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ABSTRACT

Using novel survey data on technology licensing, we report the first empirical evidence linking the three main sources of failure emphasized in the market design literature (lack of market thickness, congestion, lack of market safety) to deal outcomes. We disaggregate the licensing process into three stages and find that although lack of market thickness and deal failure are correlated in the first stage, they are not in the latter stages, underscoring the bilateral monopoly conditions under which negotiations over intellectual property often occur. In contrast, market safety is only salient in the final stage. Several commonly referenced bargaining frictions (congestion) are salient, particularly in the second stage. Also, universities and firms differ in the stage during which they are most likely to experience deal failure.

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1 Introduction

Many innovative firms face the strategy decision of whether to engage in the ideas market (e.g., licensing out their innovation) or to compete downstream in the product market (Teece, 1986; Gans and Stern, 2010). The ideas market is playing an expanding role in economic growth and the diffusion of knowledge. Its size has increased by more than three times between 1995 and 2002 in terms of transaction value (Arora and Gambardella, 2010). Robbins (2006) estimates domestic income from licensing intellectual property (IP) in the United States was approximately $50 billion in 2002, and Arora and Gambardella (2010) estimate the global market for technology was about $100 billion in the same year.[1] In addition to the potentially high social and private gains to trade, a well-functioning market for ideas can facilitate vertical specialization; for example, many biotechnology firms specialize in upstream idea production and sell them downstream to pharmaceutical firms that specialize in marketing and distribution. Furthermore, a well-functioning ideas market can improve the efficiency of resource allocation decisions and direct R&D effort through pricing information in contrast to in-house allocation decisions made by fiat.

However, growing anecdotal evidence suggests the market for ideas is prone to failure. In other words, many potentially surplus-enhancing transactions fail to occur. In terms of scale, Rivette and Klein (2000) claim "a staggering $1 trillion in [ignored] intellectual property asset wealth" is foregone in the U.S. We present survey data where a quarter of the firms claim they are likely to license less than 50% of their potentially licenceable inventory of IP. To explain this phenomenon, economists and management scholars have identified various information asymmetry problems, such as Arrow's Paradox (Arrow, 1962), moral hazard (Arora, 1996), and hold-up problems (Pisano, 1991), that are often associated with

[1] Both Robbins (2006) and Arora and Gambardella (2001) assume the proportion of technology licensing, as opposed to licensing of trademarks, copyrights, and packaged software, is the same as that in cross-border transactions, which implies licensing of industrial processes amounts to $66 billion. Of this, around $50 billion is earned domestically. Arora and Gambardella (2010) assume the US accounts for 60% of the global market for technology, which implies the global market for technology in 2002 was about $100 billion.

technology licensing.

Moreover, given the economic significance of the market for ideas, it is perhaps surprising we know relatively little about how it functions. In traditional markets, we typically evaluate transactions based on information on prices and quantities in competitive settings. However, with a few exceptions on university licensing, data in the ideas market is generally quite poor. Furthermore, it is unclear what should be the appropriate benchmark used to evaluate technology transactions.

The market design literature (Roth, 2007, 2008) identifies three primary market features associated with efficient market operation: 1) market thickness (buyers and sellers have opportunities to trade with a wide range of potential transactors), 2) non-congestion (transaction speed is sufficiently rapid to ensure market clearing but slow enough to allow participants to seek alternatives), and 3) market safety (agents do not have incentives for misrepresentation or strategic action that undermines the ability of others to evaluate potential trades). Gans and Stern (2010) consider well-established economic properties of the technology sector in the context of these market design principles and conclude that licensing is particularly susceptible to market failure since these three features are often lacking.

For the first time, to our knowledge, we bring licensing data to shed light on sources of deal failure in the ideas market in the context of the Roth (2007, 2008) and Gans and Stern (2010) frameworks (hereafter, RGS). Furthermore, we divide the licensing process into three stages - 1) identifying a buyer/seller, 2) initiating negotiations, and 3) reaching an agreement - which enables us to better describe when the relationship between each of the market design features and deal failure is most salient. We find market thickness is salient only in the first stage; identifying a licensee is harder when the market is thin. Perhaps more surprising is that market thickness is not correlated with deal success in the two latter stages. This underscores the bilateral monopoly conditions under which licensing negotiations often occur (Anton and Yao, 1994; Gans and Stern, 2000). Market safety, on the other hand, is only correlated with deal success in the final stage of reaching an agreement. We speculate this may be due to the

dynamics of legal due diligence. Bargaining frictions, our operationalization of "congestion," are correlated with deal failure in the (second) negotiation stage. In particular, we find the firms most likely to fail to initiate negotiations are the ones with higher perceived costs of due diligence. This may be because they have less experience or in-house capability and thus a higher marginal cost to carry out due diligence.

We also examine how organization type (universities versus firms) and industry type (Healthcare versus Software & Electronics) mediates the relationship between market features and deal failure. Universities are more likely to experience deal failure in the first stage of the licensing process, perhaps due to the embryonic nature of their inventions (Jensen and Thursby, 2001). However, they are less likely to experience deal failure in the final stage of the process, perhaps due to the incentives faced by technology transfer offices and faculty (Lach and Schankerman, 2008; Thursby and Thursby, 2002). We also find in the final stage healthcare firms are more harmed than IT firms by a lack of market safety, perhaps because IT firms rely less on formal patent protection and more on rapid innovation and versioning.

Overall, we offer three contributions in this paper. First, we provide the first empirical evidence (correlations) relating market features to deal outcomes in the context of licensing, exploiting firm-level variation in market features and deal success. We cannot make causal claims concerning how a specific feature, such as lack of market thickness, *causes* deal failure since our data is cross-sectional and also based on perception rather than action (survey data). Nevertheless, our correlations offer evidence consistent with the causal mechanisms suggested by theory, and the provision of these basic empirical facts stand in contrast to the general paucity of data on licensing in general and on deal failures in particular. In terms of prior research, other papers have focused on how certain factors, such as the presence of multiple technology holders (Fosfuri, 2006), patent effectiveness (Arora and Ceccagnoli, 2006), and institutional prestige (Sine, Shane, and Di Gregorio, 2003), affect a firm's propensity to license. However, these papers do not empirically examine the relationship between the three main market features highlighted in the market design literature and the rate of

deal success. Anand and Khanna (2000) provide one of the few econometric investigations into the rate of licensing. However, their study is aggregated at the sector level; they do not examine firm-level differences in licensing rates.

Our second contribution is that we identify three distinct stages in the licensing process based on expert interviews and then use this disaggregation of the process to describe variation in the timing of when each market feature is most relevant. Finally, we show how the relationship between market features and deal failure is mediated by organization type (universities versus firms) and industry type (Healthcare versus Software & Electronics) in ways that can be explained by their economic properties.

2 Stages of the Licensing Process

We categorize licensing activities into three discrete stages based on interviews with experts at LES: 1) identifying a buyer/seller, 2) initiating negotiations, and 3) reaching an agreement. Each of these stages is itself complex. For example, with respect to the second stage, in advance of a negotiation, a party may spend many months defining business objectives, assessing leverage, researching the other party, deciding positions on key terms, and protecting intellectual property (IP), among other tasks. In addition, each negotiating party needs to decide on its legal counsel and which parties to bring to the table (WIPO, 2004). Even so, we believe dividing the process into the three stages provides significant insights. Thus, we present a loose theoretical explanation of how various market features may come into play at different stages of the licensing transaction. While our intention is to provide a useful and illustrative framework for thinking about discrete elements of the licensing process, what follows is neither exhaustive nor rigorous.

Stage 1: Identifying a buyer/seller A market is thick if it brings together a large enough proportion of potential transactors at the same time (Roth, 2007, 2008). If the market is thin, a natural implication is, all else equal, the likelihood of finding potential buyers or sellers is

lower. Anecdotal evidence suggests finding a potential licensor or a licensee largely relies on old-fashioned word-of-mouth networking and research (Licensing Executives Society, 2009). "Individuals may not know about particular needs or know the right individuals to contact ... Because that process relies heavily on personal networking, it may take up to 18 months (or more) to find a buyer and to negotiate a deal" (Yet2.com).[2] Given that the first stage of the licensing process we examine is related to finding potential parties to transact with, it is straightforward to show thickness is likely an important market feature in the first stage. Whether market thickness plays a role in latter stages depends on the degree to which competition can influence negotiations. Gans and Stern (2010) suggest the influence of potential outside parties is limited because the value of the idea declines when the seller negotiates with multiple buyers.

Stage 2: Initiating negotiations Early in the bargaining process, the main transaction cost stems from acquiring sufficient information about the deal. Given the heterogeneity of ideas for sale, one of the main challenges that arises is the cost of conducting due diligence on the "fair" price to pay for the technology and evaluating its potential market prospects. This process is often lengthy and expensive. It typically involves both parties signing non-disclosure agreements and gathering public and private data to evaluate the technology, the IP, and various terms of the contract. Whereas licensing a tangible object, such as a house, also faces substantial heterogeneity in the products available, it is relatively straightforward to assess the relevant attributes of the product because many comparable transactions are on the market. In contrast, substantial information asymmetry exists when licensing technology. Furthermore, licensing is typically conducted on a bilateral basis, which means both parties agree to limit contact with other potential buyers and sellers for a certain amount of time. While a seller can conduct due diligence on the buyer by examining the kinds of products it has brought to the marketplace and how successful they have been (Licensing Executives Society, 2009), both parties cannot fully assess outside alternatives due to bilateral secrecy, so

[2]Yet2.com is one of the leading online marketplaces for technology.

there is often significant uncertainty regarding the "fair" price for an idea of a given quality. Indeed, Lemley and Myhrvold (2008) label the market for patents as "blind." "Want to know if you are getting a good deal on a patent license or technology acquisition? Too bad" (Lemley and Myhrvold, 2008). Given the cost and difficulty of conducting due diligence on an IP deal in a bilateral environment, many prospective buyers and sellers are reluctant to start substantive negotiations and are often slow to enter into an agreement (Licensing Executives Society, 2009). Not surprisingly, some buyers purchase an option, or an exclusive right, to assess the idea before starting negotiations. Otherwise, the only viable option in a bilateral environment is to start negotiations in good faith.

Later in the bargaining process, the main transaction cost stems from contracting problems and opportunism. Once negotiations begin, a variety of contracting problems can arise that may lead to negotiation breakdown. As a result of bounded rationality, both parties cannot foresee all the contingencies that might arise and incorporate them into the contract (Williamson, 1999). In particular, disagreements over financial and non-financial terms of the deal, such as the scope of the IP, can lead to bargaining breakdown. Having multiple parties at the negotiating table can also hold-up the deal and delay reaching an agreement. Standard setting committees (e.g., patent pools) are examples where multiple parties act in concert for the purpose of standard setting. However, participants in standard setting organizations (SSOs) often have private agendas, which may cause a delay in reaching a consensus (Simcoe, 2008). On the flip side, deals may break down if one or more parties find better alternatives, or deals may expire if both parties cannot reach an agreement in time. Even though offers may be left open for less time to encourage reaching an agreement, such exploding offers can result in inefficient "matches" or deal failure if the offer expires. These different transaction costs arising from the bargaining process capture the key dimensions of congestion as described by RGS.

Stage 3: Reaching an agreement In the last stage of the licensing process where substantive negotiations have started, important details regarding the technology are revealed to all

parties. The paradox of disclosure becomes salient because revealing the idea to multiple sellers also reduces the individual valuation of the idea by each seller (Arrow, 1962). Without market safety (i.e., effective IP protection), information about each party's preferences can be exploited. When information about market participants' preferences or type can be exploited, both buyers and sellers tend to disclose this information strategically (Gans and Stern, 2010). For instance, sellers may be unwilling to disclose aspects of their idea due to expropriation concerns, and buyers have an incentive to walk away from the table and expropriate the invention by themselves. Effective intellectual property protection increases the likelihood that market participants will disclose their preferences truthfully and minimizes the likelihood they will engage in ex post opportunistic behavior once the seller reveals important details of the idea in the course of negotiation. Thus, having market safety increases the likelihood negotiations will reach an agreement.

3 Empirics

3.1 Data

We use the 2006 annual survey conducted by the Licensing Foundation, the charitable and educational arm of the Licensing Executives Society (LES) (USA & Canada), which we co-designed with subject experts from the Foundation. The Foundation's purpose is to develop an improved understanding of the "industry" of licensing in North America. It serves companies and organizations that create IP and technology directly or are IP asset owners, rather than professional services firms (legal, consulting, etc.). The survey focuses on asking organizations to provide information about their organization and its licensing activity. We administered the survey via email with a link to an online form we built using SurveyMonkey.com. For a detailed description of the data, see Razgaitis (2006) and Berneman, Cockburn, Agrawal, and Iyer (2009). What is particularly interesting about the

2006 survey is that a central theme is impediments to licensing. The data are at the firm-level, and survey responses provide an interesting and, to our knowledge, unique window into how organizations perceive licensing challenges and the extent to which such challenges affect their licensing activities.

We provide descriptive statistics in Table 1. We survey 600 technology-oriented organizations. While the sample is not unrepresentative of LES membership, we cannot conclude it is representative of a random sample of licensing firms. The firms in our sample come from a variety of industries and are relatively large; the average firm in our sample has annual revenues between $1 billion and $10 billion, an R&D budget between $200 million and $500 million, and between 5,000 and 10,000 employees. These firms represent a variety of industries, including Energy (11%), Healthcare (44%), Software & Electronics (11%), Transportation (3%), and Universities (28%). Not all respondents answer every survey question, which is reflected in the varying number of observations across different variables (Table 1). The response rate tends to drop further into the survey, although the response rate for questions regarding deal success and sources of bargaining breakdown is around 70%. Conditional on participating in the survey, we do not find any obvious differences in industry affiliation and firm size between responders and non-responders.

3.2 Measures

Our analysis focuses on when each market failure highlighted by RGS is salient during the licensing process. All dependent variables are binary measures that equal 1 if the percentage is greater or equal to the median response category, and 0 otherwise. We construct all of our variables from discrete categories of survey responses (Appendix B). Each dependent variable corresponds to a measure of deal success at a specific stage of the licensing process. The three dependent variables are operationalized as follows:

Level of unlicensed IP with at least one potential licensor/licensee. In the first stage of

the licensing transaction, firms seek to identify potential buyers or sellers. Our measure of deal success is the level of the organization's unlicensed IP where they are able to identify a potential buyer or seller. The survey asks respondents: "Thinking about intellectual property that could have been licensed in the last 12 months but wasn't, for what percentage was your organization able to identify at least one potential licensee/licensor?" Note this measure focuses on IP the organization is *willing and able* to license. IP the firm cannot or will not license is, at least in principle, excluded. The preceding survey questions ask respondents to identify the percentage of their entire inventory of IP they would never license voluntarily and the percentage they would like to license but cannot. Thus, we attempt to exclude "junk patents" from this measure.

Level of negotiations started. We measure deal success in the second stage by the fraction of negotiations started after buyers or sellers were identified. The survey asks respondents: "Where potential licensees/licensors were identified, in what percentage of cases were substantive negotiations ever started?"

Level of agreements reached. We measure deal success in the third stage by the fraction of negotiations that resulted in an executed agreement. The survey asks respondents: "Of all the times you entered into substantive licensing negotiations in the last 12 months, what percentage resulted in a successful agreement?"

Our key explanatory variables correspond to the market features outlined by RGS:

Level of market thickness. Market thickness is a difficult phenomenon to measure and is highly context-specific. Here, we measure lack of market thickness by whether respondents agree to the statement that: "There are usually fewer potential buyers/sellers for the IP [relative to tangible assets]." The variable takes on a value of 1 if the respondent agrees, and 0 otherwise. This measure roughly corresponds with RGS's definition of market thickness.

Bargaining frictions (congestion). We capture different types of transaction costs that arise during the bargaining process, some of which correspond to key dimensions of congestion described by RGS. Early in the bargaining process, the main transaction cost arises

from acquiring sufficient information. As a result of the heterogeneity of ideas available on the market and the cost of observing comparable transactions, substantial information asymmetry exists, hence the cost and difficulty of conducting due diligence in the absence of a multilateral exchange environment. As with market thickness, these costs are not easy to measure directly, and again we look to responses to questions that compare licensing transactions to transactions in tangible assets: "Due diligence will be much more difficult/costly for the IP deal [relative to tangible assets]." The variable takes on a value of 1 if the respondent agrees, and 0 otherwise.

Later in the bargaining process, key transaction costs are associated with opportunism and contracting problems. As noted by Gans and Stern (2010), the degree of congestion is related to whether exchanges take place in the shadow of an endogenous outside option for both parties. This is reflected by either deal breakdown due to better alternatives emerging for one or more parties or time running out before a deal is completed. We measure these bargaining frictions by responses to some of the survey questions that ask respondents to identify reasons for negotiation breakdowns. For example: "Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to 'better alternatives emerged for one or more parties' or 'delay (i.e., the clock ran out)."' Respondents answer by choosing between several discrete response categories (0%, 1-5%, 5-25%, 25-50%, 50-75% ,75-99%, 100%); we use the mid-point of these ranges.

We also examine other potential sources of bargaining breakdown, such as disagreement over financial and non-financial terms, having too many parties at the table, legal and regulatory problems, poor negotiating skills, lack of trust, and ego (Appendix B).

Lack of market safety. We measure a lack of market safety by responses to the question: "Of the IP that your organization would like to license but cannot, approximately what fraction would you say is not effectively protectable by patents, trade secrets, etc.?" This measure corresponds closely to the RGS definition because effective intellectual property

protection increases the likelihood that market participants will disclose their preferences truthfully, minimizing the likelihood they will engage in ex post opportunistic behavior once the seller reveals important details of the idea during the course of a negotiation. As before, respondents answer by choosing between discrete response categories, and we use the midpoint of these ranges.

We control for a number of factors that may affect our key relationships.

Demand for IP. One concern when estimating the relationship between market thickness and market failure is that we might be confounding a thin market with a lack of demand for IP. The distinction is that a market can have a low volume of transactions even in the presence of many potential buyers and sellers due to low demand for a particular technology. We control for this using responses to the following question: "Of the IP that your organization would like to license but cannot, approximately what fraction would you say has no discernible demand from end-users?"

Organization size. To address the concern that large firms might be better at participating in the ideas market because they have more resources to find buyers and sellers and enforce effective IP protection, we include four measures of firm size: revenue, R&D budget, number of employees, and number of licensing professionals employed.

Industry. Similarly, some industries may have institutions that facilitate more effective use of the ideas market. For example, firms in the biotechnology and pharmaceutical industries have traditionally conducted negotiations on a bilateral basis (Gans and Stern, 2000), whereas semiconductor firms have not historically relied heavily on patents to appropriate the returns to R&D (Hall and Ziedonis, 2001), which may suggest they have other ways of ensuring market safety. We include five industry indicator variables that take on a value of 1 if the firm's focal activities are in that industry: Energy, Software & Electronics, Healthcare, Transportation, and University & Government. The latter is the omitted category in all specifications.

3.3 Empirical strategy

As discussed above, the cross-sectional nature of our data does not allow us to identify causal relationships. Instead, we use correlations to gain insights into our research question. The main estimating equation is:

$$DealSuccess_i = \beta_1 Lack of MarketThickness_i + \beta_2 Lack of MarketSafety_i + \beta_3 BargainingFrictions_i + \gamma FirmSize_i + \delta Industry_i + \epsilon_i,$$

where $DealSuccess_i$ measures the level of deal success for organization i at a particular stage of the licensing process. The main parameters of interest, $\beta_1, \beta_2, and \beta_3$, represent the estimated effect of a lack of market thickness, bargaining frictions, and a lack of market safety, respectively, on measures of deal success. $FirmSize$ represents a vector of variables that captures the size of the organization, as described above. Similarly, $Industry$ represents a vector of industry dummies. We report average marginal effects from probit models and employ robust standard errors in all our specifications, although the key findings are robust to alternative probability models and samples.[3]

[3]In models not presented in the paper, we run additional regressions using linear probability models, logit models, and ordered probit models, each with both binary and continuous versions of the main independent variables. We also run an ordered probit model with known thresholds, which allows us to accurately specify the thresholds of our survey response categories rather than treating them as unknown (see http://www.applied-ml.com/download/amldoc.pdf). In order to alleviate concerns of respondents specific propensities to answer high or low on rating scales, we jointly estimate the effect of market features on all three stages of the licensing transaction with a random respondent effect common across all three equations. We also try logged transformations of our dependent variable to ensure we are not estimating beyond the survey category boundaries (e.g., less than 0% or greater than 100%). Our results are largely consistent across all models and specifications.

4 Results

4.1 Descriptive evidence

Before turning to regression analysis, we present summary statistics to provide some basic intuition on the relationship between each of the three market features and deal success in each stage of the licensing process. We categorize firms based on the degree of deal success. We classify a firm as having high deal success if the measure of deal success is greater than the median percentage category. We present the means of our measures of lack of market thickness, lack of market safety, and bargaining frictions for each of the three dependent variables, respectively, in Tables A1-A3 in Appendix A. In almost all cases, firms in the low-deal success category are more likely to experience market thinness, lack of market safety, and bargaining frictions, relative to firms in the high-deal success category. However, the relative magnitude in differences of means varies for each dependent variable, suggesting the relative importance of market thickness, bargaining frictions, and market safety varies at each stage of the licensing process.

4.2 Main results: Market features and licensing stages

We now turn to our regression analysis for a more nuanced examination of the link between market features and deal failure. In Table 2, we consider each of the three discrete stages of the licensing process, respectively: 1) identifying a potential buyer/seller, 2) initiating negotiations, and 3) reaching an agreement. The dependent variable in each table corresponds to our measure of an organization's success rate at each stage of the licensing process: 1) the level of unlicensed IP with at least one potential licensor/licensee identified, 2) the rate at which negotiations are started once potential licensors/licensees are found, and 3) the fraction of negotiations started that ultimately results in a completed agreement. Each column includes controls for demand for IP, firm size, and industry.

4.3 Market thickness

Our results are consistent with our main conjectures about the structural features of the ideas market. Lack of market thickness appears to be most important in the first stage of the licensing process since it is the only market feature correlated with deal success at this stage and is not significant in any other stage. It is not surprising that lack of market thickness is associated with lower deal success in the first stage given that it is more difficult to identify potential transactors when the market is thin. Perhaps more interesting is that lack of market thickness is not correlated with deal success in the latter stages. This underscores the bilateral monopoly conditions under which licensing negotiations often occur. Indeed, Gans and Stern (2010) point out that "detailed negotiations over the precise terms and conditions of a license take place in a bilateral rather than multilateral environment...Each potential buyers' value may depend on whether other buyers have had access to the technology or not (since rival access would allow competitors to expropriate some portion of the value by imitating technology)" (page 820). In other words, although many negotiations are influenced by the shadow of competition, rivalry curtails the influence of potential outside parties and limits the ability of participants to consider alternative offers. We find evidence consistent with Gans and Stern that these negotiations take place in conditions of bilateral monopoly since lack of market thickness is not correlated with deal success during the negotiation phase. Another though not mutually exclusive explanation is that parties that anticipate deal failure in the later stages of negotiations due to market thickness issues avoid initiating interactions at the outset and so select out of the process in advance.

4.4 Market safety

Lack of market safety is most salient in the third stage. In this last stage of the licensing process, where substantive negotiations have started, the seller reveals material information about the technology. This is likely due to the dynamics of legal due diligence. Due to

its cost, many firms only engage in due diligence after they have determined the general feasibility of reaching an agreement. Negotiating parties may be less likely to reach an agreement when sellers are hesitant to provide full disclosure due to expropriation risk (or buyers are hesitant to pay after they have appropriated), consistent with Arrow's Paradox (Arrow, 1962). Thus, effective market safety in the form of IP protection provides a way to limit such behavior ex ante. Interestingly, firms do not seem to anticipate market safety issues since it is not correlated with deal success in the first two stages.

4.5 Bargaining frictions

Various bargaining frictions are correlated with deal failure in the negotiation stage. In particular, we find firms most likely to fail to initiate negotiations are the ones with higher perceived costs of due diligence. An implication of conducting deals in the market for intangibles relative to the product market is that participants face higher levels of uncertainty and heterogeneity regarding the prospects of a deal. As a result, market participants face a higher cost of conducting due diligence, which is exacerbated by the bilateral exchange environment. Thus, even if potential buyers and sellers of IP have been identified, participants are less likely to initiate negotiations and reach deal completion if the marginal cost of carrying out due diligence is high. Consistent with expectations, the inability to arrive at mutually acceptable financial terms as well as too many parties at the table are also salient frictions in the second stage. In the third stage, frictions associated with legal/regulatory problems are salient. Again, market participants do not seem to anticipate these problems, since these frictions are not correlated with deal failure in the first stage of the licensing process (identifying a buyer/seller). Also, we do not find evidence that "delay" and "better alternatives emerged for one or more parties" to be correlated to our measures of deal success. Furthermore, frictions related to behavioral elements, such as "lack of trust," "poor negotiating skills," and "ego," although often cited by practitioners as common sources of

deal failure (LESI, 2002), are not associated with reported rates of deal success at any stage. Taken together, this suggests that bargaining frictions in licensing are mainly shaped by the cost of assessing the deal in a bilateral environment.

4.6 Selection

A natural concern when observing a lower level of deal success in the first stage is that the unlicensed IP is of low quality. If this is true, then poor-quality deals, rather than a lack of market thickness, are associated with low-deal success. After all, the skewness of ideas has long been established (Scherer, 1965). We take a step towards addressing this concern by limiting the sample to firms that have at least 5-25% of negotiations reaching an agreement (Table 3). By focusing on firms that achieve a minimum level of agreements, we reduce the concern that high rates of deal failures early on are mainly attributable to a preponderance of low-quality IP in the firm's portfolio. The estimated coefficients using this restricted sample are similar to those generated from using the full sample. Further, raising the threshold to firms with at least 25-50% of negotiations reaching an agreement does not change the main findings. In results not presented in the paper, we also jointly estimate the effect of market features on all three stages of the licensing transaction with a random respondent effect common across all three stages, which accounts for underlying unobserved respondent heterogeneity across the three stages. The results are largely consistent.

4.7 Mediating factors: Organization type and industry effects

Finally, we explore how the relationship between deal failure and market features is mediated by organization type (Universities versus Firms) and industry type (Healthcare versus Software & Electronics). Jensen and Thursby (2001) document that university technologies are often licensed at an "embryonic" stage, frequently even before patent applications are filed. We find universities are less likely than firms to be able to identify potential buyers

for their IP (Table 4, Column 1). This is likely due to greater difficulties in establishing product-market fit due to the early-stage nature of their inventions. The predicted probability of deal success in the first stage is roughly 20% less for universities compared to firms; in other words, university technologies are more likely to be orphaned. However, conditional on finding a buyer to transact with, universities are 31% more likely to reach an executed agreement relative to firms in the final stage (Column 3). We speculate this has to do with the different incentives (both pecuniary and intrinsic) faced by faculty, technology transfer officers, and university administrators, which are distinct on several dimensions from the incentives faced by firms (Lach and Schankerman, 2008; Thursby and Thursby, 2002). Not only do many universities count utilization, as opposed to profit maximization, as a primary objective, they also do not consider downstream product market competition an alternative to licensing for extracting rents from their intellectual property, unlike many firms.

In Table 5, we restrict the sample to only Healthcare and IT (Software & Electronics) firms. Ideally, we would like to compare just Healthcare and Software industries. Unfortunately, we do not have enough variation from the limited number of firms in the latter industry. We know from prior literature healthcare and IT operate quite differently in terms of technology licensing. Firms in the biotechnology and pharmaceutical industries traditionally conduct negotiations on a bilateral basis (Gans and Stern, 2000), whereas IT firms historically have not relied as heavily on patents to appropriate their returns to R&D (Hall and Ziedonis, 2001). The main result here is that in the final stage of reaching an executed licensing agreement, healthcare firms are more harmed than IT firms by a lack of market safety (Column 6). This may be because the IT industry also engages in a variety of substitute approaches for patent protection, such as rapid innovation and versioning. Furthermore, we find lack of market safety is also negatively correlated with deal success for healthcare firms in the first stage (Column 2), suggesting that to some extent firms may be able to anticipate the problems that might arise due to a lack of market safety.

5 Conclusion and Implications

When do deal failures occur in the licensing process? Despite theory and anecdotal evidence suggesting the ideas market is prone to failure, sources of licensing frictions on the rate of deal success have not been systematically examined empirically. Furthermore, little research exists on when during the licensing process market failures occur. We bring rare firm-level licensing data to shed light on how market imperfections impact different stages of technology licensing. Our results provide suggestive evidence that deal failure is not only prevalent but that the relative salience of each market feature varies across the different stages of the licensing process.

How can these trading frictions be minimized? A growing number of firms begun to utilize online marketplaces that facilitate licensing and other forms of trading between buyers and sellers. Additionally, firms may experience significant returns to developing their licensing team and selecting appropriate legal counsel to navigate negotiations in order to mitigate due diligence costs. Many of the problems currently experienced by firms arise from lack of information; very often, this is information about prices and transactions. Government policy may be able to improve the functioning of ideas markets by increasing transparency through better public reporting of IP transactions and their economic impact, as well as supporting the development of critical market infrastructure (such as timely and predictable dispute resolution mechanisms) and insurance against certain types of risks (akin to real estate markets, where many jurisdictions support title insurance to protect purchasers from legal and technical errors in transactions). Finally, policy makers can play an important role in reducing uncertainty about the scope, validity, and enforceability of IP rights through reform of patent law, building consensus around patent valuation, and active exploration of new technologies and processes to improve patent examination (Cockburn, 2007).

In future work, we plan to explore the relative importance of alternative forms of intellectual property protection (i.e., copyrights and trade secrets) on rates of deal success across

various licensing stages. We also hope to identify empirical indicators for the characteristics of ideas noted by Gans and Stern (2010) - idea complementarity, value rivalry, and user reproducibility - which are likely to pose distinct challenges for the efficient operation of the ideas market. We believe the analyses of these issues are not only important to the study of idea dissemination but also vital to understanding an increasingly economically significant and complex market.

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Table 1: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Dependent variables:					
Level of unlicensed IP with a potential licensor/licensee	358	0.402	0.491	0	1
Level of negotiations started once licensor/licensee is identified	383	0.501	0.500	0	1
Level of agreements reached once negotiations have started	398	0.563	0.497	0	1
Explanatory variables:					
Lack of market thickness	397	0.839	0.368	0	1
Lack of market safety	360	19.443	23.682	0	100
Bargaining Frictions/Congestion:					
Due diligence is costly/difficult	408	0.794	0.405	0	1
Negotiations are difficult to bring to closure	398	0.764	0.425	0	1
Inability to agree on financial terms	393	30.854	27.775	0	87.5
Inability to agree on non-financial terms (i.e., exclusivity, field of use, etc.)	389	24.602	24.917	0	87.5
Inability to agree on scope of IP	388	8.756	16.418	0	87.5
Too many parties at the table	392	4.931	12.407	0	87.5
Due diligence reveals enforceability problems	390	11.745	17.892	0	87.5
Better alternatives emerge	390	14.353	20.112	0	87.5
Legal/regulatory problems (i.e. antitrust)	391	3.145	8.886	0	87.5
Delay (i.e., clock ran out)	391	4.96	11.313	0	87.5
Poor negotiating skills	388	7.173	14.256	0	87.5
Lack of trust/bad faith	393	8.184	15.646	0	87.5
Ego/hubris	391	8.43	15.839	0	87.5
Control variables:					
Lack of demand for IP	368	42.313	32.169	0	100
Annual revenue	453	5032.072	8671.421	0.5	25000
Annual R&D budget	354	352.235	534.684	0.5	1500
# of Employees	495	6309.814	7991.447	10.5	20000
# of Licensing professionals employed	486	12.240	28.733	1	200
Energy	504	0.107	0.310	0	1
Healthcare	504	0.444	0.497	0	1
Software & Electronics	504	0.107	0.310	0	1
Transportation	504	0.032	0.175	0	1
University	504	0.280	0.449	0	1
Other industry	504	0.029	0.170	0	1

Notes: We have converted survey responses into continuous variables. The mean annual revenue corresponds to the category $1B-10B. The mean annual R&D budget corresponds to the category $200M-500M. The average number of employees in our sample corresponds to the category 5,000-10,000. The average number of licensing professionals employed corresponds to the category 10-25. See Appendix B for survey questions that correspond to the main independent variables.

Table 2: Market Features & Stages of the Licensing Process

Regression model: Probit	(1)	(2)	(3)
Dependent variable: Rate of deal success	Stage 1	Stage 2	Stage 3
Lack of market thickness	-0.268**	0.021	-0.122
	(0.095)	(0.104)	(0.094)
Lack of market safety	0.001	-0.000	-0.002+
	(0.001)	(0.001)	(0.001)
Bargaining Frictions:			
Due diligence is costly/difficult	0.010	-0.208+	-0.067
	(0.100)	(0.111)	(0.103)
Negotiations are difficult to bring to a close	-0.126	0.047	-0.069
	(0.098)	(0.104)	(0.100)
Inability to agree on financial terms	0.002+	-0.003*	-0.001
	(0.001)	(0.001)	(0.001)
Inability to agree on non-financial terms	-0.000	0.003+	-0.001
	(0.002)	(0.002)	(0.001)
Inability to agree on scope of IP	0.005*	0.003	0.003
	(0.002)	(0.002)	(0.002)
Too many parties at the table	0.000	-0.012**	-0.004
	(0.003)	(0.004)	(0.003)
Due diligence reveals enforceability problems	0.002	-0.001	-0.004+
	(0.002)	(0.002)	(0.002)
Better alternatives emerges for one or more parties	-0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)
Legal/regulatory problems (i.e., antitrust)	-0.003	0.002	-0.013**
	(0.005)	(0.004)	(0.004)
Delay (i.e., clock ran out)	-0.003	-0.001	0.002
	(0.003)	(0.003)	(0.003)
Poor negotiating skills	0.001	-0.004	-0.001
	(0.003)	(0.003)	(0.003)
Lack of trust/bad faith	0.007+	0.004	-0.003
	(0.004)	(0.004)	(0.004)
Ego/hubris	-0.005	-0.005	-0.003
	(0.003)	(0.003)	(0.003)
Control Variables	Yes	Yes	Yes
Observations	169	168	169
R-squared	0.16	0.12	0.19

Notes: All specifications use probit models. The dependent variable for Stage 1 is a binary variable that equals 1 if the percentage of unlicensed IP with at least one potential licensee/licensor is greater than or equal to the median response (50-75%). The dependent variable for stage 2 is a binary variable that equals 1 if the percentage of negotiations started once potential licensees/licensors are found is greater than or equal to the median response (25-50%). The dependent variable for Stage 3 is a binary variable that equals 1 if the percentage of agreements reached once substantive negotiations are started is greater than or equal to the median response (50-75%). See Appendix B for survey questions that correspond to the main independent variables.
Robust standard errors in parentheses.
+ p<0.10; * p<0.05; ** p<0.01

Table 3: Restricted Sample
(Firms that have at least 5-25% of their negotiations result in an agreement)

Regression model: Probit Dependent variable: Rate of deal success	(1) Stage 1	(2) Stage 2	(3) Stage 3
Lack of market thickness	-0.262**	0.050	-0.123
	(0.097)	(0.108)	(0.089)
Lack of market safety	0.002	-0.001	-0.003**
	(0.001)	(0.001)	(0.001)
Bargaining Frictions/Congestion:			
Due diligence is costly/difficult	-0.007	-0.187	0.012
	(0.100)	(0.115)	(0.095)
Negotiations are difficult to bring to a close	-0.126	0.067	-0.020
	(0.101)	(0.108)	(0.091)
Inability to agree on financial terms	0.002	-0.002+	0.000
	(0.001)	(0.001)	(0.001)
Inability to agree on non-financial terms	0.000	0.004*	-0.001
	(0.002)	(0.002)	(0.001)
Inability to agree on scope of IP	0.005*	0.002	0.002
	(0.002)	(0.003)	(0.002)
Too many parties at the table	0.000	-0.013**	-0.001
	(0.004)	(0.004)	(0.004)
Due diligence reveals enforceability problems	0.001	-0.001	-0.002
	(0.003)	(0.003)	(0.003)
Better alternatives emerges for one or more parties	-0.001	0.002	-0.001
	(0.002)	(0.002)	(0.002)
Legal/regulatory problems (i.e., antitrust)	-0.001	0.001	-0.017**
	(0.004)	(0.004)	(0.004)
Delay (i.e., clock ran out)	-0.001	-0.001	0.004
	(0.003)	(0.004)	(0.003)
Poor negotiating skills	-0.001	-0.005	-0.003
	(0.003)	(0.003)	(0.003)
Lack of trust/bad faith	0.006	0.001	-0.009*
	(0.005)	(0.005)	(0.004)
Ego/hubris	-0.005	0.000	0.005
	(0.005)	(0.005)	(0.004)
Controls	Yes	Yes	Yes
Observations	153	150	151
R-squared	0.178	0.111	0.274

Notes: The regression models employed here are similar to Table 2 but use a restricted sample. This sample restricts firms that have at least 5-25% of their negotiations result in an executed agreement.
Robust standard errors in parentheses.
+ p<0.10; * p<0.05; ** p<0.01

Table 4: University versus Industry Deals

Regression model: Probit	(1)	(2)	(3)
Dependent variable: Rate of deal success	Stage 1	Stage 2	Stage 3:
University	-0.196+	0.031	0.312**
	(0.102)	(0.114)	(0.107)
Market Features	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	169	174	175
R-squared	0.151	0.121	0.164

Notes: All specifications report average marginal effects from probit models. The dependent variable for Column 1 is a binary variable that equals 1 if the percentage of unlicensed IP with at least one potential licensee/licensor is greater than or equal to the median response (50-75%). The dependent variable for Column 2 is a binary variable that equals 1 if the percentage of negotiations started is greater than or equal to the median response (25-50%). The dependent variable for Column 3 is a binary variable that equals 1 if the percentage of agreements reached once substantive negotiations are started is greater than or equal to the median response (50-75%). See Appendix B for survey questions that correspond to the main independent variables.
Robust standard errors in parentheses.
+ p<0.10; * p<0.05; ** p<0.01

Table 5: The Effect of Market Safety on Healthcare and Software & Electronics

Regression model: Probit	Stage 1		Stage 2		Stage 3	
Dependent variable: Rate of deal success	(1) Without Interaction	(2) With Interaction	(3) Without Interaction	(4) With Interaction	(5) Without Interaction	(6) With Interaction
Lack of market safety	0.001	0.011**	0.000	-0.009*	-0.003*	0.006+
	(0.001)	(0.004)	(0.002)	(0.004)	(0.002)	(0.003)
Healthcare	0.139	0.399*	-0.012	-0.232	-0.041	0.181
	(0.124)	(0.197)	(0.124)	(0.169)	(0.116)	(0.124)
Lack of market safety*Healthcare		-0.011*		0.012*		-0.011**
		(0.005)		(0.005)		(0.004)
Market Features	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	114	114	118	118	119	119
R-squared	0.216	0.245	0.17	0.197	0.249	0.279

Notes: All specifications report average marginal effects from probit models. The dependent variable for Columns 1 and 2 is a binary variable that equals 1 if the percentage of unlicensed IP with at least one potential licensee/licensor is greater than or equal to the median response (50-75%). The dependent variable for Columns 3 and 4 is a binary variable that equals 1 if the percentage of negotiations started is greater than or equal to the median response (25-50%). The dependent variable for Columns 5 and 6 is a binary variable that equals 1 if the percentage of agreements reached once substantive negotiations are started is greater than or equal to the median response (50-75%). See Appendix B for survey questions that correspond to the main independent variables.
Robust standard errors in parentheses.
+ p<0.10; * p<0.05; ** p<0.01

Appendix A Additional Tables

Table A1: Level of Unlicensed IP that has a Potential Licensor/Licensee
(High-deal success is defined as a level of unlicensed IP with potential licensor/licensee greater than or equal to the median percentage of 50-75%)

Variable	High-deal success	Low-deal success	t-test
Lack of market thickness	0.757	0.930	4.442
Lack of market safety	21.748	18.416	-1.191
Bargaining Frictions/Congestion:			
Due diligence is costly/difficult	0.755	0.798	0.899
Negotiations are difficult to bring to closure	0.723	0.797	1.527
Inability to agree on financial terms	35.861	26.741	-3.006
Inability to agree on non-financial terms (i.e., exclusivity, field of use, etc)	24.081	24.182	0.037
Inability to agree on scope of IP	10.170	7.729	-1.338
Too many parties at the table	5.391	4.859	-0.371
Due diligence reveals enforceability problems	13.170	11.424	-0.865
Better alternatives emerge	14.489	13.829	-0.302
Legal/regulatory problems (i.e., antitrust)	2.591	3.435	0.869
Delay (i.e., clock ran out)	5.095	5.275	0.136
Poor negotiating skills	7.620	6.656	-0.611
Lack of trust/bad faith	8.146	7.788	-0.214
Ego/hubris	8.883	7.985	-0.522
Industries:			
Energy	0.111	0.089	0.0414
Healthcare	0.5	0.416	-1.579
Software & Electronics	0.076	0.089	0.414
Transportation	0.035	0.042	0.350
University	0.243	0.350	2.168

Notes: We measure the level of deal success using a binary variable that is equal to 1 (high-deal success) if respondents answer that the percentage of unlicensed IP with an identifiable licensor/licensee is greater than or equal to the median response (50-75%), and 0 (low-deal success) otherwise. The Lack of Market Thickness measure is a binary variable that is equal to 1 if respondents "Strongly agree" or "Agree" to the statement that "There are usually fewer potential buyers/sellers for IP [relative to a tangible asset of similar value]," and 0 otherwise. The first two Congestion measures are binary variables that are equal to 1 if respondents "Strongly agree" or "Agree" to the corresponding statement that compares an IP deal with a deal involving tangible assets. The remaining Congestion measures are continuous variables that are equal to the percentage of cases of bargaining breakdown. The measure of Market Safety is a continuous variable that equals the percentage of cases where the IP is not effectively protectable by patents, trade secrets, etc. See Appendix B for corresponding LES survey questions and variable construction.

Table A2: Level of Negotiations Started Once Potential Licensor/Licensee is Found (High-deal success is defined as a level of negotiations started greater than or equal to the median percentage of 25-50%)

Variable	High-deal success	Low-deal success	t-test
Lack of market thickness	0.839	0.851	0.298
Lack of market safety	19.264	20.739	0.548
Bargaining Frictions/Congestion:			
Due diligence is costly/difficult	0.712	0.865	3.508
Negotiations are difficult to bring to closure	0.726	0.794	1.470
Inability to agree on financial terms	30.620	31.201	0.198
Inability to agree on non-financial terms (i.e., exclusivity, field of use, etc)	26.289	22.420	-1.485
Inability to agree on scope of IP	8.212	9.251	0.597
Too many parties at the table	3.101	6.886	2.856
Due diligence reveals enforceability problems	10.551	13.799	1.690
Better alternatives emerge	14.963	14.225	-0.348
Legal/regulatory problems (i.e., antitrust)	3.113	3.247	0.142
Delay (i.e., clock ran out)	5.278	4.652	-0.528
Poor negotiating skills	6.795	7.135	0.231
Lack of trust/bad faith	7.946	8.087	0.151
Ego/hubris	7.621	8.568	0.597
Industries:			
Energy	0.119	0.094	-0.807
Healthcare	0.443	0.461	0.354
Software & Electronics	0.089	0.094	0.193
Transportation	0.057	0.021	-1.837
University	0.255	0.309	1.167

Notes: We measure the level of deal success using a binary variable that is equal to 1 (high-deal success) if respondents answer that of the cases where potential licensor/licensees were identified, the percentage of cases where negotiations were started is greater than or equal to the median response (25-50%), and 0 (low deal success) otherwise. The Lack of Market Thickness measure is a binary variable that is equal to 1 if respondents "Strongly agree" or "Agree" to the statement that "There are usually fewer potential buyers/sellers for IP [relative to a tangible asset of similar value]," and 0 otherwise. The first two Congestion measures are binary variables that are equal to 1 if respondents "Strongly agree" or "Agree" to the corresponding statement that compares an IP deal to a deal involving tangible assets. The remaining Congestion measures are continuous variables that are equal to the percentage of cases of bargaining breakdown. The measure of Market Safety is a continuous variable that equals the percentage of cases where the IP is not effectively protectable by patents, trade secrets, etc. See Appendix B for corresponding LES survey questions and variable construction.

Table A3: Level of Agreements Reached Once Negotiations are Started
(High-deal success is defined as a level of agreements reached that is greater than or equal to the median percentage of 50-75%)

Variable	High-deal success	Low-deal success	t-test
Lack of market thickness	0.852	0.828	-0.602
Lack of market safety	17.874	21.739	1.449
Bargaining Frictions/Congestion:			
Due diligence is costly/difficult	0.736	0.849	2.604
Negotiations are more difficult to bring to closure	0.717	0.816	2.175
Inability to agree on financial terms	28.401	34.610	2.152
Inability to agree on non-financial terms (ie., exclusivity, field of use, etc)	24.745	23.808	-0.364
Inability to agree on scope of IP	6.918	10.25	2.019
Too many parties at the table	3.569	6.894	2.542
Due diligence reveals enforceability problems	9.674	14.001	2.335
Better alternatives emerge	12.775	16.742	1.893
Legal/regulatory problems (ie., antitrust)	1.983	4.321	2.579
Delay (ie., clock ran out)	4.087	5.884	1.561
Poor negotiating skills	5.643	8.627	2.046
Lack of trust/bad faith	6.718	9.911	1.962
Ego/hubris	6.822	10.08	2.004
Industries:			
Energy	0.125	0.098	-0.852
Healthcare	0.371	0.552	3.655
Software & Electronics	0.058	0.144	2.907
Transportation	0.049	0.017	-1.714
University	0.371	0.161	-4.743

Notes: We measure the level of deal success using a binary variable that is equal to 1 (high-deal success) if respondents answer that of the cases where they entered into licensing negotiations, the percentage of cases that reached a successful agreement is greater than or equal to the median response (50-75%), and 0 (low deal success) otherwise. The Lack of Market Thickness measure is a binary variable that is equal to 1 if respondents "Strongly agree" or "Agree" to the statement that "There are usually fewer potential buyers/sellers for IP [relative to a tangible asset of similar value]," and 0 otherwise. The first two Congestion measures are binary variables that are equal to 1 if respondents "Strongly agree" or "Agree" to the corresponding statement that compares an IP deal to a deal involving tangible assets. The remaining Congestion measures are continuous variables that are equal to the percentage of cases of bargaining breakdown due to the corresponding statement. The measure of Market Safety is a continuous variable that equals the percentage of cases where the IP is not effectively protectable by patents, trade secrets, etc. See Appendix B for corresponding LES survey questions and variable construction.

Appendix B Data Appendix

Table B.1: Comparison of Market Feature Definition

	Roth (2007, 2008)	Gans and Stern (2010)	Our paper
Market thickness	"A market is thick if it brings together a large enough proportion of potential buyers and sellers to produce satisfactory outcomes for both sides of a transaction." (p.2)	"Market thickness is the degree to which a large number of buyers and sellers participate within a market, and hence the degree to which each buyer and seller has an opportunity to engage in an effective match." (p. 8) "Lack of market thickness in MfT is most likely caused by ideas complementarity to be of the most value, ideas require matching of complementary assets and complementary ideas." (p.13)	Market thickness refers to the volume of potential traders in the market.
Market Safety	"A market is safe if the market offers participants incentives to reveal confidential information." (p.2)	"Markets are safe when the disclosure of buyers and sellers own preferences or type allows them to seek out favorable matches with other market participants and cannot be directly exploited to undermine bargaining power or allow hold-up." (p.10) "When users can reproduce an idea at a zero or very low marginal cost (ie., high user reproducibility), there are often significant limitations on whether the seller can control how users exploit or distribute the idea." (p.16)	Market safety refers to the degree that the IP is effectively protected, either by formal (ie., patents) or informal (ie., trade secrets) intellectual property rights.
Non-congestion	"The market needs to give market participants enough time or the means to conduct transactions fast enough to make satisfactory choices when faced with a variety of alternatives. Congestion is usually brought about by thickness." (p.2)	"Congestion arises when the timing or circumstances of potential trades requires that trades are completed without access to alternative options in the marketplace. While a prerequisite for a lack of congestion is market thickness (i.e., sufficient traders in a market are required to make bargaining with others worthwhile), the degree of congestion also depends on the precise rules and timing of the market mechanism. (p.9) "The main consequence of value rivalry is congestion. In the MfT, buyers and sellers have to engage in bilateral negotiations in order to preserve the value of the idea. These due diligence periods imply that the detailed negotiations over the precise terms and conditions of a license take place in a bilateral rather than multilateral environment. This results in poor quality matches and uncertainty regarding the fair price of an idea of a given quality." (p.15)	We think of congestion as largely arising from frictions during the bargaining process between buyers and sellers. We capture different types of transaction costs arising from the bargaining process that also corresponds to key dimensions of congestion described by Roth (2007) and Gans and Stern (2010). In early stages of the bargaining process, the salient transaction cost stems from acquiring sufficient information about the deal. This is reflected in the market for ideas context by the cost and difficulty of conducting due diligence in the absence of a multilateral environment. In later stages, the main transaction cost stems from contracting problems and opportunism. This is reflected in the market for ideas context by deal breakdown due to better alternatives emerging for one or more parties and time running out before a deal is completed.

Table B.2: 2006 LES Survey Questions Corresponding to Market Features

	Questions from LES (measures for *lack of market thickness, congestion, and lack of market safety*)
Market thickness	[Respondents rank statements from "strongly agree" to "strongly disagree".] 23a. Compared to a $10M IP licensing transaction with one involving a tangible asset of similar dollar value. In your experience: There are usually fewer potential buyers/sellers for the IP.
Market Safety	[Respondents choose between 0%, 1-5%, 5-25%, 25-50%, 50-75%, 75-99%, 100%.] 28b. Of the IP that your organization would like to license but cannot, approximately what fraction would you say is not effectively protectable by patents, trade secrets, etc. ?
Bargaining Frictions (Congestion)	[Respondents rank statements from "strongly agree" to "strongly disagree".] 23c. Due diligence will be much more difficult/costly for the IP deal. 23d. For the IP deal, negotiations with a specific buyer/seller will be more difficult to bring to closure. [Respondents choose between 0%, 1-5%, 5-25%, 25-50%, 50-75%, 75-100%.] 40a. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: inability to arrive at mutually acceptable financial terms? 40b. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: inability to arrive at mutually acceptable noon-financial terms (exclusivity, field of use, etc.)? 40c. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: inability to agree on the appropriate scope of IP to be included in the agreement (patents, know-how, or other key IP assets)? 40d. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: too many parties at the table (multiple licensors/licensees)? 40e. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: due diligence revealed problems with enforceability/validity of IP? 40f. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: better alternatives emerged for one or more parties? 40g. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: legal/regulatory problems (national security, antitrust, etc.)? 40h. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due: to delay (ie. clock ran out)? 40i. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: poor negotiating skills? 40j. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: lack of trust/bad faith? 40k. Over the past 12 months, when substantive licensing negotiations have failed to reach an executed agreement, in what percentage of cases was the breakdown due to: ego/hubris?

Table B.3: Variable Construction

Percent Ranges	Number Ranges	Value Ranges
0 =‘0%’	0 =‘0’	0 =‘0’
3=‘1-5%’	0.5=‘0-1’	0.05 = ‘Less than $100K’
7.5=‘5-10%’	1=‘1’	0.3 =‘$100K-500K’
15=‘5-25%’	2=‘1-3’	0.5=‘Less than $1M’
15.000001=‘10-20%’	3=‘1-5’	0.75=‘$500K-1M’
30=‘20-40%’	3.5=‘2-5’	1.5=‘$1M-2M’
37.5=‘25-50%’	4=‘3-5’	3.5 = ‘$2M-5M’
50=‘40-60%’	7.5=‘5-10’	5.5=‘$1M-10M’
62.5=‘50-75%’	10.5=‘1-20’	7.5=‘$5M-10M’
80=‘60-100%’	12.5=‘5-20’	10=‘$1M-20M’
87=‘75-99%’	15=‘5-25’	15=‘$10M+’
87.5=‘75-100%’	17.5=‘10-25’	30=‘$10M-50M’
100=‘100%’	35=‘20-50’	35=‘$20M-50M’
150=‘100%+’	37.5=‘20-100’	75=‘$50M-100M’
.=‘Don’t know’	60=‘20-100	75=‘$50M-100M’
	70=‘50+’	150=‘$100M-200M’
	75=‘50-100’	300=‘$100M-500M’
	200=‘More than 100’	750=‘$500M-1B’
	150=‘100-200’	1500=‘$1M+’
	350=‘200-500’	5500=‘$1B-10B’
	750=‘500-1,000’	25000=‘$10B+’
	1000=‘More than 500’	.=‘Don’t Know’
	3000=‘1,000-5,000’	
	7500=‘5,000-10,000’	
	20000=‘10,000+’	
	.=‘Don’t know’	

Notes: In our variable construction from survey responses, we take the midpoint from discrete response categories to transform responses of a particular question into a continuous variable. For instance, if the response to the question “How many people does your organization employ? is 200-500, we translate that response into 350. Similarly, if the response to the question “Of the IP that your organization elects not license, approximately what fraction would you say is not effectively protectable by patents, trade secrets, etc?” is ‘50-75%’, we code that response as 62.5%. We code any response of “Don’t know” as missing.