were market wide, we would expect providers to reduce prices. That the mix of providers whom consumers chose became more expensive after the switch does, however, suggests that consumers may not be shopping effectively.

These studies suggest that consumer shopping for medical providers may not be effective in enhancing competition in health care markets. There are factors that are not taken into account: search costs incurred every time a consumer shops for a provider, the quality of

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<sup>2</sup>This obviously does not control for increases in prices that would occur for those median priced doctors when they see an increase in demand for their services, but it also does not control for the reduction in the prices of those providers with higher than median prices.

the doctor, and the switching cost of choosing a new provider. These are difficulties that economists encounter when analyzing the shopping behavior of consumers in the health care market. We may be able to avoid these difficulties by analyzing how consumers choose prescription drug plans (PDPs).<sup>3</sup>

Several studies show that upon enrollment in Medicare Part D, consumers choose PDPs that are not optimal by not choosing the lowest cost alternative for a given level of coverage. Abaluck and Gruber (2011) show that only 12 percent of consumers chose the lowest cost plan in their state (with a mean savings of 30 percent possible), and if only plans with non-increasing variance in expenditure are analyzed, 70 percent of consumers did not choose the lowest cost plan, conditional on realized expenses. These authors also found that consumers put more weight on plan premiums than on expected out of pocket costs.

This may be a somewhat unfair test, since consumers cannot perfectly foresee their prescription usage throughout the year. Heiss et al. (2013) provide benchmarks for various types of consumers: perfect foresight, rational expectations (using past data plus current information to forecast costs), adaptive expectations (assuming next period's cost will equal last period's cost), minimum premium, and random. The authors calculate the optimal plans for individuals using these benchmarks and compare them to consumers' actual choices and find that only compared to randomly choosing a prescription drug plan do more than half of consumers choose a lower cost plan than the benchmark. The percent of consumers choosing a plan with total higher costs than the benchmark varies from 66 percent when compared to the cheapest premium benchmark to 93 percent with the perfect foresight benchmark.<sup>4</sup> So even when compared to rules-of-thumb behavior, consumers overspend.

Zhou and Zhang (2012) and Patel et al. (2015) find similar results of consumer overspending

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<sup>3</sup>There are likely lower switching and search costs associated with changing pharmacists than doctors, and there is less human interaction that colors one's experience with getting prescriptions.

<sup>4</sup>Average overspending relative to benchmark ranges from \$115 (lowest premium) to \$315 (perfect foresight)

and non-enrollment in lowest cost plan, and Ho et al. (2015) find that consumers' inattention blunts competition to reduce prices among plan providers. Evidence on consumer learning is mixed with Ketcham et al. (2012) finding significant learning, with 81 percent of the sample benefiting from reduced overspending, while Abaluck and Gruber (2016) find little evidence of learning. When provided with information about potential savings, many consumers switch to the lower cost plan (Patel et al., 2009).

There is some evidence that consumers can effectively shop under different payment contracts. Robinson and Brown (2013) examine a change in payment arrangements for knee and hip replacement surgery within the California Public Employee's Retirement System (CalPERS). CalPERS switched to a reference price system in which CalPERS set a maximum amount it would pay for knee and hip replacements. Patients could choose any number of hospitals to receive the knee or hip replacement. If the negotiated price was higher than the reference price, the patients had to cover the difference. Before CalPERS put this payment arrangement into effect, high-cost (priced above the reference price) hospitals served 52 percent of CalPERS knee and hip replacement patients. After the change, high-priced hospitals operated on only 37 percent of CalPERS patients. In addition, those high-priced hospitals reduced their prices by an average of 26 percent after CalPERS switched to reference pricing. This suggests that for certain procedures, increasing the marginal cost the consumer faces may lead to increased shopping. I should note that, in addition to switching to reference pricing, CalPERS also provided patients a list of hospitals that charged less than the reference and were of sufficiently high quality. Without this information, it is unclear how well patients would have been able to shop for the procedure.

This brings up the idea that consumers will be able to shop better for some health care based on the urgency of treatment. If consumers can shop for some services, such as hip and knee replacements, we may expect that prices are less variable. Frost and Newman (2016) analyze a nationally representative data set of health insurance claims and categorize

the services into shoppable and non-shoppable.<sup>5</sup> They find that shoppable services have a smaller variation in prices than nonshoppable services. This is crude evidence that shopping does occur in the health care market. The authors also calculate that about 43 percent of health expenditure is on shoppable services and that only 7 percent of out-of-pocket spending was on shoppable services. This suggests that, under current institutional arrangements, the range of shopping (whatever the effectiveness) in the health care market is rather limited.

This review of the literature suggests that health care consumers face difficulties in shopping for health care. This could be because there are switching costs involved in changing providers, high search costs due to the Rube-Goldberg nature of the health care system, cognitive limitations that impede proper calculation, or consumers not bearing the full marginal cost of care.<sup>6</sup> While there is some evidence to suggest that health care consumers can effectively shop for health care services, under most institutional arrangements we see today, shopping remains marginal and muted. We must then ask if there are any institutional arrangements that allow for and aid in consumer shopping and whether there are barriers to expanding those arrangements.

### 3.3 Asymmetric Information and Health Care

The health care market is characterized primarily by asymmetric information in two relationships.<sup>7</sup> First, the provider has more information about the patient's condition than the patient. The providers sell what are known as credence goods, which the consumer has difficulty ascertaining the quality of the product even after consumption. Second, if a third party

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<sup>5</sup>Shoppable services are both the highest spending and could be scheduled in advance. This is a crude measure, and it is unclear as to why the actual price would make it more or less shoppable.

<sup>6</sup>See Bhargava et al. (2015) and Johnson et al. (2013) for experimental evidence that consumers have trouble distinguishing objectively better health insurance plans from strictly dominated ones.

<sup>7</sup>While asymmetric information is a characteristic of other expert markets (auto mechanic, taxi driver, attorneys, etc.), many economists argue that the many levels asymmetric information (doctors, third-party payers, etc.) along with the overall importance of the service makes the market imperfections much more acute than in other markets See Arrow (1963) for an example.

payer is involved, the patient has more information about her health status and behavior than the payer. This affects what types of patients buy coverage from the third party payer and what types of behavior the patient engages in after purchasing coverage.

In the first relationship, the provider can engage in hidden action by either mistreating a patient or overcharging the patient.<sup>8</sup> This is the standard moral hazard outcome. The provider can mistreat the patient in two ways. First, the provider can undertreat the patient by providing a simple, low-cost treatment when the patient needed a sophisticated, high-cost treatment. Second the provider can overtreat the patient by providing the high cost treatment when the patient only needed the simple low cost option. Overcharging results when the provider only gives the patient the low-cost treatment but charges her for the high-cost treatment.

Wolinsky (1993, 1995) note that competition can mitigate some of the negative aspects in the market for health care provision. This is due to the consumers' ability to shop for multiple diagnoses before buying treatment. Thus, if the diagnosis and the treatment purchases are separable, consumer shopping will reduce, though not eliminate, fraud in the market for credence goods. In the context of health care provision, this separability characterizes some procedures, while procedures (especially in emergency situations) may not display this separability. Dulleck and Kerschbamer (2006) note that when economies of scope between diagnosis and treatment exist the separability assumption will likely not hold. In general, inefficiencies arise in models of credence goods when the consumer cannot verify the treatment, the provider faces no liability for bad outcomes, or the diagnosis and treatment are linked.<sup>9</sup> Consumers' ability to verify treatment prevents overcharging but not under- or over-treatment. Liability for bad outcomes prevents under-treatment, and separating diagnosis and treatment may prevent over-treatment.

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<sup>8</sup>See Dulleck and Kerschbamer (2006) for an overview of the literature on credence goods.

<sup>9</sup>See Dulleck and Kerschbamer (2006) for a lengthy discussion of assumptions in credence good models.

The relationship between the third-party payer and the patient suffers from asymmetric information both before and after the purchase of coverage. That the consumer has more information about her health status affects what types of policies third-party payers offer. This is the standard adverse selection problem. There is also the moral hazard problem that arises once the patient has coverage. Obtaining coverage lowers the expected costs of risky health behaviors or visiting the doctor, which induces the patient to engage in more of both activities. Third-party payers mitigate this effect by requiring the patient to bear some of the costs through copayments and coinsurance or, in the case of preventing excessive provider visits, require approval to see the provider.

The following sections will focus on the problem of provider moral hazard. The key issue for consumers is how to mitigate the informational advantage of medical providers. This problem can be overcome by developing institutions for the public revelation of quality and enforcement of contracts that incentivize cost reduction.

### **3.4 Lodge Doctors**

Two alternatives to the prevalent fee-for-service model used today are for an organization to hire a doctor on contract (practiced by mutual aid societies, unions, and some employers) or for an individual to have a prepaid plan with a particular group practice (Chapin, 2015). These arrangements have essentially the same incentive structure for both consumers and doctors. If an organization hires a doctor on a fixed salary contract, the doctor benefits himself the most by treating the patients as minimally as possible, possibly given some minimum quality threshold. Because the patient faces zero (or near zero) marginal cost for seeing the doctor, the patient benefits most from visiting the doctor more than if he faced the full marginal cost of the visit. This contrasts with the fee for service where the doctor has the incentive to over-treat.

These different types of payment contracts open up new avenues of competition, but the potential impediments to consumer shopping are still inherent in the market. Consumers may not have enough information about the quality of the doctor or fully understand the prepayment contract, and search and switching cost are not mitigated by these contracts, *per se*. The main benefit of this model is that, even though consumers still do not face the full marginal cost of seeing the doctor, the doctor's incentive is to minimize the amount of care, which reduces the cost of service. This leaves more room for the possibility of price reducing competition, but even if two prepaid group practices open up next to each other, the consumer still faces the problem of shopping effectively. We will examine how mutual aid societies' contracts with doctors solved the problems of search costs and informational asymmetries.

Mutual aid societies (or lodges) formed around various functions, such as burial insurance and early versions of privately provided workers' compensation insurance. These lodges charged membership fees and held regular meetings to socialize and participate in lodge rituals. Lodges hired doctors on a fixed salary basis and generally charged members a \$2 annual fee that covered doctor's services but not the cost of medicine (Beito, 2000, p.111-112)<sup>10</sup>. This fee was approximately a day's wages for a laborer and was around the same price as one nighttime house call from a non-lodge doctor. Lodge doctors were elected by members of mutual aid societies on a yearly basis, which meant that every year he had to compete with other doctors to get the lodge contract.

The fixed salary contract<sup>11</sup> paired with the hiring through election provides the main benefit of the structure of lodge doctor contracts. With access provided through membership in the lodge plus the annual fee, the price the consumer faces for seeing the doctor is near certain. Because the doctor is paid a fixed salary, the only marginal medical cost borne by the patient

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<sup>10</sup>The dollar figures stated are for the first decade of the twentieth century

<sup>11</sup>As mentioned above, third-party payment can result in overuse of doctor services. In order to prevent this, lodges restricted the types of ailments for which they could use lodge resources, particularly banning any treatment for injury resulting from drunkenness or from sexual promiscuity (Beito, 2000).

was the medicine given by the doctor. Hiring by election acted to publicly reveal the quality of the lodge doctor. These ballots were often held openly.<sup>12</sup> Due to the social nature of lodges, an individual could obtain information about the doctor through conversation with other lodge members. Members could discuss various topics: the outcome of a treatment, the bedside manner of the doctor, how the lodge doctor compares to other doctors they have visited, etc. The annual elections were generally held in an open fashion, so there was public debate about the quality of the doctor. These two aspects of the selection process ensured that at least the quality of the incumbent doctor was public knowledge,<sup>13</sup> even by those who had not visited the doctor. Thus the informational asymmetry between doctor and patient was reduced,<sup>14</sup> and the bidding process reduced the cost of searching for another physician.

Because this was a yearly process, the doctors were never far removed from competition. This was a time before there were large restrictions on the supply of doctors (Chapin, 2015), so the prospect of losing a contract with a lodge was a real possibility. In order to maintain the contract, the lodge doctor would have to ensure he maintained at least an acceptable level of care.

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<sup>12</sup>The social aspect of the mutual aid society encouraged discussion of the lodge doctor among members. Thus, when it was time to elect the lodge doctor, the information obtained by members who sought care during the year and the information gathered by individuals who talked to those patients during the year is aggregated in the outcome of the vote.

<sup>13</sup>One may ask why, if medical care is a credence good, would the information exchange between lodge members lead to more accurate quality evaluation. The credence qualities of these goods require additional costly information to evaluate the quality of the good or service. Take the simple case of a cab ride. The quality of this service is mostly a function of the time it takes to get from point A to point B. How does a consumer evaluate the quality if she is unfamiliar with the area? Today, she can consult any number of map apps on a smartphone. Before smartphones, she could mention the cab ride to a friend who lives in the area, and that friend could provide some insight into whether the cab driver overcharged her. If she discovers the cab driver overcharged her, she can opt not to hire that cab driver or company in the future. While medical care is more complicated than cab rides, the same logic applies. If an individual finds that many of the lodge members who went to the doctor were back to normal health much more quickly than those who had similar symptoms and did not go the doctor, then that individual can reasonably think the doctor provides at least some positive value. Note that the credence quality does not make it impossible to evaluate the product; it just makes it more costly to obtain the information. So long as the exchange of information acts to reduce the cost of product evaluation, the credence quality is diminished.

<sup>14</sup>Medical society ethics enforcement (e.g., sanctions for violations of codes of conduct) provides only a roundabout way of regulating quality and the feedback is generally only sensitive to extreme cases of malfeasance.



Additionally, lodges also competed for members by advertising their mortality rates (Beito, 2000, p.119). With competing lodges providing information about their mortality compared to the local populations, there was at least some incentive for individual lodges to hire doctors of a minimum sufficient quality. If a lodge had a higher mortality than the general population, this would make potential members think twice about the benefits they would receive. So even if the lodge members were willing to discount the quality of care they received, they would still need to select a doctor of sufficient quality to attract new members.

Due to the fixed salary payment scheme, extra doctor's visit did not impose additional costs on the lodge or its members, and the hiring-by-election system incentivized the doctors to respond in a timely manner to request from lodge members. Not only did the fixed salary payment encourage members to contact the doctor at the onset of an ailment, leading to quicker treatment, but it also encouraged doctors to practice preventative medicine. Because doctors incurred a personal cost and no extra revenue every time they saw a patient, it was in the doctors' best interest to cure the patient as quickly as possible. The regular negotiation of contracts mitigates the incentive to undertreat, which may reduce perceived quality.

Both the practice of lodge doctors and prepaid groups were competitive threats to existing solo practice physicians. Local medical societies led the way in fighting against the practice of lodge doctors. Because of the fixed salary payment, lodge members could see the lodge doctor for much less than seeing a non-lodge doctor. This put downward pressure on prices that non-lodge doctors could charge. To give an idea of the reach of the lodge practice, Beito (2000, p.111) notes that in Seattle about 20 percent of males over age 21 had access to a lodge doctor. Lodge doctors represented a significant competitive threat to doctors outside of mutual aid societies.

In the second decade of the twentieth century, local medical societies not only withdrew some lodge doctors' memberships but also led boycotts against the lodge doctors. Revoking a doctor's membership or not admitting the doctor altogether impeded a doctor's ability

to obtain malpractice insurance (Chapin, 2015, p.23). These boycotts took the form of not aiding or consulting with the lodge doctor. This would reduce the ability of a lodge doctor to provide good quality service, especially for a difficult medical case. Medical society members also colluded to have lodge doctors admitting privileges to local hospitals revoked. This further reduced the lodge doctor's ability to provide a high quality of service to lodge members. State medical societies also charged lodge doctors and doctors in prepaid group practices with various ethics violations leading to some doctors losing their licenses.

The efforts of local medical societies were successful in part due to the increasing restriction on the supply of doctors and due to the monopolies the state medical societies had over certification of doctors. With a monopoly over granting licenses to doctors, state medical societies could credibly threaten doctors who engaged in the various alternative payment arrangements discussed above. The ever tighter certification requirements on doctors and medical schools led to a much lower rate of doctors in the population, from 164 per 100,000 people in 1910 to 125 per 100,000 in 1930 Beito (2000, p.128). This increased the cost of hiring a lodge doctor and enabled local medical societies to have a tighter grip on the market for doctors services.

Given the reduction in the membership in mutual aid societies and the fragmentation and price inflation of health care, the type of arrangement provided by the mutual aid societies may be infeasible today, but it does provide us with general lessons of how payment contracts for health care that enhance consumers' shopping capabilities can be structured. In order to reduce information asymmetries, there must be some way to aggregate quality data on the doctor. The threat of the consumer exiting the doctor-patient relationship must be credible. This ensures that the doctor is under competitive pressure to provide a sufficient level of quality. Mutual aid societies achieved these goals through yearly elections of the lodge doctor. Throughout the year, members could gain information about the doctor through conversation and gossip with their fellow lodge members. The open balloting process gave

some incentive to be truthful; it would be embarrassing to have spoke badly of the current doctor only to vote to extend his contract.

The doctor must also face cost minimization incentives while still maintaining sufficient quality, which was achieved through combining a fixed salary with the yearly election. This fixed fee contract reduces the doctor's incentive to provide high cost treatments when lower cost treatments would be appropriate. Paired with yearly renewal, this fixed fee contract incentivizes cost minimization without sacrificing quality, mitigating the problem of provider moral hazard. While there is now less opposition to fixed fee contracts with the success of companies like Kaiser Permanente and Geisinger Health System, the ease of consumer switching and lower search cost remain pertinent goals. In the next section I discuss the example of medical tourism and how this may provide a way of translating the lessons from mutual aid societies to present day.

### **3.5 Medical Tourism**

The promise of medical tourism is that patients can choose to have a procedure performed at a lower cost hospital while still receiving a sufficient level of quality, and this in turn increases the competitive pressure on higher cost to lower prices. Medical tourism can take place internationally and domestically, and while domestic tourism may not have as great of a cost saving function, the easier enforcement of liability laws may serve as a greater incentive to maintain quality. Medical tourism can take place either through insurance policies or independent of insurance. While any medical tourism can serve to increase competitive pressure on high cost hospitals, I will show that tourism through insurance policies provide the greatest enhancement to consumer shopping. The ability of medical tourism through insurers to control cost is generated through the insurer effectively steering consumers towards higher quality and lower cost providers. Medical tourism acts to increase competition

by providing more relevant alternatives for consumers to choose from.

Let's look at the case of the non-insured medical tourist. The procedures consumers usually purchase are one-offs, so competition may be blunted because the consumer cannot switch providers. Once the procedure is performed and the consumer returns to her home country, the relationship is over. Foreign hospitals can develop a reputation for being high quality, but it can be difficult for the consumer to verify. The consumer can search for quality information from the Joint Commission International (JCI), which rates and accredits hospitals internationally (Labonte, 2013). JCI ratings improve a consumer's ability to shop for health care internationally, but it does have limitations. At face value, JCI gives consumers more information about hospital quality, but the consumer is now, rather than relying on what hospitals say about their own quality, relying on JCI to be truthful about the quality of the hospitals it rates. In a sense, by suggesting that consumers can take JCI at its word, we are just pushing the asymmetric information problem up a level. Because JCI gains revenue for certifying hospitals, not all of its incentives are necessarily aligned with truthful revelation, though reputation concerns (supported through internet ratings sites or message boards) may strengthen truth telling incentives. The foreign hospital can also partner with a high-quality institution in America to signal its own high quality, but the correlation between the partner quality and the quality of the foreign hospital remains uncertain because the oversight of the partner institution may be lax (Cohen, 2015).

Facilitators also serve as an information aggregator for medical tourism. These middleman organizations help potential patients plan their medical tourism trip, many offering packages that include flight and hotel reservations, recommending destination hospitals, scheduling the procedure, and even organizing sight-seeing excursions while the patient is in the destination country. This dramatically cuts down the transaction costs incurred by the patient, yet many of the same difficulties from the patient performing all these functions still apply. Many medical tourism facilitators gain revenue from referral fees paid by foreign hospitals

(Spece, 2010). Just like in the case of JCI accreditation, having a facilitator vouch for a provider's quality shifts the principal agent problem from the patient-hospital relationship to the patient-facilitator relationship.

One may suggest that liability enforcement can mitigate much of these issues. With regard to accreditors and facilitators, the body of case law has not found the connection between treatments and these third parties to be close enough to justify finding them liable for post-operative complications or malpractice (Cohen, 2015).<sup>15</sup> Because the consumer's relationship with the foreign hospital ends upon the consumer's return to her home country, the foreign hospital is not responsible for any complications that may arise from the procedure. While bringing a malpractice lawsuit against a foreign hospital could mitigate incentives to skimp on care quality, in reality, there are many logistical obstacles of, for example, a US citizen bringing a lawsuit against a Thai provider (Cohen, 2015). These liability and malpractice issues are reduced when medical tourism occurs within the domestic market. So while medical tourism independent of insurers can provide competitive pressure on high cost providers and enhance consumers' ability to shop, difficulties remain that may be resolved by medical tourism through insurers.

Medical tourism facilitated by health insurers holds the possibility of overcoming some of the difficulties involved with individuals engaging in tourism on their own. We must first note that for insured medical tourism to effectively aid in consumer search, consumers must be able to shop effectively for those insurance policies. This comes with all the caveats mentioned in Section 2. In the case of insured medical tourism, health insurers, like the various accrediting agencies, can act as data aggregators for the price and quality of hospitals, but in this case insurers have an advantage because they will have the ability to constantly monitor the quality of these hospitals. This can occur through the use of the data health insurers have

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<sup>15</sup>While I have not seen it discussed in the literature, it is unclear why facilitators cannot credibly offer a money back guarantee or to voluntarily choose a contract that transfers liability from the foreign provider to facilitator. It may be that the terms of these types of contracts are unobservable or hard to verify, but this remains an underexplored topic with regards to medical tourism.

on their customers. If the insurer's customers that visit a particular destination hospital, suddenly show signs of increasing morbidity or mortality, the insurer is in a position to either stop sending patients to that facility or to aid that facility in correcting any failings. With the accrediting agencies, data on quality may be updated every few years (at most, annually). The insurer's role as data aggregator reduces any search cost or informational asymmetry that may exist. This allows consumers to shop much more effectively. The prices of medical tourism for both insured and uninsured patients are generally negotiated as a fixed fee and is known to the patient before undergoing the procedure (Herrick, 2007).

Even though insurers cannot generally be held liable for medical malpractice, insured medical tourism has an advantage over uninsured in that the insurer has the incentive to verify and enforce quality standards of destination hospitals. This is because the insurer bears the cost of procedures that result from postoperative complications upon the patient's return home. This was not the case in uninsured medical tourism, in which accreditors and facilitators bear no burden of the cost of complications that arise upon the patient's return home.

The role of the insurer is to essentially act as a well-informed consumer. The same ingredients for successful consumer shopping that characterized the practice of lodge doctors may also be found in medical tourism contracts. The doctor does not have the incentive to overtreat due to the fixed fee transaction. The quality of care can be sustained by the insurer channeling customers only to high-quality destination hospitals and threatening to exit from the relationship if quality becomes too low. The insurer has the incentive to maintain relationships with high-quality hospitals because the insurer bears the cost of postoperative complications when the patient returns home. This puts downward pressure on prices of the local high-priced facilities. So long as the cost savings to consumers are sufficiently high, they will participate in the practice of medical tourism.

The ability of insurers to produce cost savings depends on how the insurer manages its network of providers and how effectively the insurer can channel consumers to the providers.

As noted above, consumers tend to be unsophisticated shoppers when buying medical care, but evidence does suggest that insurance contracts affect the amount and type of medical care consumers buy. Aron-Dine et al. (2015) show that consumers, in addition to spot prices, take into account the pricing nonlinearities introduced by premiums, copayments, and coinsurance rates. Rosenthal et al. (2009) show that excluding providers from the insurance network decreases the likelihood of a consumer seeing that provider, and Scanlon et al. (2008) show that providing financial incentives induce consumers to visit hospitals of higher quality.<sup>16</sup>

Many efforts of insurers to control cost and steer patients to higher quality providers can be described as implicitly or explicitly restricting the network of providers patients can access. In the 1980s and 1990s, HMOs explicitly excluded providers and/or facilities from their networks while charging one copayment for the providers and facilities within its network, and the lowest rates of medical price inflation during the 1990s and 2000s coincided with the years in which enrollment in HMOs was highest (Robinson, 2003). Since the push back against HMOs and increasing exclusion of the late 1990s and early 2000s, insurers have introduced tiered insurance contracts in which patients pay different copayments depending on the tier the provider is classed under.<sup>17</sup> Insurers also implicitly restrict the network of providers by replacing fixed dollar copayments with percentage coinsurance, which implicitly tiers the providers by price (Robinson, 2003). Robinson and Brown (2013) also show how reference pricing can be used by insurers to steer consumers to lower priced providers.

Insurers must balance the restrictiveness of the network with the preferences of consumers. If the network of providers an insurer covers is too narrow, consumers will not buy the insurance product. In order to provide a broad enough network while holding down costs, insurers

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<sup>16</sup>This effect seems to to be mediated by education levels of patients, with more educated patients responding more to the financial incentive.

<sup>17</sup>Insurers generally place providers in tiers based on some combination of average cost and quality (Rosenthal et al., 2007). Rosenthal et al. (2007) also show that what hospitals fall into what tiers depends heavily on the weights placed on quality measures relative to cost measures.

must be able to effectively negotiate with providers. Capps and Dranove (2004) show that consolidation of providers increases the prices insurers pay. An insurer's bargaining power is determined by not only the number of consumers in the insurance plan but also the ability of insurers to channel patients to particular hospitals (Wu, 2009).<sup>18</sup> Provider bargaining power vis--vis insurers depends on what the insurer's best alternative is. If the insurer's best alternative is to replace the provider with another, the provider's bargaining power depends on the incremental value it adds to the insurer's network relative to other providers that could replace it. If the insurer's best alternative is to just exclude the provider from the network, the provider's bargaining power depends on the value it adds to the providers already in the network. Town and Vistnes (2001) show that this affects how hospital mergers impact prices insurers pay. Mergers of a provider with its next best substitute within the network leads to an expected price increase of 7 percent, while a merger of a provider with its next best substitute outside the network leads to an expected price increase of 2 percent.

What medical tourism allows is the extension of the provider network without weakening the insurers bargaining power. As noted by Town and Vistnes (2001), even dense urban markets with many providers may have enough differentiation among providers to allow the exercise of market power. By broadening the scope of providers an insurer can choose to allow in its network, medical tourism can mitigate the exercise of market power by providers. Currently, it is the insurer's lack of ability to channel consumers to providers via medical tourism that limits the potential benefits.

There are several impediments to insurers' offering these types of services.<sup>19</sup> Federal and state regulation on geographic coverage and accessibility prevents insurers from selling insurance policies based solely on medical tourism. For HMOs these laws require that medically

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<sup>18</sup>Insurers' ability to steer patients may be severely limited if the patients receive recommendation from within their social network. Sinaiko (2011) shows, via survey results, that while a copayment difference of \$50 would induce 11.7 percent of consumers to switch providers, a copayment difference of \$440 would be needed to induce the same amount of consumers to switch if they had previously received a recommendation for the provider with the higher copayment.

<sup>19</sup>All these examples are discussed in Cohen (2015, p.141-144).



necessary services to be available 24 hours a day and 7 days a week. They also require that services “within the area served by the health maintenance organization available and accessible to each of its members... and in a manner which assures continuity” (Cohen, 2015, p.142). The assurance of continuity seems to forestall the ability of an HMO to provide medical tourism coverage policies. State regulations for preferred provider organizations on the distance that defines accessibility similarly prevents PPOs from offering stand alone medical tourism policies.

The main impediments to selling insurance with medical tourism coverage are laws limiting the financial incentives insurers can offer to or the financial disincentives insurers can impose upon their customers. By limiting the deductible, copay, or coinsurance difference between a preferred and non-preferred provider (commonly between 20 to 25 percent), these regulations impede the main promise of medical tourism of substantial savings reaped through providing competition with hospitals that have dramatically lower costs.<sup>20</sup>

### **3.6 Conclusion**

A large body of research suggests that individuals are not very sophisticated consumers of health care. Given this understanding of consumer behavior, how can the problems of moral hazard on the side of providers be overcome? After documenting the ways in which the health care market is prone to moral hazard, I illustrate how this problem can be overcome by setting up the appropriate institutions. The example of lodge doctors illustrates the attributes of provider quality revelation, disincentives to overtreatment, and incentives to maintain quality that must characterize the institutional arrangements. I then showed that insurers, via medical tourism, can achieve these attributes. By setting it in the context of provider networks, we see that medical tourism is just another example the benefits of

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<sup>20</sup>Because many policies provided by self-insured employers are exempt from state insurance laws, we see greater uptake of policies augmented by medical tourism.

extending the scope of a market.

I have shown that the current lack of consumer shopping in the health care market is contingent on current institutional features. The example of the lodge doctor demonstrates three basic features that characterize a well-functioning health care market: provider quality is truthfully and publicly revealed, health care providers are incentivized to control costs, and the payment arrangement must incentivize providers to maintain quality. While the lodge doctor practice illustrates the institutional arrangements necessary for a well-functioning health care market, the lodge doctor practice is not something that is feasible today.

Health insurers have the potential to serve as the institutional cornerstones of a well-functioning health care market through the use of high-powered incentives. Brot-Goldberg et al. (2015) show that just increasing patients' out-of-pocket cost does not necessarily lead to consumer shopping and price competition. This may be due to the overwhelming amount of information consumers have to sift through in order to make an informed decision. Robinson and Brown (2013) show that increased out-of-pocket expense paired with quality information and some degree of price transparency not only leads to consumer choosing less expensive alternatives but also that higher cost providers face an incentive to lower their prices. The example of medical tourism highlights how exchange in a health care market with insurers differs from one without insurers. Insurers can negotiate prices with providers, provide consumers relevant quality information, and incentivize providers to maintain quality through contracting. Consumer shopping aided by insurers shows how the right institutional arrangements can support a well-functioning health care market.

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# Appendix A

## Chapter 2 Proofs

*Proof of Result 1.* Starting from the contribution decisions, the condition is the same as the Affiliation game above. If an individual joins group 1, she contributes if  $r_i \geq a(1 - s_1)$ . If the individual joins group 2, she contributes if  $r_i \geq a(1 - s_2)$ . I will first analyze the situation where Leader 2 splits to the left, i.e.  $s_2 < s_1$ .

Because the size of the club good provided by each group depends on how many contributors each group has, this becomes a coordination game. Individuals in group 1 will only switch to group 2 if they expect a sufficient number of other individuals to also switch. There are many combinations of switching that could lead to a split occurring. I will look at the combination in which individuals with an  $r_i \geq r^*$  switch to group 2.  $\underline{r}$  represents the cutoff where those individuals with  $r_i < \underline{r}$  did not join at the first affiliation decision node. The key to finding a solution is to note that those who contribute to group 2 must be indifferent between joining group 1 or group 2. There are many configurations of the various cutoffs that allow for a split. I will go through them case by case.

**Case 1.** Here  $\underline{r} \leq a(1 - s_1) \leq a(1 - s_2) \leq r^*$ . This is case illustrated in Figure 2.2. Because contributors to group 2 need to be indifferent between joining group 1 or joining group 2,



we use the following indifference condition to derive  $r^*$ .

$$\left[ \int_{(1-s_1)a}^{r^*} \frac{1}{a} di \right] N = \left[ \int_{r^*}^a \frac{1}{a} di \right] N - c \quad (\text{A.1})$$

This yields  $r^* = \frac{1}{2}a(2 - s_1 - \frac{c}{N})$ .

**Case 2.** Here  $\underline{r} \leq (1 - s_1)a \leq r^* \leq (1 - s_2)a$ . The indifference condition yields  $r^* = a(s_2 - s_1) + a(1 - \frac{c}{N})$ .

**Case 3.** Here  $(1 - s_1)a \leq \underline{r} \leq r^* \leq (1 - s_2)a$ . The indifference condition yields  $r^* = as_2 + \underline{r} - \frac{ac}{N}$ .

**Case 4.** Here  $(1 - s_1)a \leq \underline{r} \leq (1 - s_2)a \leq r^*$ . The indifference condition yields  $r^* = \frac{1}{2}(a + \underline{r} - \frac{ac}{N})$ .

**Case 5.** Here  $(1 - s_1)a \leq (1 - s_2)a \leq \underline{r} \leq r^*$ . The indifference condition yields  $r^* = \frac{1}{2}(a + \underline{r} - \frac{ac}{N})$ .

Given each  $r^*$ , a split is possible if the individuals believe that at least those with  $r_i > r^*$  will switch.

We next move to leader 2's optimal choice of  $s_2$ . Note that leader 2 will not choose an  $s_2$  such that  $r^* > (1 - s_2)a$ . This is because leader 2's utility is increasing in contributions and decreasing in  $s_2$ . If leader 2 chooses an  $s_2$  such that  $r^* > (1 - s_2)a$ , he is increasing  $s_2$  without a compensating increase in contributions. This eliminates cases 1, 4, and 5. Using the bounds in cases 2 and 3 where  $r^* \leq (1 - s_2)a$ , we find the following conditions:

$$s_2 \leq \frac{1}{2}\left(s_1 + \frac{c}{N}\right) \quad (\text{A.2})$$

or

$$s_2 \leq \frac{1}{2} \left( \frac{c}{N} - \frac{\underline{r}}{a} \right). \quad (\text{A.3})$$

These conditions depend on the choice of  $s_1$  by leader 1. Leader 1, thus, sets the bounds on leader 2's choice of  $s_2$ . Leader solves this maximization problem subject to (9) or (10) :

$$\operatorname{argmax}_s \quad \ln(Ns_2) - \ln\left(\frac{1}{1-s}\right) \quad (\text{A.4})$$

If the constraints do not bind, leader 2 chooses  $s_2 = \frac{1}{2}$ .

Now we move to the first affiliation decision. The sizes of the club goods have been determined, conditional on individuals joining group 1. Individuals now choose whether or not to join based on the size of the club goods and the strictness levels. I will focus on those who join group 1 and stay with group 1 because the condition will hold for those who join group 1 and later switch to group 2. The non-contributing individual will join group 1 at the first affiliation node if

$$(1-s_1)a + r_i \left[ \frac{r^*}{a} - (1-s_1) \right] N \geq a \quad (\text{A.5})$$

or

$$r_i \geq \frac{as_1}{\left[ \frac{r^*}{a} - (1-s_1) \right] N} \equiv \underline{r}. \quad (\text{A.6})$$

Given the number of individuals who will join group 1 at the first affiliation node, leader 1 chooses the optimal strictness level. As in the case of leader 2's choice  $s_2$ , leader 1 will not choose an  $s_1$  such that  $(1-s_1)a \leq \underline{r}$ , because this only comes at a cost without the added benefit of more contributions. Given this, we know that the case we will examine

for leader 1's maximization problem is  $\underline{r} \leq (1 - s_1)a \leq r^* \leq (1 - s_2)a$ , which gives us  $r^* = a(s_2 - s_1) + a(1 - \frac{c}{N})$  and  $s_2 = \frac{1}{2}(s_1 + \frac{c}{N})$ . The size of group 1's club good is  $(r^* - (1 - s_1)a)N = (\frac{1}{2}s_1 - \frac{1}{2}\frac{c}{N})N$ . Leader 1 maximizes

$$\ln \left[ \frac{1}{2} \left( s_1 - \frac{c}{N} \right) N \right] - \ln \left( \frac{1}{1 - s_1} \right). \quad (\text{A.7})$$

The optimal choice for leader 1 is  $s_1 = \frac{1}{2} \left( 1 + \frac{c}{N} \right)$ <sup>1</sup>. Plugging this into leader 2's reaction function, we find  $s_2 = \frac{1}{4} + \frac{1}{8} \frac{c}{N}$ .

Provided  $c < N$ , then  $s_1 > \frac{1}{2}$  and  $s_2 < \frac{1}{2}$ . □

*Proof of Result 2.* The club good size of group 1 is  $(\frac{r^*}{a} - (1 - s_1))N$ . Substituting for  $r^*$ , the size of group 1's club good is  $(\frac{1}{4} - \frac{7}{8} \frac{c}{N})N$ . The size of group 2's club good is  $(1 - \frac{(1-s_2)a}{a})N$ , which is equal to  $(\frac{1}{4} + \frac{1}{8} \frac{c}{N})N$ . Summing these, total club production is  $(\text{half} - \frac{3}{4} \frac{c}{N})N$ . The total production in the monopoly case was  $\frac{1}{2}N$ . □

*Proof of Result 3.* As noted in Result 2, the total club production is lower than in the monopoly case (for which  $s = \frac{1}{2}$ ). In the split left,  $s_1 > \frac{1}{2}$ , which means  $(1 - s_1)a < \frac{1}{2}a$ . Any individual with  $r_i > (1 - s_1)a$  is willing to contribute to either leader 1 or leader 2. If there were no free-riders, the total club production would be  $s_1N > \frac{1}{2}N$ . But we have shown that this is not the case. Because everyone with  $(1 - s_1)a < r_i < r^*$  contributes to leader 1 and everyone with  $r_i > (1 - s_2)a$  contributes to leader 2 and total club production is less than  $s_1N$ , it must be the case that  $r^*$  is strictly less than  $(1 - s_2)a$ . Thus, there are a positive number of free-riders in the group that splits to the left. □

*Proof of Result 4.* Similar to the optimization problem above, the individuals to the right of  $r^*$  choose the leader with the lowest  $s$ . I will focus on the equilibrium path, which (as above)

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<sup>1</sup>I must make the assumption of  $c < N$  to ensure  $0 \leq s_1 \leq 1$

will restrict to Case 2, with  $\underline{r} \leq (1 - s_1)a \leq r^* \leq (1 - s_2)a$ . Substituting the indifference condition into leader 2's maximization problem, the Kuhn-Tucker conditions imply that leader 2 will either choose  $s_2 = 0$  or  $s_2 = 1 - \frac{\underline{r}}{a}$ . By assumption, leader 2 is splitting to the right, so we will restrict attention to the latter case. Note that this means leader 2 chooses  $s_2$  such that  $(1 - s_2)a = \underline{r}$ . If an equilibrium exists, then there will be no free riders in leader 2's group.  $\square$

*Proof of Result 5.* Plugging in the indifference condition and  $s_2$  into leader 1's maximization problem, the Kuhn-Tucker conditions imply that  $s_1 = \frac{1}{2}$  or  $s_1 = \frac{1}{2}(1 - \frac{\underline{r}}{a} + \frac{c}{N})$ , which will be less than one half. Using  $s_1$  and  $s_2$ , we find the cut off for joining group 1 in the initial affiliation decision is a quadratic function of  $\underline{r}$  (I focus on the positive root):

$$-\frac{1}{2}\underline{r}^2 + \underline{r}\left(1 + \frac{1}{2}a - \frac{1}{2}\frac{ac}{N} - c\right) - a = 0. \quad (\text{A.8})$$

For  $\underline{r}$  to be less than  $\frac{1}{2}a$ ,  $a < \frac{4N+4cN}{-2c+N}$  and  $c < N$  and  $N > 2$ .

The value of  $\underline{r}$  that comes from these conditions induces leader 1 to choose  $s_1$  such that  $(1 - s_1)a = r^*$ . This means there are no free-riders in group 1. Provided the above conditions hold, because  $\underline{r} < \frac{1}{2}a$  and because there are no free-riders in either group, then the total production of club goods must be greater than  $\frac{1}{2}N$ , the monopoly production.  $\square$