Competition and Socially Responsible Behavior: Evidence from the Liver Transplant Market

Jason Snyder

Northwestern University

10/15/07

Job Market Paper #1

Abstract:

This paper examines the impact of competition on ethical behavior in the liver transplant market. Prior to March 1, 2002, livers were allocated by a standards based regime in which strategic misrepresentation of severity of patient illness could enhance a center's chances of performing a transplant. After March 1, 2002, a rules based allocation regime was introduced that eliminated subjective factors in the allocation of livers. Using this policy change for identification, I show that centers in highly competitive transplant markets were more willing to misrepresent patient health status in order to obtain livers for relatively healthy patients, thereby denying access to sicker patients at competing centers. Current ethical and organizational practices appear to be insufficient to deter health care providers from engaging in socially harmful behavior in competitive markets, which has implications for strategy and the design of a broad set of health care policies.

I: Introduction[1]

There is broad consensus among academics and managers that competition drives firm strategy. Increased competition causes firms to strategically respond in ways that are beneficial to both the firm and to the broader set of firm stakeholders. Strategic responses such as technology investment, lower prices, increased product quality, and increased product variety can benefit both the firm and other stakeholders. Yet competition not only induces strategic responses that are socially beneficial to stakeholders, but also can spawn unethical strategic choices that harm many of the firm's stakeholders and the greater public welfare (Staw & Szwajkowski (1975) and Shleifer (2004)). Business stealing, predatory pricing, sabotage, and dishonesty can spread across firms as strategic responses to increased competition. While these responses may yield private benefit to the firm, they may also yield market dynamics with disturbing implications. Many of these firms are competing, profiting, and surviving not on economic performance but on unethical strategies.

The key mechanism that drives the relationship between competition and unethical firm strategies is that firms are unable to commit to ethical behavior. In many interactions, if all firms could commit to eschew unethical strategies then collectively they would be better off.[2] However, if all of the other firms are behaving ethically then there are enormous incentives for any one firm to behave unethically.

---

[1] This is still early stage research. Do not cite without prior permission. This research was conducted with gracious sponsorship from the Searle Center at the Northwestern University School of Law. I would like to thank Ronen Avraham, Victor Bennett, Annalise Keen, Siona Listokin, Mary Catherine Snyder, Lamar Pierce, and Albert Yoon for useful conversations and discussions. Sarah Hagar provided outstanding research assistance. All mistakes are mine alone. Please e-mail me with questions or comments at j-snyder@law.northwestern.edu

[2] This is the prisoner's dilemma problem from game theory.

This generates a race to the bottom where the lack of commitment makes all of the firms behave unethically and leads them to be collectively worse off.

In response to this commitment problem many scholars advocate that firms respond to this problem by trying to self-regulate their behavior. Practices such as having a strong professional ethics system and lowering the intensity of incentives to engage in unethical strategies are seen as crucial steps towards cultivating an environment favorable to self-regulation. If firms in a competitive environment take steps that enable effective self-regulation, it is plausible that the impact of competition on unethical behavior would be minimized.

Uncovering evidence of ethically dubious strategies is quite difficult because these practices are usually hidden under a veil of secrecy. Firms intentionally hide unethical practices from public view to avoid legal and market-based sanctions of their strategic behavior. To study the impact of competition on unethical behavior I use a focused empirical study of the liver transplant market that uses particularly rich data, substantial variation in competition, and a shift in policy to overcome many of the hurdles in studying the impact of competition on unethical firm behavior.

Approximately 6,000 transplants are performed annually and, on average, 2,500 people die while waiting for a liver.[3] There is substantial variation in competition for livers across markets; some markets have only one firm while other markets have multiple participants. Prior to March 1, 2002, a major determinant of whether a patient would obtain a liver was whether they were in the intensive care unit (ICU). Patients in the ICU jumped to the top of the priority list regardless of

[3] See figures 1 and 2.

how sick they actually were. There is considerable anecdotal evidence suggesting that in order to obtain livers for their patients the transplant centers created faux-ICUs where relatively healthy people were put in the ICU to strategically advance their positions on the waiting list. After March 1, 2002, the allocation of livers changed to a system where livers were allocated solely on clinical indicators of sickness. ICU status was no longer a factor in determining whether a patient obtained a liver or not. This policy resulted in, if anything, an increase in the sickness of the average patient at transplant (figure 3) and a *dramatic discontinuous decrease* in the number of patients who were in the ICU at the time of their transplant (figure 4). This seemingly contradictory behavior is consistent with centers strategically misrepresenting the health of their patients prior to the policy reforms.

Using the policy change for identification, I find that after the policy changed, the use of the ICU decreased more in highly competitive markets. This is consistent with competition encouraging firms to strategically misrepresent the sickness of their patients to move them ahead on the transplant waiting list. After the policy changed the percentage of relatively healthy people in the ICU decreased markedly in competitive transplant markets. I also find that prior to the policy change, centers in competitive markets were limitedly sensitive to the sickness of patients at other centers. Centers decisions of whether to put a patient in the ICU or not were only limitedly influenced by the sickness of other patients at competing centers. Finally, I show that competition had no impact on centers that strategically misrepresented the health status of patients who might be less deserving of a liver. These results show that competition had a strong impact on unethical behavior in the liver transplant

market. The strength and consistency of the results highlight that competitive pressures can lead to unethical behaviors in industries with strong codes of ethics and a uniformly not-for-profit status. Strong government-based regulations, which change the rules of the game, may be the most effective way to reduce the impact of competitive pressures on unethical business strategies.

This paper proceeds as follows: Section II reviews the relevant literature. Section III describes the relevant institutions and some qualitative evidence. Section IV develops the hypotheses. Section V discusses the identification strategy and summarizes the sample. Section VI presents the results, and Section VII concludes.

II: Prior Literature

There has been some prior literature on the impact of competition on ethical behavior.[4] Staw & Szwajkowski (1975) and Shleifer (2004) present a straightforward argument on how competition can increase unethical behavior. They define unethical behavior as "a behavior that is morally sanctioned by the larger community but can improve firm performance." Unethical behavior on the part of competitors forces the firm to behave unethically even if the firm places some value on ethical behavior.[5]

There have been various approaches to the empirical study of the impact of competition on unethical behavior. Hegarty and Sims (1978) provide some of the

[4] There is an exceptionally large literature on ethics in business which is beyond the scope of this paper. See Ford & Richardson (1994), Loe, et. al (2000), and Trevino, et. al (2006).

[5] This is part of the more general argument that ethical behavior is endogenous to social circumstances. Milgram (1963) and Trevino et. al (2006). Scalet (2006) provides an intriguing argument that it might not always be optimal to design institutions to solve ethical induced by competition.

first evidence linking competition to unethical behavior in the laboratory setting. They find a strong result indicating that competition increases unethical behavior, but the laboratory setting is of concern when trying to generalize the results. In contrast, in a survey of sales person behavior Dubinsky and Ingram (1984) find no significant evidence of competition influencing ethical behavior. It is difficult to take this work as definitive due to the difficulties that are pervasive in using surveys in this area. Cai, et al. (2007) find a positive association between increases in competition and an increase in tax avoidance activity among Chinese manufacturers. This current paper is similar to Cai in that both empirical studies that show the importance of competition as an explanation of unethical behavior. The current study is distinctive because many of the factors that suggest self-regulation can work are absent in Cai, et al.'s work on Chinese manufacturers.

There is a small economics literature studying the impact of the opportunity to engage in business stealing practices on market entry. These papers demonstrate in a variety of settings that free entry can be inefficient when the entrant's business plan is to steal incumbent's business rather than generate new value.[6]

There are also a set of studies in the healthcare literature that look at the impact of incentives[7] on ethical behavior. Dafny (2005) provides a useful framework for dividing this literature into two areas: nominal responses to incentives and real responses. The work on nominal responses focuses on how price changes in reimbursement rates provide incentives for hospitals to change their diagnosis. This behavior essentially redistributes wealth from the insurance providers to the hospital

[6] See Hsieh and Moretti (2003), Berry and Waldfogel (1999), and Davis (2006)
[7] These studies to my knowledge ignore competition as a driver of ethical behavior.

without providing additional services. Carter, et. al (1990), Dafny (2005), Silverman and Skinner (2004), and Psaty, et. al. (1999) find that as the relative reimbursement rates for treatments change, hospitals respond by moving to more lucrative diagnoses.[8]

This literature also studies how real responses, such as treatment choices, are affected by financial incentives. In an influential paper Gruber and Owings (1996) show that an increase in reimbursements for cesarean sections is associated with an increase in the number of cesarean sections performed by obstetricians. Cutler (1995) and Gilman (2000) additionally find evidence of a positive association between reimbursement rate and procedure intensity, as measured by length of stay or number of procedures performed. However, the results are not ubiquitous. Dafny (2005) finds little evidence of increases in reimbursements leading to changes in length of stay, procedure volume, or survival rates.

This paper contributes to the literature in two ways. First, the ethical dilemma is much more intense in liver transplants than in other markets. Second, none of these studies looks at the impact of competition on ethical behavior.[9] One could easily imagine that when the potential for harm is high a relatively small number of hospitals could find ways to cooperate so as to avoid giving a liver to a relatively healthy patient. Professional codes of ethics and not-for-profit organizational status are major factors that could push these centers to cooperate. This paper shows that even with a limited number of competitors and muted incentives, many centers act unethically.

[8] Vaughn (1983) provides a detailed case study on Medicare fraud that is related to this empirical literature.
[9] There is a literature on how hospital competition influences other outcomes (health, costs, etc.). See Dranove, et. al. (1992), Kessler and McClellan (2000), and Kessler and Geppert (2005).

III: Institutional Background

In the United States the demand for liver transplants exceeds the supply of available livers. Figure 1 shows that the number of liver transplants has risen steadily to approximately 6,000 transplants per year. Figure 2 shows there is still a significant gap, as more than 2,000 people die each year waiting for a liver. Occasionally part of a liver can be given from a living donor to a patient in need, but the risk associated with this procedure is high. Over 95% of all liver transplants come from deceased donors.

Liver transplants are performed by over 100 centers in the United States, and each center is part of a hospital. The procurement and distribution of deceased donor livers is handled by 49 geographically designated Organ Procurement Organizations (OPOs). The OPOs are not run by specific hospitals and each center is a member of only one OPO. When an OPO obtains a liver suitable for transplant, the centers within the OPO have first priority to that organ. Most of the time the liver remains within the OPO. If there is not a patient sick enough within the OPO the liver is occasionally distributed to a hospital within another OPO. There is considerable variation in availability of livers across different OPOs. In some OPOs it is relatively easy to get a liver and in others it is difficult.[10] These boundaries are maintained in part for political reasons; areas with a relatively good supply of organs are reticent to share them with other parts of the country. Within each OPO there

[10] Trotter and Osgood (2004) document this fact.

are a variety of market structures; some OPOs only have one center that provides liver transplants, and others have multiple transplant centers. When a patient needs a liver, they join the waiting list that is specific to a particular center. While a patient can be listed at multiple centers for a liver transplant, in practice this is rare. There are certain compatibility concerns based on blood type. The matching requirements tend to not be as severe as those for kidney transplants.

Prior to March 1, 2002, livers were allocated on both objective and subjective criteria.[11] Patients were allocated livers based on clinical and subjective measures of illness, how long they have been on the waiting list, and whether they were in the ICU or not. The system was criticized for creating numerous incentives and opportunities to manipulate who gets a liver. Centers could put potential patients on the waiting list years before they would actually need a liver so as to inflate their waiting time. Many of the subjective indicators could also be manipulated. For example, one of the subjective indicators transplant centers were required to measure was the severity of ascites, which is an accumulation of fluid in the abdomen. Without an invasive surgery measurement of this condition is subjective and left considerable discretion to the centers.[12]

Crucially, putting someone in the ICU improved their priority status, even over those who had more time on the waiting list. There was some anecdotal evidence that ICU admission was being used strategically. The most salient case involved the University of Illinois' liver transplant program in the highly competitive

[11] See the Institute of Medicine's 1999 report for a detailed discussion of the allocation prior to the policy change.
[12] In response it is widely believed that most centers gave almost everyone a high score. The data to confirm this observation unfortunately does not exist.

Chicago liver transplant market. It was claimed that "according to the Chicago Tribune, some of the patients [in the ICU] at the University of Illinois Medical Center spent weekends at home, one acted the part of a clown at a blood drive, and another was at a restaurant having dinner when he got word that a suitable liver had been located. Authorities alleged that one patient on the list was not even eligible for transplantation" (Murphy 2004).[13] Centers could use the ICU strategically by admitting patients who were not critically ill so as to move them ahead on the list. The University of Illinois was eventually fined two million dollars by Medicare for this abuse of the transplant system. These behaviors are consistent with this paper's hypothesis that competition leads to unethical strategic behavior.

In response to these problems, the United Network for Organ Sharing completely changed the allocation policy by instituting the Model for End-Stage Liver Disease (MELD) allocation policy.[14] The MELD policy was instituted March 1, 2002. The MELD allocation policy for livers is based on a linear combination of three clinical indicators: serum bilirubin, INR, and serum creatinine. These factors combined to create a continuous MELD score that is strongly associated with severity of liver disease. Higher MELD scores reflected higher expected mortality rates for patient with end stage liver disease absent a transplant. After the policy change, waiting list time and ICU status were no longer considered in the allocation of livers. Priority was now based on clinical indicators that came from blood tests, which are markedly more difficult indicators to manipulate.

[13] Also see Transplant News 11/30/2003

[14] For more details on the policy change and some of its direct effects see Freeman (2003), Freeman et al. (2002), Trotter and Osgood (2004), and Wiesner, et al. (2003)

IV: Hypothesis development

Using the logic of Staw & Szwajkowski (1975) and Shleifer (2004) I propose a simple framework for analyzing the impact of competition on strategic misrepresentation in the liver transplant market. Prior to the policy change within an OPO with multiple competitors it is sensible to believe that strategic use of the ICU by centers to move patients ahead on the list can be a rational outcome, absent the ability to commit to ethical strategies. If one center in an OPO decided not to engage in strategically using the ICU, that center would face the prospect of losing opportunities to perform liver transplants. More centers should lead to more competition. After the policy change the impact of competition on strategic use of the ICU should be eliminated. This leads to the following hypothesis:

Hypothesis 1: After the policy change, the rate of ICU usage should decrease more in OPOs with more competition.

A natural point of concern is that areas with more competitors may also have sicker patients on average. If the patients are sicker in more competitive areas then hypothesis 1 could be true without strategic manipulation. This can be addressed in a number of ways. First, it is possible to control for the underlying number of sick patients on the waiting list. Secondly, I can construct an objective clinical measure of illness at time of transplant. This measure can be used to examine what the threshold for admission to the ICU was. If strategic manipulation was present prior to the policy change then in competitive areas there would be a higher likelihood that

relatively healthy patients would be in the ICU at transplant. If the policy change eliminated the incentives for this behavior then:

Hypothesis 2: After the policy change the rate of relatively healthy patients in the ICU should decrease more in OPOs with more competition.

To further test the mechanisms described above it is possible within competitive markets to test the sensitivity of transplant centers to the sickness of patients at competing centers. A center's waiting list is composed of patients who are fairly healthy and those who are severely sick. Without a liver the severely sick patients will die soon. If centers fully internalize the impact of admitting a patient to the ICU on the chances of patients at competing centers getting a liver, then a center's share of severely sick patients should be equivalent to its share of ICU usage. A center that has 10% of the severely sick patients in an OPO on their waiting list should account for approximately 10% of the patients admitted to the ICU prior to transplant. This is a one-to-one relationship between share of severely sick patients and percentage of patients admitted to the ICU. If centers make the determination based on factors like the strategic manipulation of the allocation process then this relationship would be skewed away from a one-to-one relationship between the share of sick patients in an OPO and the percentage of patients admitted to the ICU. After the policy change the only reason to admit a patient to the ICU would be their level of sickness, which leads to the following hypothesis:

Hypothesis 3: After the policy change the relationship between a center's share of severely sick patients and it's share of ICU usage should be a one-to-one relationship.

Additionally, for similar reasons we might believe that there are ethical reasons to prioritize one set of patients over another. A substantial number of patients acquire liver disease through excessive consumption of alcohol, while others contract it as a consequence of activities that are beyond their control. There is considerable debate in the transplant community as to whether or not these patients deserve a liver, because there is a popular perception that many of them will return to drinking after they get a transplant. It is sensible to believe that centers may prioritize patients who have liver disease due to misfortune over those whose liver disease is a consequence of alcoholism. In competitive markets this preference could be reversed, and as competition increases a center's willingness to perform transplants will not be contingent on the etiology of the patient's liver disease.

Hypothesis 4: After the policy change the percentage of patients who acquired liver disease as a consequence of alcoholism should decrease in more competitive markets relative to less competitive markets.

V: Data & Sample Selection

The data for this project comes from a comprehensive database on every liver transplant performed in the United States from the middle of 1987 to the end of 2006 maintained and provided free of charge from the United Network for Organ Sharing (UNOS). This patient level data includes observations when (A) a patient registers for the waiting list, (B) a patient gets a transplant, and (C) if a patient dies. In this data there is clinical information sufficient to create a MELD score for each patient,

identification of the center where the patient was wait-listed and received their transplant at, when they were wait-listed and transplanted, demographic data, cause of liver disease, and whether they were in the ICU or not at transplant. From this data I was able to incorporate the identity of the OPO with each center based on data publicly available on the UNOS website. Even though the data is at the patient level all of the data is collapsed to the OPO/Month level or the Center/Month level.

To study the impact of the change in allocation policy I restrict the sample to one year before and one year after the policy shift. This intuitive sample selection procedure allows for a sharp before and after difference in differences study. Since the vast majority of liver transplant programs are based in universities, I define a center based on the university affiliations of the surgeons, not based directly on the center identifiers. For example in Chicago both Northwestern Memorial Hospital and Children's Memorial Hospital are in the Northwestern University system. The transplant teams in both of these hospitals work together and the surgeons at both institutions are Northwestern faculty members. For the purposes of this study I consider both hospitals as one center and merged all of the other children's hospitals in with their parent university.

Another difficulty with the data was that there were many observations where the MELD score could not be computed because one of the three clinical indicators was missing. To address this problem I created predicted MELD scores at transplant when one or two of the clinical factors were missing. Though this is not desirable it provides a useful way to incorporate more than 98% of the data into the analysis.

The remaining observations where no MELD score could be computed for a transplant recipient were dropped.

VI: Empirical Strategy

To test hypotheses 1-4 I compare how the number of firms in an OPO influences the key outcome variables: ICU usage rates, percentage of healthy patients in the ICU, share of patients in the ICU, and percentage of patients with liver disease as a consequence of alcoholism. This comparison is done in two ways: in the cross section and through a difference in differences approach. In the cross section I look at how competition across markets impacts the outcomes before and after the policy change. A common objection to a cross sectional approach is that omitted fixed characteristics at the OPO level drives the results. To address this concern I estimate how firms in competitive markets *respond* to the change in policy. If there was more strategic manipulation of the waiting list in competitive markets, then, for example, we would expect a decrease in the percentage of patients who were admitted to the ICU relative to less competitive markets.

To examine the impact of market structure on the different sets of outcomes in the cross section before and after the policy shift I use the following estimator at the OPO/Month level:

$$(1)\ \text{Outcome}_{i,t} = \beta_1 \text{FirmCount}_i + \beta_2 \text{SickRatio}_{i,t} + \text{Region}_i + \text{Month}_t$$

Here *FirmCount* is the number of distinct centers active during the two-year sample period in a given OPO. While the count of the number of firm's in an OPO is a crude measure of market competition, it has the advantage of being plausibly

exogenous. One could use a Herfindahl index based on number of transplants performed, but the distribution of transplants is likely to be endogenously determined by the behaviors of moving patients into the ICU strategically. Additionally it may be important to measure the presence of a small player in the market since they could threaten the positions of the other firms in the market. *SickRatio* is the monthly ratio of severely sick people in an OPO relative to the number of livers available in the OPO in a given month. Severely sick is the number of patients on the waiting list who are in immediate need of a liver. A patient on the waiting list is classified as being severely ill if either (A) they die within 6 months waiting for a liver or (B) they are transplanted within 3 months and have a MELD score greater than or equal to 25.[15] Dividing the number of severely sick patients by the number of livers in the market provides a single variable that captures the excess demand in an OPO. If the ratio is greater than one, that means for any given month there are more people who are in critical need of a liver than there are livers available. The *Month* variable is a fixed effect for each month in the sample, so the same calendar month in separate years have separate fixed effects. *Region* is a fixed effect that controls for 11 different regions of the country.

To partially obviate the concerns about using a cross sectional approach I employ a difference in differences estimation strategy:

$$(2)\ Outcome_{i,t} = \beta_1 FirmCount_i + \beta_2 SickRatio_{i,t} + \beta_3 MELDera_t * FirmCount_i + \beta_4 MELDera_t * SickRatio_{i,t} + OPO_i + Month_t$$

[15] MELD scores of 25 or greater are commonly associated with very sick patients. The results are robust to changes in these thresholds.

Here the identification of the impact of competition on the outcome of interest is measured by the β_3 parameter. This measures how OPOs with different numbers of firms respond to the policy change where *MELDera* equals zero before the policy change and equals one afterwards. Since there are dummies for each month the main effect of *MELDera* is absorbed. If the cross sectional results indicate an effect of competition on the outcome but there is no difference in the response to the policy shift the evidence would be far less compelling. Since the variation in the market structure of the OPOs does not change over time when the OPO fixed effects are included the parameter β_1 will be absorbed. However the interaction effect is still identified.

There are further worries about specification (2) that could pollute the validity of the regressions. First if there are different trends in the movement of the outcome variable of interest at the OPO level that could lead to an omitted variables bias. While the month fixed effects absorb the common changes over time to the entire system, they do little to address changes at the OPO level. While it would be ideal to add OPO specific month effects, this would absorb all of the variation to observe the parameter of interest β_3. One compromise is to allow for linear trends at the OPO level. I create a linear term for months centered at zero for March 2002 and going backwards and forwards one unit for each month difference. Though this imposes a linear structure on the trends, it is much less restrictive than not allowing for any OPO specific time changes.

In other specifications I relax the assumptions on the crucial control variable *SickRatio* by not imposing a linear structure and instead creating quartile fixed effects.

This means that the 25% of OPOs with the lowest average *SickRatio* (as computed over the two year span of the sample period) are given a common fixed effect, the next 25% are given a separate fixed effect, and so forth. In some specifications I interact these fixed effects with the MELD era dummy and the OPO fixed effects. The intention of this strategy is to estimate the β_3 parameter while flexibly controlling for the level of scarcity in a given market.

As a final robustness test I include a specification that interacts *MELDera* and *Region* to further allow for flexible time effects across geographically connected OPOs.

While most of the results use the prior two specifications, to test hypothesis 3 I change the analysis from the OPO level to the center level. For this table I use the following specification:

$$\text{(3) Center Share of ICU Patients}_{i,t} = \beta_1 \text{Center Share of Sick Patients}_i + \beta_2 \text{MELDera}_t * \text{Center Share of Sick Patients}_i + \text{Center}_i + \text{Month}_t$$

If centers are sensitive to the needs of sick patients in the OPO who are not listed at their particular center we would expect the share of sick patients to be equal to the share of OPO level ICU usage absent strategic manipulation. This would imply that $\beta_1=1$ and $\beta_2=0$. Like the prior set of specifications linear trends are used to estimate the inherent trends at the center level and OPO fixed effects are interacted with the *MELDera* variable estimate the results within the center's OPO.

All of the results are estimated using clustering at the OPO or center level depending on the unit of analysis. This addresses the problem of serial correlation without which the regression would assume that each observation is independent.

VII: Results

VII.1: Summary Statistics

Figures 3 & 4 tell a compelling story. In Figure 3 the average MELD score at transplant is computed on a monthly basis. It is difficult to determine whether there is a discontinuous jump in the average sickness at transplant, but it is clear that sickness of patients at transplant is increasing over time. Prior to the policy change the average MELD score was 18.3 and after the policy shifts the average MELD score was 19.8. While the average sickness of patients at transplant was increasing over time Figure 4 shows that there was a large discontinuous drop in ICU admissions. Intuitively one would think the opposite: as patients are getting sick they should appear in the ICU more on average. Strategic manipulation of the allocation process leads to the opposite conclusion, when the incentive to place a patient in the ICU decreases the usage of the ICU decreases overall. This occurs despite the fact that patients are getting sicker over time.

In Table 2 the market structure of the 49 OPOs is described. Approximately 40% of the OPOs had only one transplant center while only 12% of the OPOs had more than 3 centers. This variation in the market structure over the two-year sample period makes for an ideal sample to study the effects of increased competition on strategic manipulation.

VII.2: Hypothesis 1 test

Table 3 presents the basic results on the percentage of transplanted patients who come from the ICU. The results are consistent with hypothesis 1. In column

(1) the cross sectional results from the year before the policy shift shows a strong association between the number of firms in an OPO and the percentage of transplanted patients coming from the ICU. Column (2) shows the same regression for the year following the policy shift. The impact of the number of firms in an OPO has decreased and is no longer significant. Additionally the ratio of sick patients to livers available is positive but insignificant.[16]

Columns (3)-(6) show a variety of specifications estimating whether the difference between the firm count parameters in column (1) and (2) are significant. Column (3) presents the most basic difference in differences specification to test the significance of the difference between the parameter estimates of *Firmcount* in columns (1) & (2). The parameter estimate of the interaction between *MELDera* and *Firmcount* suggest that for each additional firm 3.2% less of the patients are in the ICU at transplant after the MELD policy shift. Taken together with Figure 4 this shows that the fall in the use of the ICU was most dramatic in areas with the strongest competition, implying that competition was a strong driver of strategic manipulation. The specifications in (4)-(6) address the various threats to identification that revolve around OPO specific time trends or omitted variables bias due to differences in the underlying degree of in scarcity. The parameter estimate on the interaction between *firm count* and *MELDera* is quite stable across specifications and is always highly significant.

[16] In unreported results this relationship is significant at the 10% confidence level when the regression is run without the region fixed effects. Recall that since these results are clustered at the OPO level it is as if there were only 49 observations, which leads seemingly strong relationships to be insignificant due to power issues.

Table 4 shows basic results on the correlations between the number of firms and the change in the average MELD score within an OPO. This table shows that the impact of additional firms on the average sickness of patients at transplant is small and insignificantly different from zero in all of the specifications.[17] Nevertheless, absent a statistically significant positive result, one could argue that there was simply a global decrease in ICU admissions, and it happened to be higher in more competitive areas because the increases in patient sickness at transplant was lowest in the more competitive areas. This does suggest that, on average, competition had little impact on average sickness of patients at transplant.

VII.3: Hypothesis 2 test

One major difficulty with looking at the average MELD score at transplant is that while manipulation may be present, the average MELD score may not be exceptionally revealing since the majority of transplants occur when patients are not close to being in the ICU. It would be more informative to look at the admission threshold to get into the ICU. Does competition lead to relatively healthier people being admitted to the ICU? To operationalize this point I look at the percentage of patients who were in the ICU at transplant who had a MELD score less than or equal to 15. Merion et. al. (2004) shows that patients who have a MELD score below 15 have a lower one-year survival rate if they get a liver transplant. This scientifically validated cut point is provides a convenient way to test whether the ICU was being used for patients who really didn't need to be there. In Table 5

[17] Of tangential interest is the result on the impact of the sick ratio of the selection of patients. This shows that after the MELD policy change the association between scarcity and average sickness increased dramatically. This again suggests that the MELD policy prevented distortions to the stated allocation of policy of giving livers to the sickest individuals first.

columns (1) & (2) suggest that prior to the MELD reforms the percentage of cases coming from the ICU that were relatively healthy was higher in the more competitive areas. After the reform the threshold for admission to the ICU equalized across market structures. Again the difference in differences specifications in columns (3) – (6) confirms this intuition. After the MELD reforms competitive areas were much more likely to reduce the percentage of patients in the ICU that were relatively healthy.

VII.3: Hypothesis 3 test

Hypothesis 3 asks whether sensitivity to the need of other center's waitlists impacts a center's use of the ICU. Even if competition implies an increase in strategic use of the ICU, centers still could only use it in proportion to their need. Column (1) of table 6 shows that on average, a one percent increase in the share of severely ill patients at the OPO level is associated with a .4% increase in the share of ICU admissions prior to the MELD era. However, as predicted, in column (2) this result almost exactly implies a one-to-one relationship between share of severely ill patients and share of transplants coming from the ICU. Absent the ability to strategically manipulate the list, ICU admissions behave in a very predictable manner. Columns (3) – (6) show that this difference is significant and robust to a variety of alternative specifications. In total this evidence suggests that prior to the MELD reforms sensitivity to the plight of other patients was partially muted when centers made their ICU admissions decisions.

VII.4: Hypothesis 4 test

Table 7 examines whether competition induces differences in the patients selected for transplantation. Hypothesis 4 conjectured that competition might erode the reticence of centers to transplant patients whose liver disease is a consequence of alcoholism. Results in Table 7 show no evidence consistent with this result. Competition has no impact on the percentage of patients transplanted with liver disease as a consequence of alcoholism. This does not change before or after the policy reform. It appears that this type of ethical dimension of competition is of little relevance.

The appendix table shows that waitlisting behavior was not influenced by competition. This is possibly due to the fact that in contrast to putting someone in the ICU, putting an individual on the waiting list early is relatively costless. Therefore more or less competitive centers would be equally likely to use this practice even if the benefits were different.

VIII: Conclusions

This paper shows that competition appears to be robustly associated with increases in strategic behavior in the liver transplant market prior to the MELD reforms. The findings suggest that when centers are faced with opportunities to re-allocate livers from the patients of other centers to their own patients, these opportunities were taken. While there was little evidence to suggest that this distorted the average level of sickness of patients at transplant, I found that prior to the reforms competition encouraged centers to use the ICU more often for patients that were relatively

healthy. I also show that prior to the MELD reforms the salience of the plight of patients at competing centers only had a limited impact on a center's use of the ICU. There is no evidence to suggest that competition changed hospital behavior in terms of which patients they deemed worthy of transplant.

These findings have important implications for strategy and policy. From the strategy side it suggests that even when the climate appears to be ripe for self-regulation organizations may not implement such regulations without added factors. To generate the type of commitment that would ensure that no firm behaves unethically involves much stronger measures than ethics and muted incentives alone. In the case of liver transplants the only solution was stronger regulatory reforms. Within firms these results point to competition and subjective information disclosure as being strong substitutes. For managers that rely on soft information divisional competition can undue the veracity this information.

This paper also has results that can inform healthcare policy. If, in the current system, healthcare providers are willing to supply health gains to their own patients at the expense of larger health gains to competitor's patients then this has important implications for the design of many healthcare institutions. Regulating the allocation of scarce healthcare resources crucially depends on an understanding of the extent of the influence of competition on ethical behavior.

Bibliography

Berry, S. T., and J. Waldfogel. "Free Entry and Social Inefficiency in Radio Broadcasting." *Rand Journal of Economics* 30, no. 3 (1999): 397-420.

Cai, H., Q. Liu, and G. Xiao. "Does Competition Encourage Unethical Behavior? The Case of Corporate Profit Hiding in China." 2007.

Carter, G. M., J. P. Newhouse, and D. A. Relles. "How Much Change in the Case Mix Index Is Drg Creep." *Journal of Health Economics* 9, no. 4 (1990): 411-28.

Cutler, D. M. "The Incidence of Adverse Medical Outcomes under Prospective Payment." *Econometrica* 63, no. 1 (1995): 29-50.

Dafny, L. S. "How Do Hospitals Respond to Price Changes?" *American Economic Review* 95, no. 5 (2005): 1525-47.

Davis, P. "Measuring the Business Stealing, Cannibalization and Market Expansion Effects of Entry in the Us Motion Picture Exhibition Market." *Journal of Industrial Economics* 54, no. 3 (2006): 293-321.

Dranove, D., M. Shanley, and C. Simon. "Is Hospital Competition Wasteful." *Rand Journal of Economics* 23, no. 2 (1992): 247-62.

Dubinsky, A. J., and T. N. Ingram. "Correlates of Salespeoples Ethical Conflict – an Exploratory Investigation." *Journal of Business Ethics* 3, no. 4 (1984): 343-53.

Duggan, M. G. "Hospital Ownership and Public Medical Spending." *Quarterly Journal of Economics* 115, no. 4 (2000): 1343-73.

Ford, R. C., and W. D. Richardson. "Ethical Decision-Making - a Review of the Empirical Literature." *Journal of Business Ethics* 13, no. 3 (1994): 205-21.

Freeman, R. B. "Meld/Peld: One Year Later." *Transplantation Proceedings* 35, no. 7

(2003): 2425-27.

Freeman, R. B., R. H. Wiesner, A. Harper, S. V. McDiarmid, J. Lake, E. Edwards, R. Merion, R. Wolfe, J. Turcotte, and L. Teperman. "The New Liver Allocation System: Moving toward Evidence-Based Transplantation Policy." *Liver Transplantation* 8, no. 9 (2002): 851-58.

Gilman, B. H. "Hospital Response to Drg Refinements: The Impact of Multiple Reimbursement Incentives on Inpatient Length of Stay." *Health Economics* 9, no. 4 (2000): 277-94.

Gruber, J., and M. Owings. "Physician Financial Incentives and Cesarean Section Delivery." *Rand Journal of Economics* 27, no. 1 (1996): 99-123.

Hegarty, W. H., and H. P. Sims. "Some Determinants of Unethical Decision Behavior – Experiment." *Journal of Applied Psychology* 63, no. 4 (1978): 451-57.

Hsieh, C. T., and E. Moretti. "Can Free Entry Be Inefficient? Fixed Commissions and Social Waste in the Real Estate Industry." *Journal of Political Economy* 111, no. 5 (2003): 1076-122.

Institute of Medicine. *Organ Procurement and Transplantation: Assessing Current Policies and the Potential Impact of the Dhhs Final Rule*, 1999.

Kessler, D. P., and J. J. Geppert. "The Effects of Competition on Variation in the Quality and Cost of Medical Care." *Journal of Economics & Management Strategy* 14, no. 3 (2005): 575-89.

Kessler, D. P., and M. B. McClellan. "Is Hospital Competition Socially Wasteful?" *Quarterly Journal of Economics* 115, no. 2 (2000): 577-615.

Loe, T. W., L. Ferrell, and P. Mansfield. "A Review of Empirical Studies Assessing

Ethical Decision Making in Business." *Journal of Business Ethics* 25, no. 3 (2000): 185 204.

Merion RM et al. “The survival benefit of liver transplantation.” *American Journal of Transplant* 4 (2004)

Milgram, S. "Behavioral-Study of Obedience." *Journal of Abnormal Psychology* 67, no. 4 (1963)

Murphy, T. F. "Gaming the Transplant System." *American Journal of Bioethics* 4, no. 1 (2004)

Psaty, B. M., R. Boineau, L. H. Kuller, and R. V. Luepker. "The Potential Costs for Upcoding for Heart Failure in the United States." *American Journal of Cardiology* 84, no. 1 (1999)

Scalet, S. "Prisoner's Dilemmas, Cooperative Norms, and Codes of Business Ethics." *Journal of Business Ethics* 65, no. 4 (2006): 309-23.

Shleifer, A. "Does Competition Destroy Ethical Behavior?" *American Economic Review* 94, no. 2 (2004): 414-18.

Silverman, E., and J. Skinner. "Medicare Upcoding and Hospital Ownership." *Journal of Health Economics* 23, no. 2 (2004): 369-89.

Staw, B. M., and E. Szwajkowski. "Scarcity-Munificence Component of Organizational Environments and Commission of Illegal Acts." *Administrative Science Quarterly* 20, no. 3 (1975): 345-54.

Transplant News "University of Illinois, Chicago Settles Lawsuit Alleging Liver Transplant Waiting List Improprities." 11/30/2003 2003.

Trevino, L. K., and M. E. Brown. "Managing to Be Ethical: Debunking Five Business

Ethics Myths." *Academy of Management Executive* 18, no. 2 (2004): 69-81.

Trevino, L. K., G. R. Weaver, and S. J. Reynolds. "Behavioral Ethics in Organizations: A Review." *Journal of Management* 32, no. 6 (2006): 951-90.

Trotter, J. F., and M. J. Osgood. "Meld Scores of Liver Transplant Recipients According to Size of Waiting List - Impact of Organ Allocation and Patient Outcomes." *Journal of the American Medical Association* 291, no. 15 (2004): 1871-74.

Vaughn, D. *Controlling Unlawful Organizational Behavior: Social Structure and Corporate Misconduct*. Chicago: University of Chicago Press, 1983.

Wiesner, R., E. Edwards, R. Freeman, A. Harper, R. Kim, P. Kamath, W. Kremers, J. Lake, T. Howard, R. M. Merion, R. A. Wolfe, and R. Krom. "Model for End-Stage Liver Disease (Meld) and Allocation of Donor Livers." *Gastroenterology* 124, no. 1 (2003): 91 96.

Figure 1: Number of liver transplants from 1999 to 2006

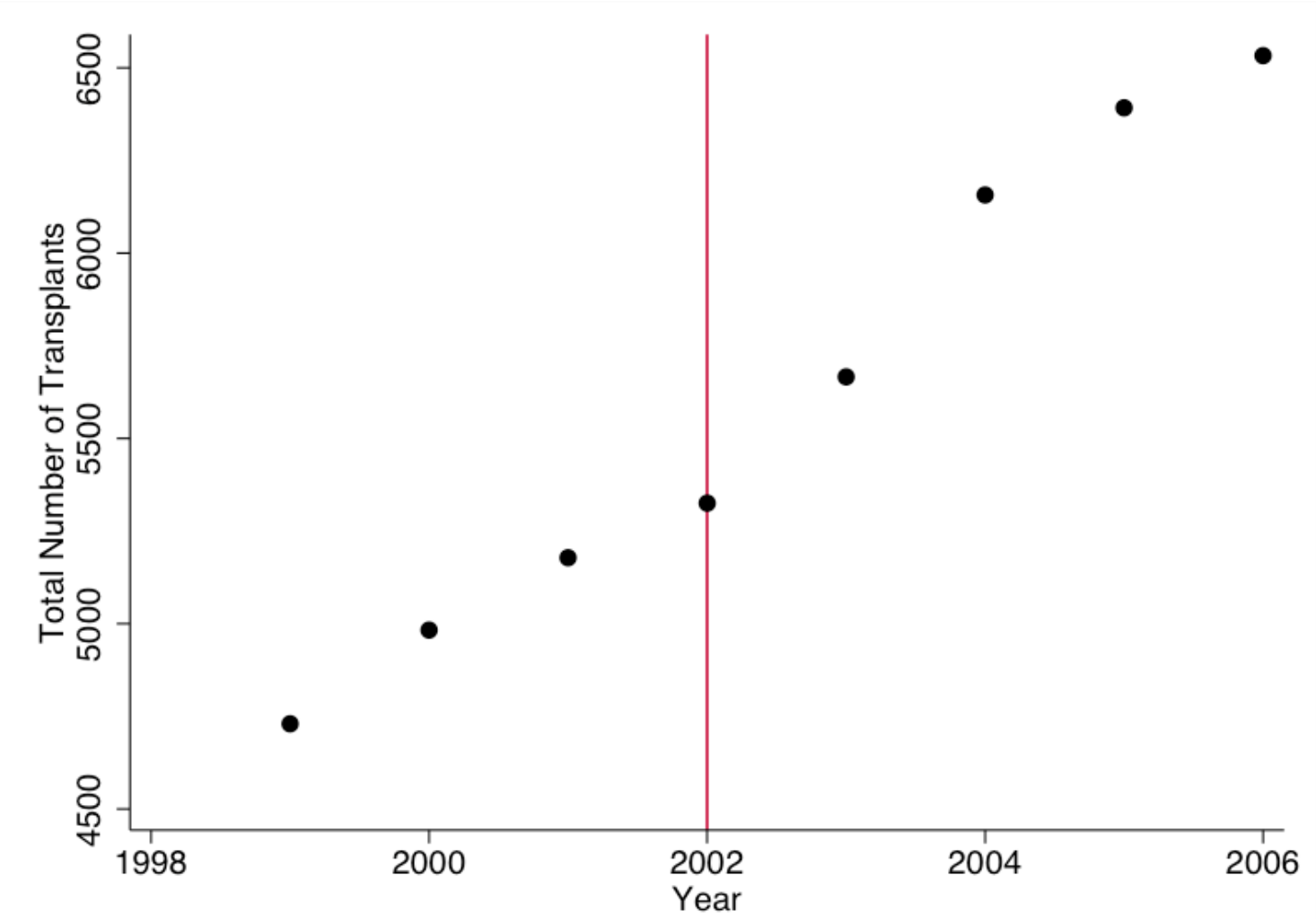


Figure 2: Number of deaths on the waiting list from 1999 to 2006

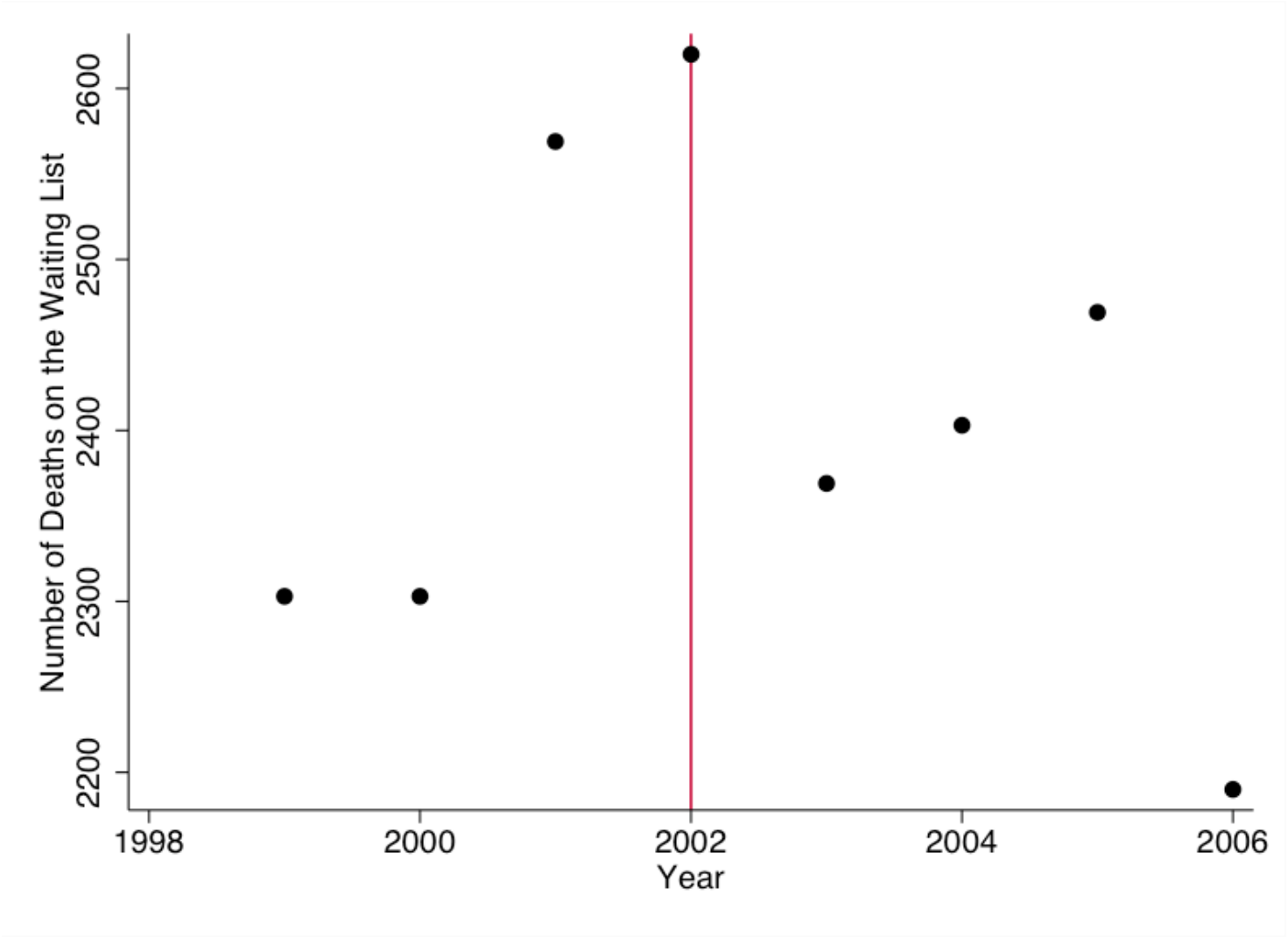
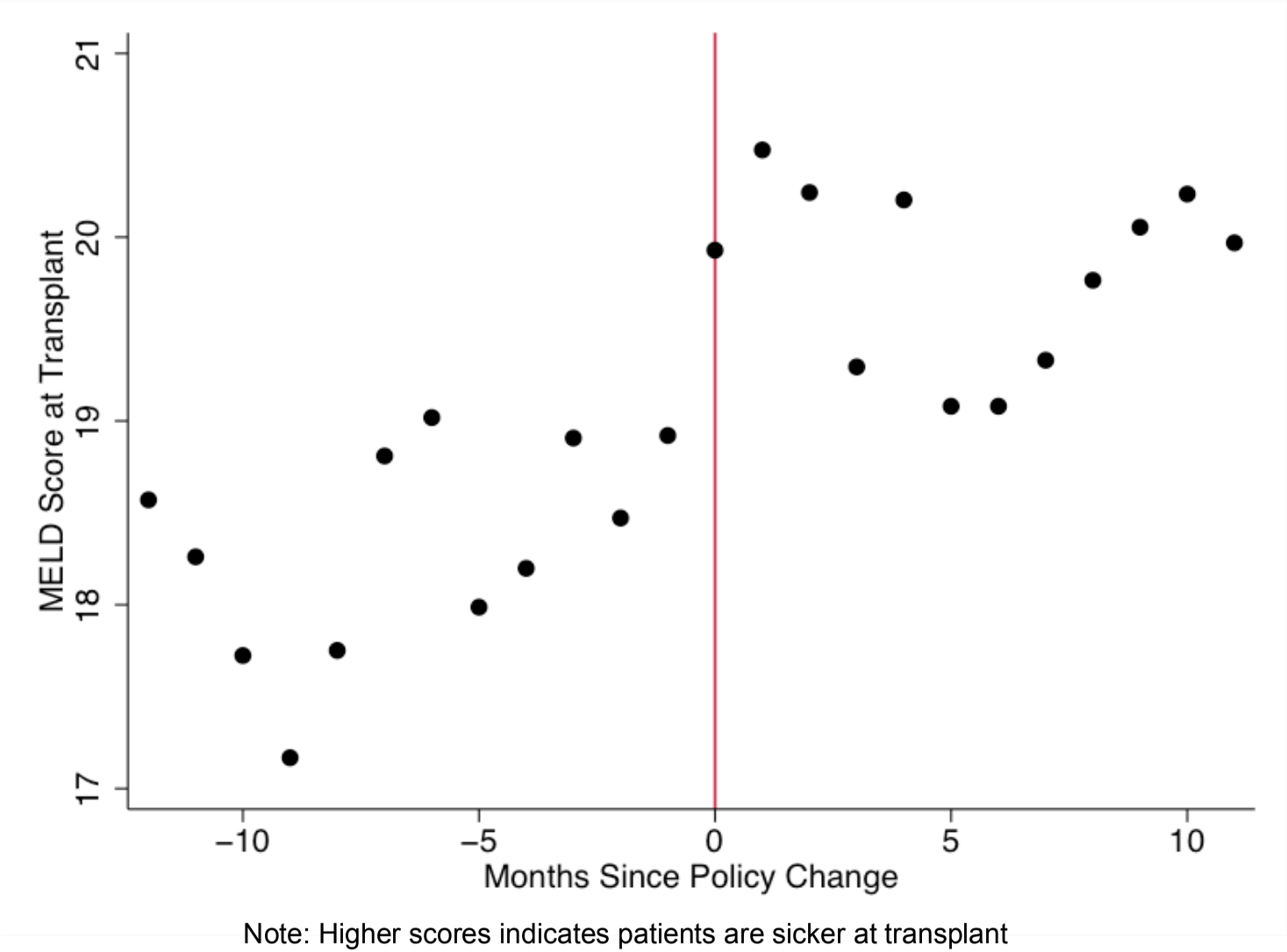


Figure 3: Sickness of patients at transplant



Note: Higher scores indicates patients are sicker at transplant

Figure 4: Percentage of patients in the ICU at time of transplantation

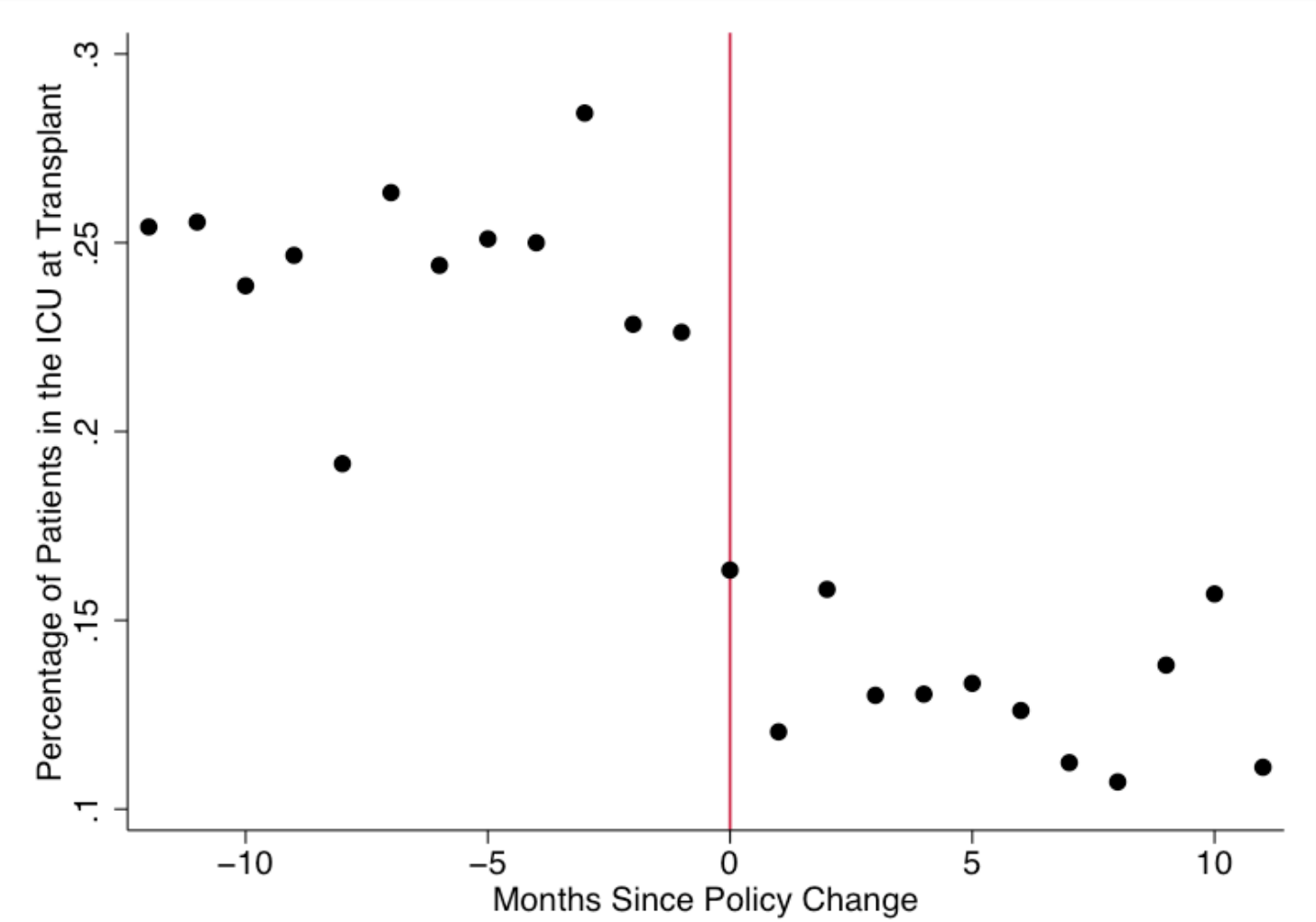


Table 1: Summary statistics

	Pre-MELD Era	Post-MELD Era
Total number of liver transplants	5212	5361
Percentage of patients coming from the ICU	24.41%	13.28%
Mean predicted MELD score at transplant	18.3	19.8
Percentage of patients on dialysis at transplant	5.51%	8.41%
Percentage of patients with alcoholic liver disease at transplant	16.77%	15.44%
Average monthly number of patients who are severely sick	891.33	920.08

Table 2: Distribution of firm counts across OPOs

Number of Centers	Frequency	Percentage
1	20	40.82%
2	19	38.78%
3	4	8.16%
4	3	6.12%
5	2	4.08%
6	1	2.04%
Total	49	100%

Table 3: The impact of competition on the percentage of patients transplanted from the ICU

	(1)	(2)	(3)	(4)	(5)	(6)
	ICU rate	ICU rate	ICU rate	ICU rate	ICU rate	ICU rate
Firm count	.043 (.013)***	.011 (.009)	Absorbed	Absorbed	Absorbed	Absorbed
MELD era * firm count			-.032 (.008)***	-.049 (.013)***	-.039 (.016)**	-.046 (.016)***
Ratio of severely sick patients to livers available	.004 (.008)	.004 (006)	.009 (.011)	.009 (.007)		
MELD era * ratio of severely sick patients to livers available			-.001 (.01)	.009 (.009)		
Era	Pre-MELD	Post-MELD	Both	Both	Both	Both
Region fixed effects	Yes	Yes	Absorbed	Absorbed	Absorbed	Absorbed
OPO fixed effects	No	No	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Linear month term * OPO fixed effects	No	No	No	Yes	Yes	Yes
Month fixed effects * region fixed effects	No	No	No	Yes	No	No
MELD era * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
OPO fixed effects * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
MELD era * region fixed effects	No	No	No	Absorbed	No	Yes
Number of observations	567	570	1137	1137	1137	1137
Number of clusters	49	49	49	49	49	49

Note: Standard errors clustered at the OPO level. * significant at 10% confidence level, ** significant at 5% confidence level, *** significant at 1% confidence level.

Table 4: The impact of competition on the average predicted MELD score of patients transplanted at the OPO level

	(1)	(2)	(3)	(4)	(5)	(6)
	MELD score	MELD score	MELD score	MELD score	MELD score	MELD score
Firm count	.23 (.26)	.025 (.25)	Absorbed	Absorbed	Absorbed	Absorbed
MELD era * firm count			-.117 (.54)	-.497 (.454)	-.515 (.506)	-.442 (.512)
Ratio of severely sick patients to livers available	-.065 (.183)	.702 (.133)***	-.018 (.219)	.021 (.182)		
MELD era * ratio of severely sick patients to livers available			.696 (.247)***	.696 (.241)***		
Era	Pre-MELD	Post-MELD	Both	Both	Both	Both
Region fixed effects	Yes	Yes	Absorbed	Absorbed	Absorbed	Absorbed
OPO fixed effects	No	No	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Linear month term * OPO fixed effects	No	No	No	Yes	Yes	Yes
Month fixed effects * region fixed effects	No	No	No	Yes	No	No
MELD era * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
OPO fixed effects * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
MELD era * region fixed effects	No	No	No	Absorbed	No	Yes
Number of observations	567	570	1137	1137	1137	1137
Number of clusters	49	49	49	49	49	49

Note: Standard errors clustered at the OPO level. * significant at 10% confidence level, ** significant at 5% confidence level, *** significant at 1% confidence level.

Table 5: The impact of competition on the percentage of relatively health patients in the ICU

	(1) % in ICU with MELD score ≤ 15	(2) % in ICU with MELD score ≤ 15	(3) % in ICU with MELD score ≤ 15	(4) % in ICU with MELD score ≤ 15	(5) % in ICU with MELD score ≤ 15	(6) % in ICU with MELD score ≤ 15
Firm count	.117 (.022)***	-.003 (.021)	Absorbed	Absorbed	Absorbed	Absorbed
MELD era * firm count			-.087 (.036)**	-.17 (.075)**	-.134 (.062)**	-.194 (.071)***
Ratio of severely sick patients to livers available	-.006 (.011)	-.023 (.014)*	-.016 (.013)	-.025 (.022)		
MELD era * ratio of severely sick patients to livers available			-.017 (.013)	-.004 (.039)		
Era	Pre-MELD	Post-MELD	Both	Both	Both	Both
Region fixed effects	Yes	Yes	Absorbed	Absorbed	Absorbed	Absorbed
OPO fixed effects	No	No	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Linear month term * OPO fixed effects	No	No	No	Yes	Yes	Yes
Month fixed effects * region fixed effects	No	No	No	Yes	No	No
MELD era * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
OPO fixed effects * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
MELD era * region fixed effects	No	No	No	Absorbed	No	Yes
Number of observations	387	320	707	707	707	707
Number of clusters	48	47	48	48	48	48

Note: Standard errors clustered at the OPO level. * significant at 10% confidence level, ** significant at 5% confidence level, *** significant at 1% confidence level. Notice that the number of observations decreases because OPO/Months with no ICU admissions are dropped.

Table 6: Center level sensitivity to the sickness of patients at other centers

	(1) Share of ICU transplants	(2) Share of ICU transplants	(3) Share of ICU transplants	(4) Share of ICU transplants	(5) Share of ICU transplants
Center share of severely sick patients	.435 (.115)***	1.005 (.182)***	.535 (.095)***	.509 (.100)***	.421 (.107)***
MELD era * center share of severely sick patients			.068 (.036)*	.173 (.072)**	.348 (.13)***
Era	Pre-MELD	Post-MELD	Both	Both	Both
Center fixed effects	Yes	Yes	Yes	Yes	Yes
OPO fixed effects	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Linear month term * center fixed effects	No	No	No	Yes	Yes
MELD era * OPO fixed effects	No	No	No	No	Yes
Number of observations	883	747	1630	1630	1630
Number of clusters	97	96	97	97	97

Note: Standard errors clustered at the center level. * significant at 10% confidence level, ** significant at 5% confidence level, *** significant at 1% confidence level.

Table 7: The impact of competition on the percentage of patients with liver disease as consequence of alcoholism at transplant

	(1) % of alcohol related cases	(2) % of alcohol related cases	(3) % of alcohol related cases	(4) % of alcohol related cases	(5) % of alcohol related cases	(6) % of alcohol related cases
Firm count	-.015 (.007)**	-.02 (.007)***	Absorbed	Absorbed	Absorbed	Absorbed
MELD era * firm count			-.003 (.007)	.007 (.019)	.011 (.014)	-.0002 (.006)
Ratio of severely sick patients to livers available	-.003 (.004)	.006 (.0006)	-.004 (.005)	-.004 (.004)		
MELD era * ratio of severely sick patients to livers available			.009 (.008)	.008 (.009)		
Era	Pre-MELD	Post-MELD	Both	Both	Both	Both
Region fixed effects	Yes	Yes	Absorbed	Absorbed	Absorbed	Absorbed
OPO fixed effects	No	No	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Linear month term * OPO fixed effects	No	No	No	Yes	Yes	Yes
Month fixed effects * region fixed effects	No	No	No	Yes	No	No
MELD era * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
OPO fixed effects * OPO sickness ratio quartile effects	No	No	No	No	Yes	Yes
MELD era * region fixed effects	No	No	No	Absorbed	No	Yes
Number of observations	567	570	1137	1137	1137	1137
Number of clusters	49	49	49	49	49	49

Note: Standard errors clustered at the OPO level. * significant at 10% confidence level, ** significant at 5% confidence level, *** significant at 1% confidence level.

Appendix Table 1: OPO level impact of competition on the size of the waiting list for a liver transplant

	(1)	(2)	(3)	(4)
	Log (OPO list size)	Log (OPO list size)	Log (OPO list size)	Log (OPO list size)
Firm count	.664 (.094)***	.668 (.094)***	Absorbed	Absorbed
MELD era * firm count			.004 (.014)	.016 (.009)*
Era	Pre-MELD	Post-MELD	Both	Both
Region fixed effects	Absorbed	Absorbed	Absorbed	Absorbed
OPO fixed effects	No	No	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes
Linear month term * OPO fixed effects	No	No	No	Yes
Month fixed effects * region fixed effects	No	No	No	Yes
Number of observations	588	588	1176	1176
Number of clusters	49	49	49	49

Note: Standard errors clustered at the OPO level. * significant at 10% confidence level, ** significant at 5% confidence level, *** significant at 1% confidence level.