The Halo Effect and Technology Licensing:
The Influence of Institutional Prestige on the Licensing of University Inventions

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Abstract

Sociologists and organizational theorists have long claimed that the processes of knowledge creation and distribution are fundamentally social. Following in this tradition, we explore the effect of institutional prestige on university technology licensing. Empirically, we examine the influence of university prestige on the annual rate of technology licensing by 108 universities from 1991 to 1998. We show that institutional prestige increases a university's licensing rate over and above the rate that is explained by the university's reputation for past performance at licensing. Because licensing success positively impacts future invention production, we argue that institutional prestige leads to stratification in the creation and distribution of university-generated knowledge.

Introduction

Sociologists and organizational theorists have long claimed that the processes of knowledge creation and distribution are fundamentally social. For example, Merton's (1968) seminal work on the Matthew effect demonstrated that, for the same quality of scientific research, more prestigious scientists were more likely to be cited than less prestigious scientists. In this paper, we extend the concept of prestige to the domain of university technology licensing. We examine the proposition that universities' ability to license inventions will be influenced by their level of institutional prestige.

Prior research on the licensing of university inventions does not pay much attention to questions of institutional prestige (Henderson et al, 1998; Rosenberg and Nelson, 1994; Mowery et al, 2001). Drawing primarily from an economic paradigm, this research has argued that a university's ability to license its inventions is influenced largely by the current and past quality of the university's inventions. A reputation for generating high quality inventions enhances licensing because the university's past invention quality provides a signal of future invention quality to potential buyers (Weizsacker, 1980; Allen, 1984). While providing useful insights into university technology licensing, this research stream fails to incorporate sociological findings that institutional prestige influences both the production (Allison and Long, 1990) and diffusion of academic knowledge (Merton, 1968; Crane, 1965). As a result, to date, no research investigates the effect of institutional prestige on the ability of a university to license its inventions.

However, examining the effect of institutional prestige on university technology licensing is important for at least three reasons. First, from a theoretical perspective, disentangling the relative effects of prestige and reputation is important. Although sociologists and economists agree that a buyer's relative positive or negative perceptions of an organization influences exchange transactions (Podolny, 1993), they disagree about the origins and effects of these perceptions. Economic research has assumed that these perceptions emerge directly from past performance and influence exchange transactions by providing signals of unobservable quality. In contrast, sociological research has argued that these perceptions are not only tied to past performance, but are also strongly tied to the organization's general prestige relative to peer institutions. Moreover, the construct of prestige holds that perceptions influence exchange transactions, not only by providing signals of the unobservable quality of an organization's goods, but also because positive external perceptions about the general organization influence external perceptions of its goods in ways not directly connected to their underlying quality (Thye, 2000; Shenkar & Yuchtman-Yaar, 1997; Perrow, 1961).

Unfortunately there have been few attempts to empirically examine institutional prestige while controlling for reputation. Prior researchers (e.g., Podolny, 1993; Podolny and Stuart, 1995) have used indirect proxies to measure the economic construct of reputation.[2] For example, Podolny (1993) controlled for reputation by measuring past market presence, and Podolny and Stuart (1995) controlled for reputation with occurrence dependence. Because reputation and prestige are often positively correlated (Podolny, 1993), the use of indirect proxies has limited the ability of researchers to claim that prestige effects are different from reputation effects. In this study, we empirically

[2] One important exception is Benjamin and Podolny (1999), which tests the effect of status on market outcomes while controlling for quality. However, their work does not examine organizational status, but rather the influence of affiliation with high status producer regions on perceived product quality.

differentiate the two constructs by examining the influence of both prestige and reputation on market transactions.

Second, this study investigates the effect of prestige in markets for knowledge. Although empirical evidence in the context of wine production (Benjamin and Podolny, 1999) and investment banking (Podolny, 1993) provide useful evidence of prestige effects, questions remain about the generalizability of these findings to transactions involving intellectual property (Benjamin and Podolny, 1999). Prior research suggests that knowledge differs from physical goods in fundamental ways that alter market transactions. For example, Arrow (1962) explained that the indivisibility, uncertainty, and inappropriability of knowledge make it difficult to buy and sell. Because prestige is more important to facilitating transactions under conditions of uncertainty (Podolny, 1993), markets for knowledge may depend more on prestige than other markets. Consequently, empirical examination of the effects of prestige on markets for knowledge provides an important test of the scope of prestige-based arguments.

Third, the investigation of the effect of prestige on university technology licensing is important because university technology plays an important role in economic growth and technical advance in this country (Jaffe, 1989; Adams, 1990; Rosenberg and Nelson, 1994). U.S. universities generate thousands of patents each year, accounting for approximately 8 percent of the total patents issued. Moreover, the licensing of university-generated intellectual property accounted for $40 billion of economic activity last year (AUTM, 1999). Therefore, explaining the effects of prestige on university technology licensing is important to understanding the knowledge economy.

In this study, we examine the rate at which 108 universities license their inventions over the period 1991-1998. We find that institutional prestige influences the number of licenses that a university generates annually, even after controlling for the university's reputation for licensing, its staffing policies, its magnitude of technology production, and its sources of research funds.

This article proceeds as follows: The next section describes the context we study. The third section reviews past research on institutional prestige and presents arguments about how it influences market transactions. The fourth section describes our methodology. The fifth section discusses the results and draws implications for future research.

The Setting: University Technology Licensing

The specific setting we examine is the market for university technology. Universities typically retain the rights to inventions developed by faculty, staff, and students that make material use of university resources in their development. As a result, universities, not the inventors themselves, make decisions about the disposition of inventions made with their resources.

University policies typically require faculty, staff, and students to file invention disclosures when they believe that they have invented new technologies. University personnel, located in offices of technology transfer, review these disclosures. Technology transfer office personnel determine whether the disclosures represent actual inventions because university personnel sometimes believe that they have invented new technology, when, in fact, they have not.

In addition to determining whether a disclosure represents an invention, the technology licensing office personnel determine whether or not to patent the invention. Because of the legal monopoly that patents provide, they are the preferred mechanism for protecting universities' intellectual property. However, not all inventions can be patented. To be patented an invention must be novel, non-obvious to a person trained in the prior art, and valuable. Moreover, patents are not equally effective in all technical fields. In some fields, like biology, they are quite effective at preventing imitation; whereas in other fields, like computer science, they are quite ineffective. Thus, only a portion of disclosures made by university inventors will result in new patents.

Many universities seek to earn financial returns from their inventions. Because universities are in the business of conducting research and educating students, they do not develop products and services directly from their inventions. Rather, they generally seek to license these inventions to private sector firms who use this technology to create new products and services in return for a fee.

The licensing of university-generated intellectual property is an important economic phenomenon. University patents account for over 8 percent of total patents in the United States (Henderson et al, 1998). Moreover, over 200 academic institutions operate technology licensing offices, (Thursby and Kemp, 2000), generating 12,324 new invention disclosures, 5545 patent applications, and 3900 new licensing agreements per year (AUTM, 1999).

These licenses generate significant economic value. Roughly 8,308 of them yielded income in 1999, and 25 percent led to a product that had sales in the marketplace. As a result, U.S. and Canadian educational institutions received $862 million in licensing income in 1999 (AUTM, 1999). Furthermore, AUTM estimates that this licensing activity generated 270,000 jobs, $5 billion in tax revenues, and $40 billion in total economic activity.

Theoretical Framework: Prestige or Reputation?

According to both economic theories of reputation and sociological theories of prestige, external perceptions of an organization influence the likelihood that buyers' will undertake exchange transactions with that organization. However, reputation and prestige-based explanations for the mechanisms behind this influence differ substantially.

Reputation

Economic theories of reputation argue that buyers form rational expectations of the quality of goods and services offered by sellers by observing the sellers' past actions, and that these reputations influence subsequent purchasing decisions (Wilson, 1985; Kreps and Spence, 1985). Reputation serves as (an imperfect) substitute for direct knowledge that is particularly influential in situations where it is difficult to ascertain quality (Shenkar and Yuchtman-Yaar, 1997). Given uncertainty, buyers are more willing to transact with organizations that have better reputations for past quality because past quality signals future quality. Thus, in economic models of reputation, past performance, future expectations, and the likelihood of transactions are tightly coupled (Weigelt and Camerer, 1988). In the context of university licensing, reputation arguments suggest that universities that have better past licensing performance should be more likely to license their current inventions than universities that have worse past licensing performance.

Prestige

Sociological theories of prestige argue that buyers' decisions are more loosely linked to past quality than economic models of reputation suggest (Perrow, 1961). These theories suggest that buyers are influenced by an organization's general prestige, that is, the relative esteem in which an organization is held in a "ordered total system of differentiated evaluation" (Parsons, 1951: 132). Prestige arguments suggest that, while the past quality of an organization's outputs influences external perceptions of the quality of its current outputs, other organizational attributes (Perrow, 1967), such as organizational size, age (Young and Larson, 1965; Shrum and Wuthnow, 1988), members' social status (Minnis, 1953), structure, network position, (Shrum and Wuthnow, 1988), and the status of its exchange partners (Podolny, 1993) also influence these perceptions.

Organizational prestige influences exchange transactions by making a high prestige producer more likely than a low prestige producer to consummate a deal to sell a product or service of equal quality. Four mechanisms underlie this effect. First, buyers attribute their positive perceptions of a high prestige organization to its outputs, thereby increasing the outputs' perceived value through a "halo effect" (Crane, 1965; Perrow, 1961). For example, Perrow (1961) found that patients relied on general hospital characteristics *unrelated* to their medical needs (such as building design) and the general evaluation of "validating groups" to decide whether or not to seek particular health services at the hospital in question.

Second, prestige increases an organization's visibility, thereby enhancing the likelihood that potential buyers will know about an organization's outputs (Lewin, 1935;

Granovetter, 1985). Context influences what information people pay attention to, and the meanings they ascribe to information (Asch, 1940). Thus, products from more prestigious organizations receive greater visibility than products from less prestigious organizations (Crane, 1965; Merton, 1968). For example, Merton (1968) found that a scientist's prestige influenced the amount of credit he or she received because articles of equal academic importance written by less prestigious authors are less likely to be read than articles by more prestigious authors.

Third, prestige increases the credibility of an organization's claims about quality. People often consider information from prestigious sources to be more valuable than information from less prestigious sources (Hovland et al, 1953). For example, if both MIT and the University of Eastern Idaho develop the same invention, past research suggests that MIT's claims about the commercialization-potential of the technology would be viewed as more credible than similar claims by the University of Eastern Idaho.

Fourth, buyers prefer to transact with more prestigious organizations because interaction with higher status others increases their own prestige (Tallman and Shenkar, 1996). This creates a dynamic in which "more customers simply flow to the producer without the producer actively seeking them out (Podolny, 1993: 838)." In the context of our study, this means that buyers prefer to search for inventions at, and transact with, more prestigious universities.

In summary, sociologists argue that institutional prestige increases the likelihood of exchange transactions through four mechanisms that operate over and above the effect of reputation for prior quality: the halo effect, increased visibility, increased credibility, and buyer preferences to transact with more prestigious others. These mechanisms lead us to the following hypothesis, which we test empirically: *A university's prestige will increase its rate of licensing over and above the rate expected from its reputation for licensing performance.*

Methodology

Sample

We explore the licensing rate of university-assigned inventions from 108 U.S. universities from 1991-1998.[3] Because many universities consider technology licensing to be an important business activity, university technology licensing offices track the life histories of the their intellectual property. The Association of University Technology Managers (AUTM), a professional association of university licensing officers, annually surveys universities to obtain information about their intellectual property activity. Because AUTM has only collected licensing activity data since 1991, we examine panel data on licensing activity for the 108 universities[4] for which licensing data exists for at least two years during this period.

Our sample captures over 90 percent of the top 100 US universities in terms of research and development expenditures and approximately 90 percent of the total number of university assigned patents.

[3] Because we lag our dependent variable by one year, our regression models actually report the licensing rate from 1992-1998 as a function of university attributes measured from 1991-1997.
[4] In our analysis, we define a university as a system that operates under a single set of intellectual property rules. When university systems have disparate campuses governed by the same policies or procedures, we aggregated data from the different campuses into a single annual observation for the university. In particular, while most state medical schools share a single TLO with the state university or at least share common policies, three state medical schools were treated as separate universities due to their distinct policies and administration. When these schools were omitted from the analysis, the results did not change.

Dependent Variable

The dependent variable in our analysis was the annual count of new technology licensing and option agreements established by the university. These data are provided by AUTM through their surveys of university technology licensing offices.

Covariates

Prestige. Our predictor variable is university prestige. Prestige arguments suggest that the behavior of potential licensees will be influenced by external perceptions of universities that are not necessarily directly linked to the underlying quality of university technology. Because the linkage between external perception and prestige is indirect, prestige must influence licensing through a different mechanism than through information about the actual quality of a university's technology. For this reason, we seek to measure prestige in a way that captures the external perceptions of universities that include assessment of areas that are not directly related to the production of technology (e.g., arts, humanities, social sciences, law, and business).

To do this, we examine the overall academic rating score of graduate schools published in the Gourman Report (Gourman, 1991; 1994; 1997). The Gourman Report is a commonly utilized measure of the overall graduate school quality and represents an assessment of the overall intellectual prestige of the university's graduate programs as compared to other universities. The Gourman Report score is a general measure of prestige because it measures the collective assessment, relative to peer institutions, of the university's graduate programs in all fields, including the arts, humanities, social sciences, physical sciences, natural sciences, medicine, law, business, and engineering.

The score is reported on a 1-5 scale. Because this survey is produced every three years, we update the Gourman Report measure in 1991, 1994, and 1997.

To confirm the validity of Gourman Report rankings as a measure of university prestige, we also collected prestige scores from U.S. News and World Report (1991-1998) and examined their effects on the rate of licensing in separate regressions. Because some of the years were reported in ranks (1992-1997), while other years were reported using a scale (1997-1998), we changed all scaled scores to ranks.

U.S. News and World Report scores were based on questionnaires distributed to college presidents, deans, and admissions directors throughout the U.S. Respondents were asked to grade the prestige of other schools by placing them into four quartiles. Four points were given for each vote in the top quartile, three for the second, two for the third, and 1 for the last category (U.S. News and World Report, September 30, 1991: 83). Universities were then placed in order of their scores and ranked against one another. In 1997, the rating scale was increased one point from a four-point to a five-point scale. We standardized yearly ranking fluctuations by ranking the universities included in the study against one another.

The U.S. News and World Report ranking had a 0.90 correlation with Gourman Report scores. University scores and rankings did not change much over the duration of the study. Correlations between rankings for the years 1991-1998 demonstrated relative stability, with all years correlated at least at the 0.88 level, and with most years correlated above the 0.92 level. Correlations between rankings in adjacent years were strongest and deteriorated slightly over time. This was true for both the U.S. News and World report rankings and the Gourman report scores.

Reputation. In contrast to prestige effects, economic theories of reputation suggest that the behavior of potential licensees should be influenced directly by the observable historical success of the universities at technology licensing. However, reputation for past performance at licensing might be manifest in different ways. Potential licensees might view reputation as the magnitude of the university's past licensing revenue; the probability that an institution's inventions are worthy of license; the frequency with which past licenses yielded income; or the average level of licensing income generated per invention. Therefore we control for reputation with four different measures (in different regression models). All four measures are derived from data provided by the universities to AUTM.

Past licensing revenues. Potential licensees might recognize that licensing is an inherently uncertain process in which a few inventions account for most of the licensing revenue. If potential licensees expect licensing revenue to be generated from a small number of successful licenses, then the total royalties generated from licensing at an institution will capture the construct of reputation. Therefore, we measure the total revenue generated from royalties on licensed inventions in the previous year. We expect that this variable will positively influence the current rate of licensing.

Past licensing yield. Potential licensees might recognize that only some university inventions are of interest to the private sector. If potential licensees expect that institutions will vary on the degree to which they produce technologies that interest the private sector, then the licensing yield will capture the construct of reputation. Therefore, we measure the proportion of invention disclosures in the past year that result in licenses. To create this variable, we divide the number of licenses issued in the past year by the number of inventions disclosed in that year. Reputation arguments would suggest that licensing should be higher from universities whose past licensing yield is higher.

Past number of licenses yielding income. Potential licensees might recognize that not all licenses yield income. If potential licensees expect that institutions will vary in the degree to which they produce commercialized technologies, then the number of licenses yielding income will capture the construct of reputation. Therefore, we measure the count of licenses yielding income in the past year. Reputation arguments would suggest that licensing should be higher from universities that have more past licenses yielding income.

Past licensing revenue per invention. Potential licensees might view the average performance of institutions at licensing their inventions as the appropriate measure of past licensing performance. If this were the case, then the average amount of licensing revenue per invention would capture the construct of reputation. Therefore, we measure the average revenue per invention in the past year. Reputation arguments would suggest that licensing should be higher from universities that generate inventions of higher average value.

<u>Level of technology production</u>. Because the volume of technology produced will influence a university's rate of licensing, we control for the volume of technology available for licensing. We capture this volume effect by measuring the number of invention disclosures that the university produces in the year under investigation.

<u>Technology licensing office resources</u>. Universities often hire personnel to market their inventions to private sector firms. Because technology-licensing officers have limited time, the effort that they can put into marketing a given invention is a function of

the total number of inventions that they must handle. To capture this resource effect, we control for the number of invention disclosures per professional staff member in the university-year. We expect an inverse relationship between the number of disclosures per professional staff member and the number of licenses created in a university-year.

Source of funding. Inventions are an outgrowth of investment in research. Government agencies or the private sector can fund university research. Prior research suggests that universities that receive more of their funding from the private sector generate more commercially-useful inventions than universities that receive more of their funding from the public sector because private firms have commercial goals for funding university research (Henderson et al, 1998). To capture the commercial orientation of university research, we measure the proportion of university research funded by private sector firms in the previous year.[5] We expect that universities that receive a greater share of funding from the private sector will have a greater number of licenses.

Medical School. Researchers have observed that biomedical inventions are more likely to be patented and licensed by universities than are other inventions (Mowery et al, 2001). For this reason, we expect that universities with medical schools will have a higher rate of licensing than universities without medical schools. We control for this effect with a dummy variable of one if the university operates a medical school.

[5] Although a one-year lag for research funding may not capture precisely the time horizon over which inventions are created, we use this lag for two reasons. First, we do not know the length of the actual lag between research funding and license, preventing us from more accurately specifying it. Second, data constraints preclude us from specifying long lags due to loss of observations. However, an examination of the correlation between industry funding ratios across years reveals that there is little year-to-year change in the funding ratios across schools. As a result, a one-year lag effectively proxies longer lags.

Year. Invention and licensing activity varies over time as a function various perturbations in the external environment during specific time periods. Therefore, we include year dummy variables to control for the time period (1992 is the omitted year).

Model Specification

Our model estimates the variation in license count per university in a specified year. Our explanatory variables are a mixture of continuous and discrete variables. We used generalized estimating equations (GEE) (Liang and Zeger, 1986), to analyze annual counts of license agreements for our seven-year panel.

Although we initially estimated a common Poisson model, closer examination revealed that the variance exceeded the mean, violating a standard assumption of Poisson models. The violation of this assumption causes over-dispersion, which results in the estimation of spuriously small standard errors for independent variables, inflating their significance level. When the assumption of equal mean and variance is violated in a Poisson model, a gamma-Poisson or negative-binomial model is appropriate (Cameron and Trivedi, 1996). Accordingly, we re-specified the model using generalized estimating equations with a negative binomial distribution and a log linear link function to estimate all equations (Liang and Zeger, 1986).

Pooling multiple observations over time for each organization increases the likelihood that the assumption of independence required for linear regression is violated, a common problem with cross sectional panel data. Cross sectional autocorrelation occurs when general factors that characterize a particular university influence the behavior of the university at all points in time, which will result in biased parameter estimates. To correct this bias, we used generalized estimating equations that are available in the XTGEE procedure (STATA, 1999), which allowed us to specify the distribution of our dependent variable and its link to covariates, while making adjustments for possible non-independence of errors (Diggle, Liang, and Zeger, 1994). This contrasts with random effects models where the covariate effects and within subject associations are modeled through a single equation.

In GEE population-averaged models, one must specify a model for the association among observations from each subject over time and a separate specification for covariate effects on marginal expectations to control for autocorrelation. Examination of the data revealed that the correlation matrix followed a common first autoregressive (AR1) pattern, where observations closest in time have higher correlations than those more temporally distant. Therefore, we specified an AR1 correlation structure in our regression models.

We used robust variance estimators in our analyses, reducing problems associated with heteroskedasticity or misspecification of the error structure (White, 1981). We also included a number of university level controls (staffing, research expenditure, and existence of a medical school) to limit problems related to repeated observations.

We do not employ fixed effects models to analyze our data for methodological reasons. Typical fixed effects models for estimating panel data cannot estimate effects for samples that include respondents for which there is no variation in the dependent variable over time. However, universities that have no licensing activity over the observation period may be systematically different from those in which there was some licensing activity. Dropping those observations (and thereby enabling the use of fixed effects models) would likely bias the estimates in the regression analysis. Estimating our regressions using a general estimating equation with an AR1 correlation structure enabled us to include universities that did not license technology during the observation period, without the typical assumptions of a random effects model, that is that errors are uncorrelated between years, and that the model is fully efficient (STATA, 1999).

Results

We provide the summary statistics for the variables in our regression analysis in Table 1. In Table 2, we present the results of our population average negative binomial estimates of the number of university licenses produced in the year. All models include the control variables (number of invention disclosures in the university-year, the industry funding ratio in the university year, the number of disclosures per professional staff member in the technology licensing office, the dummy variable for the presence of a medical school, and the year dummy variables). All models also include the Gourman Report measure of university prestige. Model 1 measures reputation as the magnitude of the university's licensing revenue in the previous year. Model 2 measures reputation as

icenses per invention disclosure in the previous year. Model 3 measures reputation as the number of university licenses yielding income in the previous year. Model 4 measures reputation as the university's average amount of licensing revenue per active license in the previous year.

Overall, Table 2 shows that the volume of invention disclosures increases the rate of licensing. Each additional invention disclosure increases the count of licenses by between three tenths of one percent and one percent. In addition, having technology licensing office staff manage more disclosures reduces the number of new licenses created. Each one-unit increase in the number of disclosures per professional staff member reduces the count of licensing by between one percent and five percent. However, the presence of a medical school and the industry-funding ratio had no significant effects on the rate of licensing.

Table 2 also shows that reputation for past licensing had a positive and significant effect on the rate of licensing. Model 1 shows that when reputation is measured as the magnitude of licensing revenue in the previous year, each $1 million increase in licensing revenue increases the count of licenses in the following year by 6.6 percent. Model 2 shows that when reputation is measured as the log of the number of licenses generated per disclosure in the previous year, each one unit increase has a 3.7 percent increase in the count of licenses in the following year. Model 3 shows that when reputation is measured as the log of the count of licenses yielding income in the previous year, each additional license yielding income increases the count of licenses in the following year by 66 percent. Model 4 shows that when reputation is measured as the average revenue generated per license in the previous year, each additional dollar in average revenue increases the count of licenses in the following year by 8.1 percent.

Most importantly, Table 2 confirms the hypothesis that we seek to test in this study. Controlling for the volume of invention disclosures, the source of university funding, the presence or absence of a medical school, the year, and the university's reputation for past licensing performance, the university's general prestige increases its rate of licensing. Depending on which measure of reputation we controlled for in the regression models, each one unit increase in the Gourman Report score increased the rate of licensing by 26 to 73 percent.

Table 3 provides a robustness check of the results presented in Table 2 by substituting the U.S. News and World Report rankings for the Gourman Report Scores. The results shown in Table 3 confirm the results presented in Table 2. The volume of invention disclosures increases the rate of licensing. The number of invention disclosure per professional staff member reduces the rate of licensing. The presence or absence of a medical school, and the proportion of industry funding have no effect on the rate of licensing. University reputation for past licensing performance has a positive impact on the rate of licensing, whether measured as the magnitude of past licensing revenue, the yield of licenses per disclosure, the number of past licenses yielding income, or the average level of revenue per license. Most importantly, the U.S. News and World Report ranking has a significant and positive effect on the rate of licensing. Depending on which measure of reputation was controlled, a one unit increase in the U.S. News and World Report ranking increased the rate of licensing between 1.2 and 1.7 percent.[6]

Discussion

This study examined why some universities license more of their inventions than other universities over the 1991-1998 period. We showed how general university prestige increases the licensing rate over that predicted by economic models of reputation alone. We also showed that this prestige effect occurs after controlling for the amount of technology produced by the university, the source of research funding, the presence or absence of a medical school, and the resources of the technology licensing office.

From a theoretical perspective, our results support an important distinction between economic conceptions of reputation and sociological conceptions of prestige. Reputation

[6] The coefficients for the Gourman Report scores and the U.S. News and World Report scores differ in magnitude because they are measured in very different ways. An increase of one unit has a different

arguments propose a tight coupling between past quality and current demand (Kreps and Wilson, 1982), whereas sociological conceptions of prestige accept a looser coupling of these two forces. By demonstrating that prestige has an effect on market transactions over and above the effects observable for past quality, this study provides evidence of the loose coupling between past quality and demand suggested by sociologists and organizational theorists (Podolny, 1993).

Readers should not interpret the evidence we present for the effect of prestige as suggesting that the preference of potential licenses for prestigious schools is non-rational. Licensees may be exhibiting risk-averse behavior by preferring to transact with more prestigious institutions.[7] Alternatively, licensees may be drawn to more prestigious universities because the university's prestige will help them to attract additional resources or to commercialize the technology. Our results simply show that university prestige increases the rate of licensing over the level explained by the reputation of the university for past licensing performance.

Differentiating between loose and tight coupling of past quality and demand is important because the strength of that coupling influences the breadth of the effect of external perceptions of organizations. By differentiating between the effects of prestige and reputation in market transactions, this paper advances recent research that treats the two constructs as interchangeable (Barney, 1991; Fombrun and Shanley, 1990). Because theories of reputation argue that external perceptions of organizations are tightly coupled to their past performance, reputation arguments hold that actors can use external perceptions to influence market transactions only in settings in which other actors

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meaning in the two measures.

perceive the reputation as relevant. However, theories of prestige argue that external perceptions and past performance are loosely coupled. Thus, while reputation arguments hold that actors cannot use external perceptions generated in one domain in another domain, prestige arguments hold that actors can transfer external perceptions across domain barriers.

Although we see merit in the efforts of researchers to examine the effects of all types of external perceptions of organizations on firm performance, the differences in how reputation and prestige theories operate indicate the value of differentiating between them. For example, just as prestige arguments suggest that a university can use the overall external perceptions that accrue from a variety of highly ranked departments (such as English, history, etc.) to license more of its inventions, these arguments suggest that the founder of a successful software firm could use external perceptions of him as a business leader to benefit his political efforts (Freeman, Fararo, Bloomberg, and Sunshine, 1962). However, reputation arguments would suggest that the business leader would receive no future political value from external perceptions of his ability as a business leader.

The difference between prestige and reputation may prove to be particularly important in contexts of new firms and new industries. Because new firms have no reputation by definition, theories of reputation would hold that these actors have a disadvantage vis-à-vis established firms in persuading others to transact with them. However, theories of prestige would suggest that prestigious actors would be more successful than others in starting new firms or in founding new industries. A new firm

[7] As one licensee explained to the authors, “no one ever gets in trouble for licensing from MIT. But if you license from a lesser school and the technology doesn’t work, you have a lot of explaining to do.”

organized by a prestigious founder (e.g., Martha Stewart) may be successful at competing with established firms because prestige can be transferred from one context to another.

A particularly intriguing avenue for extension of this concept lies in the intersection between the concept of prestige and accounts of market creation. Arrow (1974) explained that economic theory has a poor set of explanations for the emergence of new markets because the concept of contingent markets (markets not yet in existence) lies outside of the neoclassical economic framework. In contrast, White (1981) explained that markets emerge from relationships between actors. This observation poses an interesting theoretical question: Are new markets more likely to form when prestigious actors seeking to extend their prestige to new domains establish them? Our results on the role of prestige in facilitating market transactions suggest the importance of research that considers the effect of prestige on the emergence of new markets.

A second major implication of our results is that prestige helps to overcome problems of market failure, extending research on the social embeddedness of market transactions in a new direction. Prior research (Granovetter, 1985; Bradach and Eccles, 1988; Powell, 1990) has argued that social ties between actors help to overcome the problems inherent in market transactions. Because social ties enhance trust and facilitate information transfer, they overcome information problems that undermine market-based transactions. Unlike past research on social ties, this study supports a different stream of research on the social embeddedness of markets. Similar to Podolny (1994), our results demonstrate that, under conditions of uncertainty, people often use prestige to make decisions. Because the mechanism through which prestige influences market transactions is different from that of social ties, this study suggests the importance of research that examines prestige as well as social ties in explaining the social embeddedness of markets. Both streams of research would appear to be important in correcting under-socialized views of these transactions.

The third major implication of our results is to extend prestige effects to markets for knowledge. Arrow (1962) explained that markets for knowledge-based assets are plagued by problems of uncertainty, indivisibility, and inappropriability. Yet, markets for knowledge are facilitated by prestige. Although organizational theorists have often viewed economic arguments for market failure as under-socialized, they have undertaken little investigation of social mechanisms, like prestige, that overcome failure in markets for knowledge. Because these assets are increasingly important in modern society, the absence of research concerning how prestige facilitates knowledge transfer in markets is an important void in organizational conceptions of market behavior.

The fourth major implication of our study has been to provide an organizational explanation for university technology transfer. Although economists have been quick to develop theories to explain technology transfer in the post-Bayh-Dole era, few organizational theorists have sought to explain this phenomenon (important exceptions include Etzkowitz (1998) and Raider (1999). This study provides support for an organizational perspective on university technology transfer. Economic studies of technology transfer assume that inventions with the best technical specifications are the ones that will be licensed from universities. In contrast, this study follows the logic of sociologists of technology (e.g., Podolny and Stuart, 1995) who argue that technical attributes alone may be insufficient to explain the likelihood of transfer.

The evidence that prestigious universities are more successful at licensing technology is also consistent with several themes in the sociology of technology. It supports the thesis that technical outcomes are not only a function of objective attributes, but are also a function of the social context in which those activities are embedded (Granovetter, 1985; Scott, 1994; Podolny, 1994). In addition, it suggests the idea that technological evolution is socially constructed. As a result, a Matthew effect (Merton, 1968) might explain the higher performance of prestigious universities at technology licensing better than the argument that more prestigious universities produce better technology (Henderson et al, 1998). Prestigious universities may be better able to license their inventions than less prestigious universities not because the technologies that they produce are better ex-ante, but because the universities that produce them are perceived as more prestigious. Because increased revenues derived from licensing lead to greater likelihood of licensing in following years, over time, an initial prestige effect becomes embedded and strengthens status differentials in a circular flow of advantage to prestigious actors.

An important extension of this idea concerns the contribution of different universities to technical advance in industry. Because firms are more likely to invest in the development of licensed inventions than unlicensed ones, the exploitation of university technology by the private sector is enhanced by the prestige of the school transferring the technology. This pattern suggests that prestigious universities will have a disproportionate influence on the evolution of technology and industry, not because they are necessarily superior creators of technology, but because their prestige facilitates technology transfer. If more prestigious individuals are better able to diffuse knowledge than less prestigious individuals, then those institutions and their research will have a disproportionate effect on technological change in society.

Conclusion

This paper demonstrates that, over the period 1991-1998, university prestige increased the rate at which U.S. universities licensed their inventions above the rate predicted by the universities' reputations for past licensing performance. By demonstrating empirical support for the effect of prestige over and above the university's reputation for licensing, the source of research funding, their rate of invention production, and the resources of the technology licensing offices, these findings extend the arguments of sociologists and organizational theorists for prestige effects in market transactions. We hope that these results encourage future researchers to consider the importance of prestige as a mechanism to overcome market failure, particularly in the context of markets for knowledge.

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Table 2. Population Average Negative Binomial Estimation of the Annual Count of University Technology Licenses Using the Gourman Report Scores as a Measure of Prestige.

Variable	Model 1[a,b]	Model 2[a,b]	Model 3[a,b]	Model 4[a,b]
Number of Invention Disclosures	1.006*** (0.001)	1.006*** (6.320)	1.003** (0.001)	1.010*** (0.00)
Industry Funding Ratio	0.824 (0.452)	0.784 (0.441)	0.880 (0.457)	0.850 (0.44)
Disclosures per Professional Staff	0.996* (0.002)	0.995* (0.002)	0.999 (0.002)	.997* (0.00)
Medical School	1.149 (0.153)	1.110 (0.141)	1.153 (0.107)	1.101 (0.14)
Past Licensing Revenue [c] (millions of dollars)	1.014* (0.062)			
Past Licenses / Disclosures [c,d]		1.037** (0.012)		
Past Licenses Yielding Income [c,d]			1.660*** (0.098)	
Past Revenue/License				1.081* (0.04)
Gorman Report Scores [c]	1.728*** (0.159)	1.704** (0.160)	1.258* (0.104)	1.710*** (0.17)
1993	1.266** (0.110)	1.249 (0.112)	1.181 (0.131)	1.261** (0.10)
1994	1.410*** (0.113)	1.361 (0.107)	1.174+ (0.106)	1.422*** (0.12)
1995	1.302*** (0.098)	1.246 (0.095)	1.096 (0.096)	1.302*** (0.09)
1996	1.261** (0.103)	1.217 (0.096)	0.942 (0.083)	1.272*** (0.10)
1997	1.454*** (0.131)	1.423 (0.124)	1.049 (0.098)	1.441*** (0.13)
1998	1.538*** (0.159)	1.549 (0.145)	1.077 (0.114)	1.523*** (0.16)
N	540	547	545	549
Chi Square	348.9***	396.1***	639.7***	315.5***

[a] The results are reported as incidence rate ratios
[b] AR1 correlation Structure
[c] Lagged value
[d] Log transformation
*** p < .001; ** p < .01; * p < .05; + p < .10

Table 3. Population Average Negative Binomial Estimation of the Annual Count of University Technology Licenses Using the U.S. News Rankings as a Measure of Prestige.

Variable	Model 1[a,b]	Model 2[a,b]	Model 3[a,b]	Model 4[a,b]
Number of Invention Disclosures	1.005*** (0.001)	1.006*** (0.001)	1.003*** (0.001)	1.006*** (0.001)
Industry Funding Ratio	0.811 (0.390)	0.854 (0.378)	0.870 (0.428)	0.787 (0.368)
Disclosures per Professional Staff	0.996* (0.002)	0.995* (0.002)	0.998 (0.002)	0.996* (0.002)
Medical School	1.186 (0.168)	1.142 (0.151)	1.163 (0.116)	1.135 (0.154)
Past Licensing Revenue [c]	1.016* (0.000)			
Licenses / Disclosures [c,d]		1.055*** (0.010)		
Licenses Yielding Income [c,d]			1.589*** (0.091)	
Revenue/License				1.067+ (0.041)
U. S. News & World Report Rank [c]	1.012** (0.002)	1.014*** (0.002)	1.017*** (0.002)	1.014*** (0.002)
1993	1.235*** (0.114)	1.212 (0.116)	1.188 (0.133)	1.236*** (0.110)
1994	1.401* (0.120)	1.334 (0.108)	1.199 (0.112)	1.416* (0.120)
1995	1.350*** (0.099)	1.290 (0.096)	1.130 (0.100)	1.345*** (0.096)
1996	1.300** (0.106)	1.253 (0.101)	0.978* (0.089)	1.305*** (0.106)
1997	1.532*** (0.142)	1.497 (0.137)	1.107 (0.107)	1.517*** (0.143)
1998	1.583*** (0.161)	1.596 (0.147)	1.134 (0.124)	1.568*** (0.160)
N	537	534	545	521
Chi Square	303***	439.4***	639***	295.5***

[a] The results are reported as incidence rate ratios
[b] AR1 Correlation Structure
[c] Lagged value
[d] Log transformation
*** p < .001; ** p < .01; * p < .05; + p < .10

Table 1. Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Number of Licenses	1.00																
2. Number of Invention Disclosures	0.76	1.00															
3. Industry Funding Ratio	-0.13	-0.12	1.00														
4. Disclosures per Professional Staff	-0.06	0.21	-0.01	1.00													
5. Licenses / Disclosures	0.20	0.12	-0.07	-0.04	1.00												
6. Revenue/License	0.17	0.18	-0.08	0.14	0.11	1.00											
7. Past Licensing Revenue (In Millions of Dollars)	0.68	0.64	-0.11	-0.08	0.10	0.43	1.00										
8. Licenses Yielding Income	0.74	0.67	-0.13	-0.03	0.39	0.13	0.50	1.00									
9. Medical School	0.23	0.22	-0.09	-0.13	0.18	0.13	0.13	0.30	1.00								
10. Gorman Scores	0.46	0.49	-0.29	0.12	0.24	0.24	0.29	0.63	0.40	1.00							
11. U. S. News & World Report Rank	-0.44	-0.44	0.25	-0.13	-0.26	-0.20	-0.26	-0.60	-0.36	-0.90	1.00						
12. 1993	-0.02	0.00	0.02	-0.05	0.01	-0.01	-0.04	-0.02	0.04	0.06	-0.06	1.00					
13. 1994	-0.04	-0.05	-0.03	0.02	0.00	-0.01	-0.05	-0.07	0.00	-0.01	0.01	-0.15	1.00				
14. 1995	-0.03	-0.03	0.01	0.03	-0.01	0.00	-0.02	-0.03	-0.03	-0.03	0.03	-0.17	-0.19	1.00			
15. 1996	-0.02	-0.01	0.01	0.00	0.00	-0.05	-0.01	0.01	-0.03	-0.06	0.05	-0.16	-0.18	-0.20	1.00		
16. 1997	0.06	0.04	0.01	0.02	0.00	0.02	0.04	0.07	0.00	0.00	0.00	-0.15	-0.17	-0.19	-0.18	1.00	
17. 1998	0.11	0.06	0.00	-0.02	0.04	0.07	0.13	0.13	-0.01	-0.01	0.01	-0.15	-0.17	-0.19	-0.18	-0.17	1.00
Mean	20.4	71.0	0.1	27.1	.330	.732[a]	2.8	38.7	0.6	3.8	50.6	0.1	0.1	0.1	0.1	0.1	0.1
Standard Deviation	26.9	82.1	0.1	24.9	.321	.200[a]	7.4	62.0	0.6	0.8	31.1	0.3	0.3	0.3	0.3	0.3	0.3
Minimum	0.0	0.0	0.0	0.0	0.0	0.0[a]	0.0	0.0	0.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	191.0	742.0	0.6	250.0	5.8	2.72[a]	67.3	548.0	4.0	5.0	108.0	1.0	1.0	1.0	1.0	1.0	1.0

[a] 100,000 Dollars