Benchmarking U.S. University Patent Value and Commercialization Efforts: A New Approach*

June 7, 2019

David H. Hsu
Wharton School
University of Pennsylvania
dhsu@wharton.upenn.edu

Po-Hsuan Hsu
Faculty of Business and Economics
University of Hong Kong
paulhsu@hku.hk

Tong Zhou
Lingnan College
Sun Yat-Sen University
zhout59@mail.sysu.edu.cn

Arvids A. Ziedonis
Faculty of Economics and Business
KU Leuven
ziedonis@kuleuven.be

* We are grateful for helpful comments from Pierre Azoulay, Lauren Cohen, Stephen Dimmock, Chuck Eesley, Jeff Furman, Michelle Gittelman, Douglas Hanley, Thomas Hellmann, Yael Hochberg, William Kerr, Wonjoon Kim, Leonid Kogan, Josh Lerner, Kai Li, Willaim Mann, Kazuyuki Motohashi, Abhiroop Mukherjee, Ivan Png, Ariel Stern, Scott Stern, Neil Thompson, Kevin Tseng, Yanbo Wang, Yizhou Xiao, Yu Xu, and participants at the AIEA-NBER Conference, SFS Cavalcade Conference, and the Hong Kong Joint Finance Conference.

Benchmarking U.S. University Patent Value and Commercialization Efforts: A New Approach

June 7, 2019

Abstract: Despite the significance of patented university research, it is difficult to measure the economic value of their patented inventions and observe the extent to which universities are able to capture such value through patent licensing. Moving beyond assessing commercialization performance by simple statistics, we propose a new approach to benchmarking university patents and commercialization performance based on comparative corporate patent value. Our procedure involves matching university patents to patents granted to public corporations with similar patent characteristics to estimate the "potential value" of these university patents by the stock market reactions to matched corporate patent grants. We then calibrate an empirical patent valuation model for these estimated values of university patents by employing technology-level licensing data from a leading US research university. In aggregate, we compare the estimated potential values of a university's patent portfolio to its annual licensing income, and find that universities realize on average 5-9% of the estimated potential value through licensing income. Finally, we investigate the correlates of university-level potential patent value and suggest avenues for future research.

Keywords: university patents; patent value; patent licensing

JEL classification: G12; L30; O30

I. INTRODUCTION

According to the Association of University Technology Managers' (AUTM) 2015 survey of U.S. university technology transfer operations, its members filed 16,000 patent applications and received about 6,500 patent grants that year.[1] In addition, over 1,000 new ventures were formed. 879 new products based on university research were reported to have been introduced that year, and new and existing licensed products generated $29B in product sales. Recent examples of influential scientific discoveries from university research include Emory University's HIV drug Emtricitabine, New York University's anti-inflammatory agent, Remicade, to treat rheumatoid arthritis, and the University of Pennsylvania's recent pioneering work in CAR-T immunotherapy. Scientific advances have occurred not just in the life sciences; university-based breakthroughs have been achieved in cryptography (such as the RSA encryption algorithm), computing, and many other fields.

Scientific discoveries based on university research have also generated significant income. For example, over the 1991-2010 time period, licensing revenues accrued to participants of the AUTM survey averaged 22.6% of endowment income based on an estimated endowment payout of 4% per year, or 11.3% based on an 8% payout (Figure I plots the distribution of technology licensing income to endowment payouts across all university-years), to make a comparison to this more widely-discussed source of university income.[2]

[INSERT FIGURE I AROUND HERE]

[1] Although patenting by U.S. universities occurred as early as the 1920s, the Bayh–Dole Act in 1980, which allows universities to own patent rights resulting from federally-funded research, is associated with a rise in university patenting in licensing since 1980 (Mowery et al. 2004). A series of studies have examined the patenting and commercialization performance of universities since the Act (Henderson et al., 1998; Mowery, et. al. 2004).

[2] Brown et al. (2014) have examined the recent investment performance of university endowments and show that endowment payouts have become an increasingly important component of universities' revenues in recent decades.

While these statistics suggest that income from commercializing university research is significant, it is difficult to assess whether the realized licensing revenues are "small" or "large." Most assessments are based on simple statistics such as counts or dollar amounts (e.g., Huggett (2017) or AUTM annual reports). In general, estimating the private economic value of patents or patent portfolios is difficult, as observable market transactions of patent sales or licenses are rare (the transfers do not occur regularly, and even when they do, the transactions are privately struck between parties). There have been some efforts to value corporate patents based on forward citations, corporate acquisition events, observed patent renewal fees at various stages of the patent lifecycle, or through patent disputes (e.g., litigation).[3] Compounding the valuation problem is that these metrics are typically unrepresentative of the full distribution of patent values.

In this paper, we aim to evaluate the "potential" economic value of university patents (benchmarked against a similar patent portfolio granted to private firms) and to understand how much of that value has been captured through licensing revenue. We do so through the following steps: (1) we use patent-level licensing income data (including unlicensed patents) associated with 1,586 patents from a leading U.S. research university to identify patent characteristics which correlate with licensing income; (2) we use those patent characteristics to match university patents to publicly-held corporate patents and to estimate the potential value of university patents; (3) we use the patent-level licensing income data to evaluate our estimated university patent value; (4) we use the university-level licensing income of 167 AUTM-member universities to analyze the proportion of estimated university patent value that has been commercialized; and (5) using the AUTM data, we analyze university characteristics and inputs that correlate with university patent value.

[3] Trajtenberg (1990), Harhoff et al. (1999), and Hall et al. (2005) have documented a positive relation between forward citations and market value. Lanjouw (1998) and Schankerman (1998) examine the relation between patent value and patent renewal. Bhagat et al. (1994), Lerner (1995), and Bessen and Meurer (2012) have examined the market reactions to firms' involvement in patent litigation.

With that overview, we wish to provide more detail about the estimation process. We first analyze detailed patent-level licensing income data (actual licensing revenues, including patents that remain unlicensed) from a leading U.S. research university from 1974 to 2018, and find that patent quality (i.e., forward citations) and generality are important characteristics in explaining patent-level licensing income. We then identify and match U.S. university-assigned patents granted between 1976 to 2010 to a standardized list of U.S. universities. We match each patent to a publicly-held corporate patent displaying similar characteristics (described in detail below). A university patent is then assigned the median of the values of matched corporate patents estimated by Kogan et al. (2017), which is our estimated potential value.[4] To examine potential errors in our sampling and matching procedure, we conduct a simulation analysis (described below) based on randomly selected university patents and corporate patents, and find modest sampling error. It is also worth noting that while we use Kogan et al.'s (2017) estimated patent value due to its public access, our matching procedure can be based on any estimation method for corporate patent value.

We then employ the detailed patent-level licensing income data to calibrate an empirical patent valuation model. We extrapolate from this patent-level data to a sample of 167 AUTM-member universities reporting aggregate commercialization results in AUTM annual reports from 1991 to

[4] The corporate patent value estimated by Kogan et al. (2017) is based on stock market reaction to the announcement of corporate patents, which is defined as the increase in market value in the three-day period around patent approval announcements, after adjusting for benchmark returns, idiosyncratic stock return volatility, and various fixed effects (more details are provided in the Supplemental Appendix). Such a market reaction-based valuation approach follows Austin (1993) and has been widely used in the economics literature; see Bhagat et al. (1994), Lerner (1995), and Bessen and Meurer (2012) for patent litigation, and Chen et al. (2005) for new product announcements. An alternative way to evaluate the value of corporate patents is to manually collect or purchase the disclosed licensing contracts by public firms (see Kankanhalli et al., 2019); however, even those disclosed contracts are subject to selection issues and redactions. We also acknowledge the following biases in benchmarking university patents against corporate patents. On the one hand, the market reaction to patents assigned to publicly-listed companies reflects not only technological merits but also marketing and production synergies that are not available to universities (Sampat and Ziedonis, 2004). Thus, matching university patents to corporate patents may *overestimate* the value of university patents. On the other hand, it is well known that the total economic value of an invention consists of private rent and public benefits. Since market reaction to corporate patents only reflects private rents, the proposed approximation may *underestimate* the total economic value of university patents. Moreover, we evaluate each patent separately and thus unavoidably neglect the potential complementarity of patents in a patent portfolio.

2010. We find that a university's potential patent value is positively associated with its license income and startups founded. We estimate through this approach that an average university in the sample realized 5-9% of their potential patent value in licensing income.

Finally, we discuss the university characteristics and inputs that correlate with patent value creation. Among university-level variables we collect from the AUTM survey data or other sources, R&D investment, the number of faculty members, and the number of full-time employees in the technology transfer office (TTO) have explanatory power for a university's patent value, while Carnegie research ranking and the presence of an affiliated medical school have no or only weak explanatory power.

Overall, we propose a new benchmarking approach for universities and their stakeholders to evaluate the economic value of patent portfolios held by universities and assess university technology commercialization efforts. This approach may be informative to universities and policymakers for resource and asset allocation decisions relying on evidence-based indicators.[5] We also add new evidence to the literature on universities' patent value and licensing income, as well as the factors influencing their performance in commercialization.[6] A novelty of our approach is that we introduce matched corporate patent values into the evaluation. Our empirical evidence thus offers new insights to the assessment and realization of the value of university patents. Nevertheless, we also acknowledge the limitations of our estimation approach and research design

[5] For example, UMETRICS is a recent initiative in organizing all input and output indicators related to science activities in universities (see Weinberg et al., 2014; Lane et al., 2015).

[6] We find a university patent's forward citations and generality to be significantly and positively related to its licensing income. Using the licensing income data of University of California and Columbia University in the 1980s and 1990s, Sampat and Ziedonis (2004) find that the number for forward citations predicts if a patent is licensed but not the amount of revenue. Lach and Schankerman (2008) find that U.S. universities that give higher royalty shares to faculty members are associated with higher license income. Azoulay et al. (2007) and Audretsch et al. (2009) examine the determinants of the commercialization of research done by university scientists. In addition, Thursby and Kemp (2002), Thursby and Thursby (2002), Di Gregorio and Shane (2003), Siegel et al. (2003), Belenzon and Schankerman (2009), and Sampat (2006) have examined why some universities exploit their intellectual property more effectively than do others in terms of licensing patents and startup creation.

and discuss them in detail in the concluding section.

Our study also speaks to the analysis of rent-sharing of innovation output. Our estimate for university patent value is based on corporate patent value that comprises not only the direct technical value of the invention, but also complementary marketing and production (Teece, 1986; Arora et al., 2001). Because universities are unable to realize the economic value of their patented inventions by reaching the market themselves, we interpret the "conversion" rate of 5 to 9% in our AUTM dataset as a rent share to, or economic value created by academic researchers through upstream research activity with the remaining value accruing to the downstream licensee.[7]

II. DATA

We first describe the process of collecting university patents and associated information in Section A. In Section B, we describe the patent licensing dataset of a prominent U.S. research university, which allows us to associate patent characteristics with actual patent licensing revenue. We then explain our matching process for university and corporate patents and the estimation of the potential value of university patents in Section C.

A. University Patent Data

We first collect data on patents granted to U.S. universities from 1976 to 2010. Specifically, we manually construct a list of assignees and corresponding identifiers (PDPASS) that are U.S. universities, institutes, and foundations. We first examine the National Bureau of Economic Research (NBER) patent assignee file (1976-2006) and identify all assignees in the category of

[7] Relatedly, a recent study by Kline et al. (2017) also uses Kogan et al.'s (2017) patent value and shows that 29% of patent-induced operating surplus is transferred to workers (including inventors and non-inventors).

"U.S. University."[8] We then use other sources to identify research institutes and other entities affiliated with universities.[9] We then manually search possible names (universities, research institutes, and foundations) in other non-university categories in the NBER patent assignee file and extract related unique identifiers (known as "PDPASS" in the dataset). For example, the hospital of the School of Medicine of Tufts University is listed under the "U.S. Hospital" category. Also, the Purdue Research Foundation affiliated with Purdue University is listed in the category of "U.S. Institute." This process results in a list of 362 U.S. universities which received at least one patent in the sample period. The complete list of the university-PDPASS pairs is reported in Table OA.III of the Supplemental Appendix.

Based on the university-PDPASS pairs, we construct a dataset of U.S. university patents. We then combine the patent and citation data from NBER (Hall et al., 2001), Patent Network Dataverse of Harvard University (Li et al., 2014), and Patentsview to construct a dataset that includes detailed information on each patent granted to U.S. universities from 1976 to 2010.[10] The resulting sample consists of 77,880 university-linked patents.

We then assemble the following patent characteristics variables commonly used in the prior literature on university patenting: (i) *Quality* is defined as the number of forward citations received by a patent within five years after its grant year (Trajtenberg, 1990; Sampat and Ziedonis, 2004; Hall et al., 2005);[11] (ii) *Generality* is defined as one minus the Herfindahl-Hirschman Index (HHI)

[8] For example, Harvard University has several different names in this category, including "Harvard College," "Harvard President & Fellows of Harvard College," "Harvard Univ. Office of Tech Transfer," etc.
[9] Some university patents are assigned to categories other than universities, such as institutes (e.g., university hospitals) or research corporations affiliated to universities. We use the *U.S. News National University Rankings* and *Top 100 Worldwide Universities Granted U.S. Utility Patents* published by National Academy of Inventors to help identify universities and their affiliates in our sample.
[10] The NBER database is downloadable via: http://www.nber.org/patents/; Patent Network Dataverse of Harvard University is downloadable via: https://dataverse.harvard.edu/dataverse/patent; and the Patentsview database is downloadable via: http://www.patentsview.org/web/.
[11] Lanjouw and Schankerman (2004) find that forward citations explain 48% of the variation of their patent quality index. Harhoff et al. (1999) and Hall et al. (2005) show that forward citations are associated with higher patent valuation from survey and stock price data, respectively.

of patent subcategory citations received from forward citing patents (Trajtenberg et al., 1997; Hall et al., 2001); (iii) *Originality* is defined as one minus the HHI of patent subcategory citations of the focal patent (Trajtenberg et al., 1997; Hall et al., 2001); (iv) *Basicness* is defined as the ratio of the number of references to prior non-patent documents divided by the total references in the focal patent, which reflects the direct dependence on scientific and academic knowledge (Trajtenberg et al., 1997; Fleming and Sorenson, 2004; Ali and Gittelman, 2016); and (v) *Claims* denotes the number of claims of each granted patent, which defines the coverage and scope of a patent (Lerner, 1994).

In Table I, we report the averages for all five measures for the university patents in our sample and patents assigned to U.S. public firms.[12] We find that university patents receive significantly more forward patent citations (5.55 vs. 4.97) on average, are more general (0.44 vs. 0.38), are more original (0.42 vs. 0.36), are more "basic" (0.47 vs. 0.11), and contain more claims (20.39 vs. 16.31) compared to corporate patents.[13] These differences are largely consistent with the literature (e.g., Trajtenberg et al., 1997; Henderson et al., 1998). We take these five characteristics into account in our matching procedure.

[INSERT TABLE I AROUND HERE]

We also observe that university patents are concentrated in certain technology fields such as Drugs, Chemicals, and Surgery and Medical Instruments, as shown in Panel C of Table OA.I in the Supplemental Appendix. We define technology fields by the two-digit subcategory codes of Hall et al. (2001). Our matching procedure takes technology field differences into account by matching

[12] Our corporate patents include 1,361,771 patents granted to assignees in U.S. public firms (i.e., assignees with GVKEY identifiers) in the NBER assignee file from 1976-2010.

[13] Consistent patterns are observed in different sample periods (Panel A in Table OA.I in the Supplemental Appendix), in distribution (Panel B in Table OA.I in the Supplemental Appendix), and in different technology subcategories (Panel D to Panel G in Table OA.I in the Supplemental Appendix).

each university patent to corporate patents in the same technology field (to be discussed in more detail later).

B. Patent Licensing Dataset

We collect a complete patent licensing dataset from a leading U.S. research university to facilitate our estimation of university patent value as compared to corporate patent value. The dataset includes 7,797 unique technologies and 779 licensing contracts. Among unique technologies, 2,246 licensed and 5,551 unlicensed, from 1974 to 2018. Some technologies are patented and some are not. A licensing contract (i.e., agreement) includes one or more technologies with related patent numbers (if associated patent applications were filed and granted), licensing status, execution date, license fee, maximum royalty rate, exclusivity in licensing or not, lifetime revenue, technology fields, etc. There are on average 2.88 technologies included in a licensing contract. Among the 779 licensing contracts, 227 are exclusive, 12 are co-exclusive, and 540 are non-exclusive. The licensing revenue reflects the total amount of cash received based on licensing, royalties, or equity. According to our contact at the university, the majority of the startups do *not* include an equity component in the license; thus, lifetime revenue mainly comes from license fees and royalties.

We focus on 765 licensed patents and 821 unlicensed patents from 1976 to 2010 and calculate a patent's licensing revenue as the lifetime revenue of the contract divided by the number of patents involved. Because patents in our data have different "lifetimes" to be licensed, truncation bias is a potential concern. For example, the lifetime revenue from a patent that was recently granted could be zero if it has not been licensed or may be underestimated as we only know its income by 2017. We take a conservative approach and do not attempt to extrapolate or estimate the future income from those patents that are subject to such truncation bias. Note that all revenue income recorded at this level is inclusive of the amount which will be shared with the inventor and the inventor's department (which together represent an average of about 30% of the gross licensing revenues at this institution).

Our dataset also includes unlicensed patents, and their licensing revenue is set as zero if the patent is never observed to result in positive revenue. This conservative setting unavoidably underestimates the value of university patents for several reasons: first, some unlicensed patents may be valuable to industries but were unlicensed for any number of reasons. Second, these patents may have been exploited by firms without receiving royalties because universities may be less aggressive in enforcing IP rights. Finally, to be conservative in the estimation, we do not impute positive patent licensing income to unlicensed patents, though some of these patents may result in licensing income outside of the observation window (particularly for patents granted in more recent years).

Table II presents the patent-level summary statistics of variables of 765 licensed patents and 821 unlicensed patents from 1976 to 2010. Among the licensed patents, 333 are exclusive, 135 are co-exclusive, and 297 are non-exclusive. Among these 765 licensed patents, their mean, median, standard deviation, and maximum of lifetime revenue (in thousands) are 185, 17, 725, and 11,256, respectively. The mean and median of maximum royalty rate are 3.44% and 3%, respectively. The mean, median, standard deviation, and maximum of licensing fee (in thousands) are 11, 1, 52, and 625, respectively.

We also compare patent characteristics of licensed patents to those of unlicensed patents. We find that, on average, licensed patents are created by more inventors (2.73 vs. 2.44), are more highly cited (7.28 vs. 3.13), are more general (0.46 vs. 0.40), are more original (0.37 vs. 0.34), are more basic (0.55 vs. 0.49), and contain more claims (15.86 vs. 14.58) than unlicensed ones. Each of these differences is statistically significant.

[INSERT TABLE II AROUND HERE]

C. Estimating University Patent Value

To identify which patent characteristics are correlated with realized licensing revenues, we perform OLS regressions of patent lifetime revenue on quality, generality, originality, basicness, the number of claims, and fixed effects for years and subcategories using the 1,586 patents (765 licensed patents and 821 unlicensed patents) from a leading U.S. research university. The lifetime revenue of each patent is inflation-adjusted based on the consumer price index (CPI) of the grant year of the patent: we scale the lifetime revenue of a patent by the CPI from the Federal Reserve Bank of St. Louis (the index is normalized as 1 for years 1982-1984). Results are reported in Table III. Regardless of whether lifetime revenue is specified in a linear form (Panel A) or in a log-one-plus form (Panel B), both quality and generality are estimated with positive and statistically significant coefficients in most cases. Other patent characteristics do not appear to positively correlate with realized licensing revenues. We therefore conclude that both quality and generality are key determinants of university patent value, and use them in our subsequent matching and benchmarking efforts for all university patents. Interestingly, Henderson et al. (1998) also focus on these two characteristics in comparing university and corporate patents. We also argue that, as generality reflects externality and spillover effects, it captures public benefits of university patents to a certain extent.

[INSERT TABLE III AROUND HERE]

The next step is to estimate the potential value of all university patents by benchmarking them against similar corporate patents. First, we collect the patent value of corporate patents (i.e., patents assigned to public firms) from Kogan et al. (2017),[14] which calculates the value of a patent granted to a U.S. public firm using stock market reaction to the announcement of the patent – we proxy a public firm's patent value with the 3-day appreciation of market capitalization of this firm around the announcement, adjusted for measurement noise and various fixed effects. The details of the estimation is provided in the Supplemental Appendix. The estimated patent value is also inflation-adjusted based on the CPI (the index is normalized as 1 for years 1982-1984). Kogan et al.'s (2017) market reaction-based valuation approach follows Austin (1993) and is consistent with the valuation of patent litigation of Bhagat et al. (1994), Lerner (1995), and Bessen and Meurer (2012) and the valuation of new products of Chen et al. (2005).

Second, we benchmark each university patent to similar corporate patents to estimate its potential value based on a matching method based on quality, generality, technology field, and grant year. A university patent's potential value is the stock market reaction to a similar patent that is granted to the private sector. Specifically, the potential value of a university patent is set to that of a corporate patent that is in the same patent sub-category, granted in the same year, and has the shortest sum of distances to the focal university patent in terms of quality and generality.[15] If there are multiple corporate patents satisfying the above criteria, we set the university patent value to be the median value of those corporate patents. We find that the quality and generality of university patents are similar to those of matched corporate patents: 7.67 vs. 7.58 in average quality and 0.47 vs. 0.47 in average generality.

Table IV presents the distribution statistics of estimated patent value (*PatVal(Matched)*) of 77,880

[14] The patent value data is downloadable via: https://iu.app.box.com/v/patents.
[15] As shown in Table III, these two characteristics (quality and generality) have the greatest explanatory power of university licensing revenues. The distance along a patent characteristic is measured by the absolute value of the difference between two values divided by their sum. For example, if a university patent has its forward citation as 4 and its generality as 0.3 and a corporate patent has it forward citation as 6 and its generality as 0.1, then their distance is equal to 0.7, calculated as

$$\frac{|4-6|}{4+6}+\frac{|0.3-0.1|}{0.3+0.1}=0.7.$$

university patents and that of 1,361,177 corporate patents (*PatVal*). We find that the average (median) value is $14.77 ($5.33) million among university patents, compared to $12.09 ($3.62) million among corporate patents. These figures suggest that university patents may be at least similarly valuable as corporate patents when they exhibit similar patent characteristics. Figure II illustrates the distributions of the values of university patents and corporate patents. They are highly comparable except for the left tail.

[INSERT TABLE IV AROUND HERE]

[INSERT FIGURE II AROUND HERE]

We also implement simulations to examine potential errors if our collection of university patents is incomplete or if our matching method is biased. In each simulation, we randomly draw half of the university patents and half of the corporate patents within each subcategory-grant year group. We then benchmark each university patent to similar corporate patents, all from the random draw, and assign it the value of a similar corporate patent that is in the same patent sub-category, granted in the same year, and has the shortest sum of distances in terms of quality and generality. Similar to the previous procedure, we set the university patent value to be the median value of all corporate patents that satisfy the above criteria. We calculate the median and mean of the estimated values of all randomly drawn university patents and then calculate the absolute percentage deviation between the median (mean) and the full-sample median of 5.33 (mean of 14.77). By repeating the aforementioned procedure 500 times, we collect 500 absolute percentage deviations of median and mean and plot their frequency in histogram in Figure III. We find that all absolute percentage deviations of median are within the 5% range, and that most of absolute percentage deviations of mean are within 7.5%. These findings confirm that our matching and valuation method for university patents is reasonably robust to sampling of university and corporate patents – even when the sample size randomly drops by half, the majority of sampling errors in median and mean are below 5% and 7.5%, respectively.

III. VALUATION TESTS

In Subsections A and B, we cross-check our valuation method with licensing data at both the patent level and the university level, respectively. In Subsection C, we examine university characteristics which correlate with the cross-university variation in patent value.

A. University Patent Value and License Revenue at the Patent Level

We now revisit the 1,586 licensed and unlicensed patents from the leading U.S. research university analyzed above. We cross-check our valuation method by comparing the estimated patent values to patent licensing revenue. In particular, we regress patent lifetime revenue on estimated patent value, controlling for other patent characteristics, year fixed effects, and technology field fixed effects (by subcategory), in both linear and log-one-plus forms (Panels A and B, respectively). As shown in Table V, our estimated patent value is significantly and positively associated with the actual realized licensing revenue in all specifications. Such a pattern is robust to linear and log forms, the inclusion of other patent characteristics (i.e., originality, basicness, and claims), and the inclusion of year and patent subcategory fixed effects. The fact that our estimated patent value explains realized licensing revenue suggests that our method indeed captures the variation in university patent value to a certain extent. The coefficients on *PatVal(Match)* in Panel A provide an estimate of the extent to which a university patent value is successfully commercialized. Taking Column (1) as an example, the coefficient on *PatVal(Match)* is 0.1484 when we do not include the intercept term, which implies that a patent worth $1 million is associated with $0.15 million of licensing income on average. When we include the intercept term in Column (2), the coefficient on *PatVal(Match)* becomes 0.0819 and implies that an increase of $1 million worth of patent value is associated with an increase of $0.08 million in licensing income on average. The coefficient drops to 0.0608 but remains statistically significant when we include more control variables and fixed effects in the regression (Column (5)). As a result, Table V suggests that the university realizes approximately 6.1-14.8% of the total private value of corporate patents with similar characteristics.

[INSERT TABLE V AROUND HERE]

Given the importance of medical innovation in universities' patent portfolios (as shown in Panel C of Table OA.I in the Supplemental Appendix), we also report the estimated results based on 663 drug-related patents of the U.S. research university in Table OA.II in the Supplemental Appendix. We find that the coefficients on *PatVal(Match)* range between 7.1% and 12.6% in Panel A, which are largely consistent with the estimates in Table V.

B. University Patent Value, License Revenue, and Startups at the University Level

We proceed to examine the relation between patent value and license income at the university level by collecting the annual statistics of university-level license income and number of startups formed from the annual reports of AUTM.[16] These two statistics allow us to measure the commercialization performance of a university's IP in two different dimensions. We include a total of 167 U.S. universities that have reported outcomes to the AUTM survey at least once between 1991 and 2010. We use the CPI to adjust all annual licensing incomes to the level of 1982-1984. In this sample, the average, median, and standard deviation of annual license income (in millions) are 4.50, 0.69, and 16.75, respectively. Moreover, the average, median, and standard deviation of the number of startups formed are 2.84, 1.00, and 4.51, respectively. We sum up the estimated values of all patents

[16] For example, Northwestern University earned $824 million in license income in 2008, which tops all university-year observations. In terms of total license income in 1991-2010, University of California, New York University, and Columbia University are the top three universities (with totals of $1,805 million, $1,790 million, and $1,392 million, respectively).

granted to each of the 167 U.S. universities in each year. The average, median, and standard deviation of estimated university patent value (in millions) are 386.88, 109.00, and 957.07, respectively.

To understand to what extent a university's patent value explains its total license income spanning multiple years, we estimate a *cross-sectional* regression as follows: first, we define a university's patent value in year *t* as the sum of estimated values of all patents granted to the university in year *t*. We then calculate the time-series average of each university's patent value to be the main explanatory variable, *Average PatVal(Match)*, in Table VI. Second, since patents are valid up to 20 years and thus generate licensing income for multiple years, we calculate a university's total license income in a year using a straight line depreciation plan to discount its annual inflation-adjusted license income in the following 20, 15, and 10 years.[17] We then calculate the time-series average of each university's total license income to be the dependent variable in Table VI. Last, we conduct cross-sectional regressions to regress universities' average total license income on *Average PatVal(Match)*.

We report the OLS regression estimations in both a linear form and a log form in Table VI Panel A. We find that the coefficients on *Average PatVal(Match)* are significant in all specifications, suggesting that the estimated potential patent value explains license income. Taking Column (1) based on 20-year license income as an example, the coefficient on *Average PatVal(Match)* is 0.0904. This indicates that an increase of $100 million worth in a university's new patents is correlated with an increase of $9.0 million worth in a 20-year license income stream on average. When we use 15- and 10-year license income (Columns (3) and (5)), the coefficients on *Average PatVal(Match)* are 0.0689 and 0.0474, indicating that an increase of $100 million worth in a

[17] Each university-year observation is included in our regression sample for Table VI when the university shows up on the AUTM report in that year. In the 2,109 observations, we impose the missing license income of 36 observations (or 1.71% of the sample) to be zero. When we calculate future license income based on future 20, 15, and 10 years, the straight line depreciation rates are 5%, 6.77%, and 10%, respectively.

university's new patents is correlated with an increase of $7 and $5 million worth in a 15- and 10-year license income stream, respectively. These statistics suggest that universities realize 5-9% of the estimated value based on publicly-held corporate patents with similar characteristics as those from our sample of universities.

In Table VI Panel B, we examine the relation between our estimated university patent value and the number of startups formed at the university level. Similar to the approach used in Panel A, we use the time-series average of the discounted number of startups created by the university in the following 20, 15, and 10 years as the dependent variable.[18] Results reported in Panel B are also based on cross-sectional regressions, for which we regress the time-series average of discounted number of startups created by a university in the following 20, 15, and 10 years on the university's *Average PatVal(Match)*. Results suggest a positive and statistically significant relation and confirm the intuition that more technologically capable universities create more new businesses. In terms of economic magnitude, Column (1) suggests that 42 (=0.0440*957.07) more startups will be formed in the following 20 years if the value of a university's patent portfolio increases by one standard deviation. Such an estimate is substantial given that sample average and median are 2.84 and 1.00, respectively, per year.

[INSERT TABLE VI AROUND HERE]

C. University Patent Value and University Characteristics

After showing that university patent value is able to explain both patent licensing and startup formation, we analyze the production function of university patent value to understand what inputs

[18] Each university-year observation is included in our regression sample for Table VI when the university shows up on the AUTM report in that year. In the 2,109 observations, we impose the missing number of startups of 709 (or 33.62% of the observations) to be zero.

are crucial to valuable university patents. We collect the following university variables as "inputs": the five-year cumulative inflation-adjusted R&D expenditure (*R&D*, with a 20% obsolescence rate per year), a dummy variable indicating whether the sample university is a Carnegie-ranked research university or not (*Carnegie*), the number of full-time faculty members (*Faculty*), the full-time equivalents (*FTE*) in technology transfer office (*TTO*) in that year, and a dummy variable indicating whether the sample university has a medical school or not (*Medical School*). The information on R&D expenditure and the existence of a technology transfer office is collected from AUTM annual surveys. The data on full-time faculty numbers are manually extracted from the Carnegie report (1994, 2000, 2005, and 2010).[19] The information on the presence of a medical school is collected from internet searches. We require a university to have non-missing values in *R&D*, *Faculty*, and *FTE* to enter into the sample. Table VII Panel A reports the cross-sectional correlation matrix of these university characteristics. Perhaps not surprisingly, some variables are highly correlated. For example, the correlation coefficient between R&D expenditure and the number of full-time faculty (number of full-time equivalents) is 0.891 (0.928).

We then regress the estimated potential value of all patents applied by (and later granted to) a university in a year on several university characteristics in a log-log form assuming a Cobb-Douglas production function of patent value. Results reported in Panels B and C are based on pooled regressions for university-year observations and cross-sectional regressions based on university observations, respectively.[20] To avoid multi-collinearity, we first include these characteristics in regressions one by one in Columns (1) to (5) in Panel B. We find that all are positively and significantly correlated with the output of patent value. When we include all five variables together in one regression, however, we find that only R&D expenditure, the number of full-time faculty

[19] We assign the number of faculty members in 1994 to all years before 1994, and apply this rule to fill in the number for each university in all other years.

[20] For pooled regressions in Panel B, we use standard errors clustered by university to correct for errors in autocorrelation. For cross-sectional regressions in Panel C, we average all dependent variables and independent variables, and then run OLS regression using a total of 158 observations (due to missing information for some universities).

members, and the number of full-time equivalents in the TTO are statistically significant in Column (6). The coefficients of *Carnegie* and *Medical School* become insignificantly negative in Column (6), likely due to multi-collinearity. In terms of economic magnitude, a doubling of R&D expenditure, the number of full-time faculty, and TTO employees, is associated with patent value increases of 55%, 33%, and 42%, respectively, holding other variables fixed.

Panel C reports cross-sectional regressions, as longitudinal variation of the right-hand side variables may be modest. In particular, we regress the time-series average of total estimated potential value of patents applied by (and later granted to) a university in all years on the time-series averages of the five input variables. We find that when only one input variable is included at a time, each is positively and significantly correlated with university patent value, except in Column (5) for the existence of medical schools. When we include these five variables in one regression, we find that only R&D expenditure and the number of full-time faculty have statistically significant explanatory power for university patent value. Their coefficients suggest that doubling a university's research expenditure or full-time faculty is associated with increased patent value output by 64% or 30%, respectively, holding the other variables fixed.

[INSERT TABLE VII AROUND HERE]

III. CONCLUSION AND DISCUSSION

The degree to which universities should be in the business of commercially translating their scientific discoveries through patenting, licensing and startup efforts has long been debated (e.g., Bok, 1982; Etzkowitz, 1994; Mowery et. al. 2004; Åstebro et al., 2012). To better inform that debate and to more generally assess university technology commercialization efforts, we develop a novel approach to estimating (a) the potential economic value of university patents, and (b) the proportion of this value that is accrued by the university through licensing. Further analyses suggest that research expenditure, the number of researchers, and full-time equivalents in TTO are key factors correlated with university patent value.

Our analysis contains some limitations that are worth further discussion. As we have acknowledged earlier, one limitation of our "market-based" measure of patent value is that stock market reaction to comparable patents held by corporations may reflect value capture expectations of more fully-integrated operations (Teece, 1986; Arora et al., 2001) that may not be appropriate for academic institutions which lack the complementary assets often required for commercialization. Nevertheless, we are proposing a new approach that can be applied to *any* pricing data or methods for corporate patents.

Second, licensing income is not the only way for universities and academic researchers to be rewarded for their innovation output. For example, the founders of many companies in Silicon Valley started their innovation at Stanford University and later made significant donations back to the university. In addition, universities and their faculty members may lack incentive to patent their inventions or license these patented inventions – their efforts may be rewarded in other forms, such as publication, grants, and peer recognition (Lacetera, 2009). Furthermore, innovation taking place on campus also enhances the human capital of faculty members, lab researchers, and students, which is positively associated with future economic payoff at both the individual and aggregate levels. Thus, estimating the economic value of university patents or commercialization performance based on licensing income underestimates universities' intellectual contribution to society (such as spillovers).

Third, we calibrate our estimate of the fraction of patent value captured by the university based on outcomes at a single university. While our baseline university is a leading research institution and prolific patenter and licensor, its practices and outcomes may not be representative of all academic institutions. More broadly, unlike that of private firms, universities' missions extend beyond profit maximization and include broad long-term goals such as the creation and dissemination of knowledge and human capital without regard to private profit. Moreover, universities may be more likely to develop technology applicable to a wider spectrum of applications as compared to corporations, such as orphan drugs. Thus based on our analysis we cannot make social welfare arguments regarding the appropriate level of patent economic value that "should" be captured by universities.

Nevertheless, the efforts of licensing university patents importantly contribute to the mission of universities, as most powerfully illustrated by the contribution of licensing revenues to university operating budgets and compared to the more frequently discussed university endowments. The main purpose of our new benchmarking approach is to provoke conversations among university policy makers as to where they believe their institution should "sit" with regard to commercializing their intellectual property assets. Conducting such an exercise, we believe, requires rigorous statistical analysis in addition to the summary metrics often currently employed in assessing university commercialization performance. Our hope is that our estimates provide some sense of the contribution of upstream scientific research versus the downstream commercialization efforts by licensees in generating economic value from patented academic discoveries. Clearly, a complete understanding and a fair assessment of the economic value generated and captured by universities of their scientific discoveries through patents requires further research and data beyond our initial foray. We look forward to actively engaging in this research in the future.

References

Ali, A., & Gittelman, M. (2016). Research paradigms and useful inventions in medicine: Patents and licensing by teams of clinical and basic scientists in Academic Medical Centers. *Research Policy*, 45(8), 1499-1511.

Arora, A., Fosfuri, A., & Gambardella, A. (2001). *Markets for Technology: The Economics of Innovation and Corporate Strategy*. MIT press.

Åstebro, T, Bazzazian, N., & Braguinsky, S. (2012). Startups by recent university graduates and their faculty: Implications for university entrepreneurship policy. *Research Policy*, 41(4), 663-677.

Audretsch, D. B., Aldridge, T., & Oettl, A. (2009). Scientist commercialization and knowledge transfer. pp. 176-201 in *Entrepreneurship, Growth, and Public Policy*, edited by Acs, Zoltán J., David B. Audretsch, and Robert J. Strom. Cambridge University Press, 2009.

Austin, D. H. (1993). An event-study approach to measuring innovative output: The case of biotechnology. *American Economic Review*, 83(2), 253-258.

Azoulay, P., Ding, W., & Stuart, T. (2007). The determinants of faculty patenting behavior: Demographics or opportunities? *Journal of Economic Behavior & Organization*, 63(4), 599-623.

Belenzon, S., & Schankerman, M. (2009). University knowledge transfer: private ownership, incentives, and local development objectives. *Journal of Law and Economics*, 52(1), 111-144.

Bessen, J. & Meurer, M.J. (2012). The private costs of patent litigation. *Journal of Law, Economics & Policy*, 9, 59-95.

Bhagat, S., Brickley, J.A. & Coles, J.L. (1994). The costs of inefficient bargaining and financial distress. *Journal of Financial Economics*, 35, 221-247.

Bok, D. C. (1982). *Beyond the Ivory Tower: Social Responsibilities of the Modern University*. Harvard University Press.

Brown, J. R., Dimmock, S. G., Kang, J. K., & Weisbenner, S. J. (2014). How university endowments respond to financial market shocks: Evidence and implications. *American Economic Review*, 104(3), 931-62.

Chan L. K. C., Lakonishok J., & Sougiannis T. (2001) "The stock market valuation of research and development expenditures," *Journal of Finance*, 56(6): 2431-2456.

Chen, S. S., Ho, K. W., & Ik, K. H. (2005). The wealth effect of new product introductions on industry rivals. *Journal of Business*, 78(3), 969-996.

Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others? *Research Policy*, 32, 209-227.

Etzkowitz, H. (1994). Knowledge as property: The Massachusetts Institute of Technology and the debate over academic patent policy, *Minerva*, 32, 383-421.

Hall, B. H., Jaffe, A. B., & Trajtenberg, M. (2001). The NBER patent citation data file: Lessons, insights and methodological tools (No. w8498). National Bureau of Economic Research.

Hall, B. H., Jaffe, A. B., & Trajtenberg, M. (2005). Market value and patent citations. *RAND*

Journal of Economics, 36, 16-38.

Harhoff, D., Narin, F., Scherer, F. M., & Vopel, K. (1999). Citation frequency and the value of patented inventions. *Review of Economics and Statistics*, 81(3), 511-515.

Henderson, R., Jaffe, A., & Trajtenberg, M. (1998). Universities as a source of commercial technology: a detailed analysis of university patenting, 1965–1988. *Review of Economics and Statistics*, 80(1), 119-127.

Huggett, B. (2017). Top US universities, institutes for life sciences in 2015. *Nature Biotechnology*, *35*(3), 203.

Kankanhalli, G. and Kwan, A., & Merkley, K. J. (2019). Speech is silver, but silence is golden: Information suppression and the promotion of innovation. Working paper.

Kline, Patrick, Petkova, N., Williams, H., & Zidar, O. (2017). Who profits from patents? Rent-sharing at innovative firms. Working paper.

Kogan, L., Papanikolaou, D., Seru, A., & Stoffman, N. (2017). Technological innovation, resource allocation, and growth. *Quarterly Journal of Economics*, *132*(2), 665-712.

Lacetera, N. (2009). Academic entrepreneurship. *Managerial and Decision Economics*, 30(7), 443-464.

Lach, S., & Schankerman, M. (2008). Incentives and invention in universities. *RAND Journal of Economics*, 39(2), 403-433.

Lane, J.I., Owen-Smith, J., Rosen, R.F., & Weinberg, B.A. (2015). New linked data on research investments: Scientific workforce, productivity, and public value. *Research Policy*, 44(9), 1659-1671.

Lanjouw, J. O. (1998). Patent protection in the shadow of infringement: Simulation estimations of patent value. *Review of Economic Studies*, 65(4), 671-710.

Lanjouw, J. O. and Schankerman, M. (2004). Protecting intellectual property rights: are small firms handicapped? *Journal of Law and Economics* 47, 45-74.

Fleming, L., Sorenson, O. (2004). Science as a map in technological search. *Strategic Management Journal*, 25(8-9), 909-928.

Lerner, J. (1994). The importance of patent scope: an empirical analysis. *RAND Journal of Economics*, 25(2), 319-333.

Lerner, J. (1995). Patenting in the shadow of competitors. *Journal of Law and Economics*, 38, 463-495.

Li, G. C., Lai, R., D'Amour, A., Doolin, D. M., Sun, Y., Torvik, V. I., Yu, A. Z., & Fleming, L. (2014). Disambiguation and co-authorship networks of the US patent inventor database (1975–2010). *Research Policy*, *43*, 941-955.

Mowery, D.C., Nelson, R.R., Sampat, B.N., & Ziedonis, A. (2004). Ivory Tower and Industrial Innovation, Stanford University Press, Stanford, CA.

Sampat, B.N. (2006). Patenting and US academic research in the 20th century: The world before and after Bayh-Dole. *Research Policy*, 35(6), pp.772-789.

Sampat, B.N., & Ziedonis, A. (2004). Patent citations and the economic value of patents: A

Preliminary assessment. pp. 277–98 in *Handbook of Quantitative Science and Technology Research*, edited by Henk F. Moed, Wolfgang Glanzel, and Ulrich Schmoch. Dordrecht: Kluwer.

Schankerman, M. (1998). How valuable is patent protection? Estimates by technology field. *RAND Journal of Economics*, 29, 77-107.

Siegel, D.S., Waldman, D., & Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. *Research Policy*, 32(1), 27-48.

Teece, D.J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, 15(6), 285-305.

Thursby, J.G., & Kemp, S. (2002). Growth and productive efficiency of university intellectual property licensing. *Research Policy*, 31(1), 109-124.

Thursby, J.G. & Thursby, M.C. (2002). Who is selling the ivory tower? Sources of growth in university licensing. *Management Science*, 48(1), 90-104.

Trajtenberg, M. (1990). A penny for your quotes: patent citations and the value of innovations. *RAND Journal of Economics*, 21, 172-187.

Trajtenberg, M., Henderson, R., & Jaffe, A. (1997). University versus corporate patents: A window on the basicness of invention. *Economics of Innovation and New Technology*, 5(1), 19-50.

Weinberg, B.A., Owen-Smith, J., Rosen, R.F., Schwarz, L., Allen, B.M., Weiss, R.E., & Lane, J. (2014). Science funding and short-term economic activity. *Science*, 344(6179), 41-43.

Figures

Figure I: Frequency of the Ratio of License Income to Endowment Payout.

We first collect the annual statistics of university-level annual license income from the annual reports of the Association of University Technology Managers (AUTM, available from 1991 to 2010). We then collect the annual statistics of university endowments of AUTM universities in 1991-2010 from National Association of College and University Business Officers (NACUBO). We then estimate each university's endowment payout in a year by multiplying each university's endowment amount by annual returns of 4% (conservative estimate) and 8% (historical mean). We calculate the ratio of licensing income to endowment payout for each university-year observation and plot the frequencies (vertical axis) of this ratio in this figure. The dotted blue line denotes the ratio based on investment return of 8%, and the red solid line denotes the ratio based on investment return of 4%. The pooled average ratio of license income to endowment payout across all university-year observations is 11.3% based on investment return of 8% (and 22.6% based on investment return of 4%).

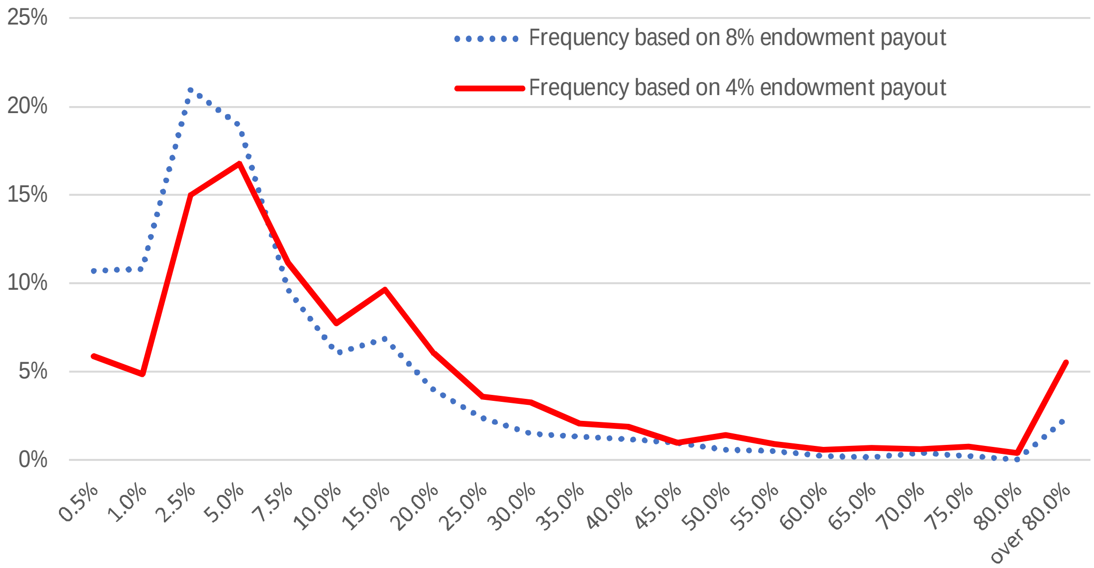


Figure II: Distributions of Value of Patents Granted to Public Firms and Universities.
We illustrate the distribution of the estimated university patent values using the reported matching method in the text, as compared to the distribution of corporate patent values. Specifically, we report the frequency of patent value in each interval for patents granted to universities and corporates, respectively.

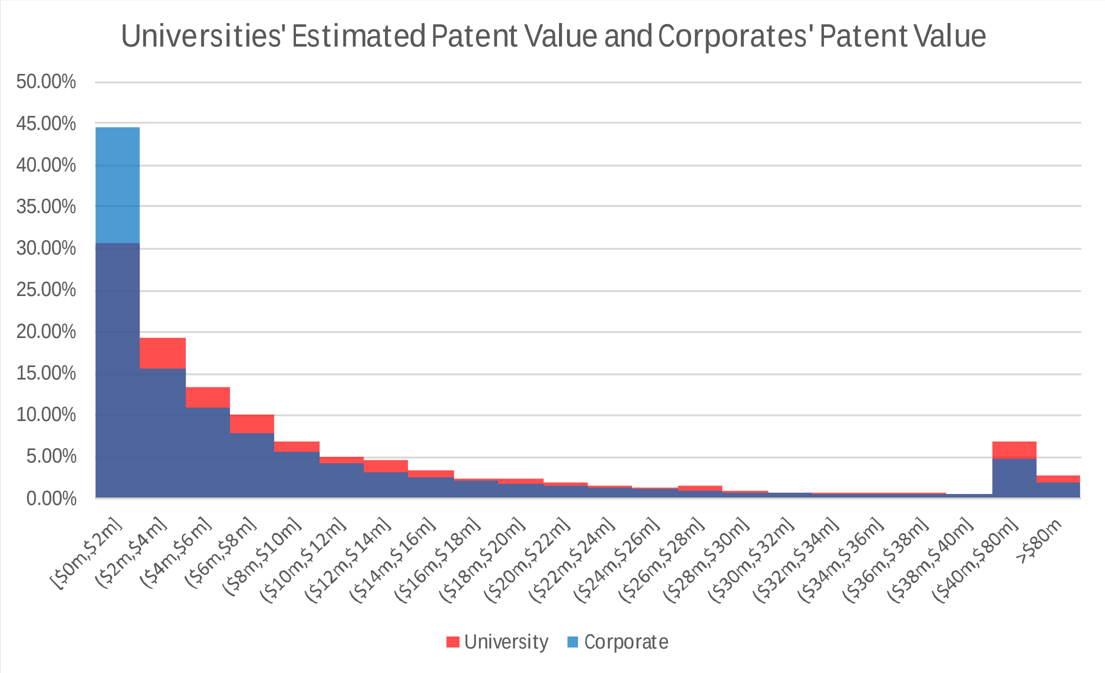
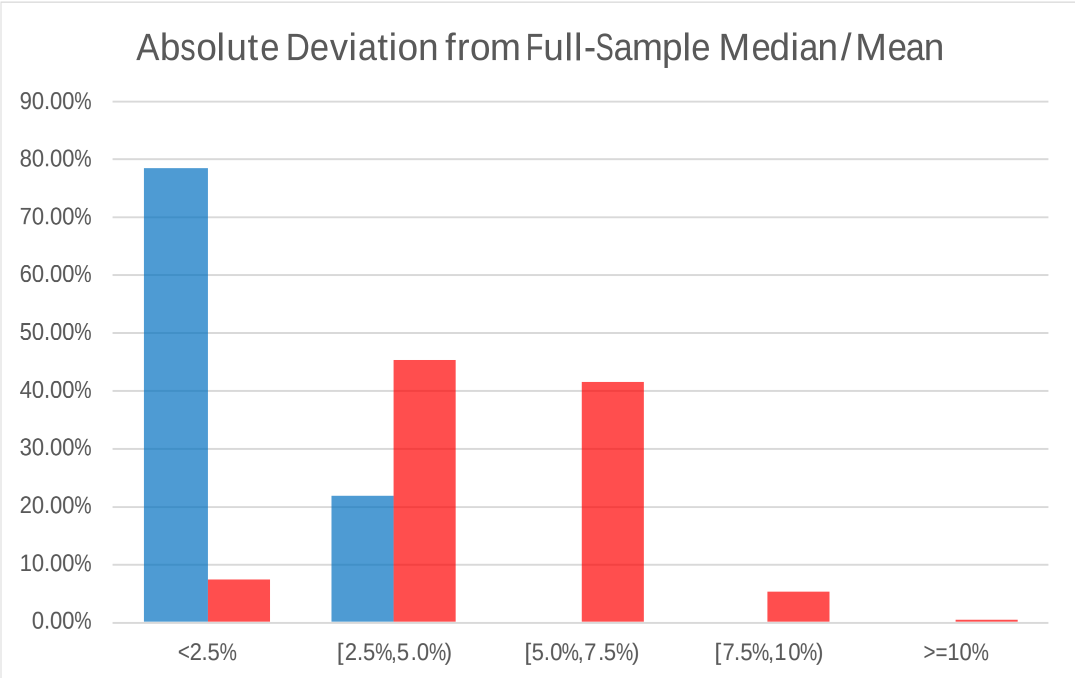


Figure III: Possible Sampling Error in the Estimation Method of University Patent Value. We examine to what extent our university patent value estimation is subject to the sampling of university patents and corporate patents. To do so, we simulate 500 sampling draws, in which for each draw we randomly select half of the university patents and half of the corporate patents by their grant years and subcategories. We estimate the value of each university patent using the matching method described in Table IV. Then we compute the median and mean of university patent value in each simulation draw, calculate its absolute percentage derivation from the full-sample median (i.e., 5.33 as shown in Table IV) and full-sample mean (i.e., 14.77 as shown in Table IV), respectively. Their distributions are shown in the blue and red histograms, respectively.



Tables

Table I: Summary Statistics of Characteristics of Patents Granted to Public Firms and Universities in the U.S.

We compare the distribution of patent quality (i.e., the citations received in five years after the patent is granted), patent generality (i.e., one minus the HHI of citations received from other patents over patent subcategories), patent originality (i.e., one minus the Herfindahl-Hirschman Index (HHI) of citations given to other patents over patent subcategories), patent basicness (i.e., the ratio of the number of references to prior "non-patent documents" divided by the total references), and number of claims of patents granted to public firms and universities. The definitions of generality, originality, and basicness follow Trajtenberg et al. (1997). ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively, when comparing the mean characteristics of universities' patents with those of public firms' patents. Sample period: 1976-2010.

	Universities					Public Firms				
	Quality	**Generaility**	**Originality**	**Basicness**	**Claims**	**Quality**	**Generaility**	**Originality**	**Basicness**	**Claims**
Mean	5.55***	0.44***	0.42***	0.47***	20.39***	4.97	0.38	0.36	0.11	16.31
Median	2.00	0.50	0.49	0.50	17.00	2.00	0.40	0.36	0.00	14.00
Standard Deviation	10.31	0.32	0.34	0.35	17.34	9.06	0.32	0.33	0.20	13.03
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
1st Percentile	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00
5th Percentile	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	3.00
25th Percentile	0.00	0.00	0.00	0.12	9.00	1.00	0.00	0.00	0.00	8.00
75th Percentile	6.00	0.69	0.69	0.79	26.00	6.00	0.66	0.66	0.14	21.00
95th Percentile	22.00	1.00	1.00	1.00	51.00	19.00	0.92	0.91	0.56	39.00
99th Percentile	50.00	1.00	1.00	1.00	84.00	43.00	1.00	1.00	0.89	63.00
Maximum	213.00	1.00	1.00	1.00	642.00	539.00	1.00	1.00	1.00	868.00
#Obs	77,880	77,880	77,880	77,880	77,880	1,361,771	1,361,771	1,361,771	1,361,771	1,361,771

Table II: Summary Statistics of Lifetime Revenue and Characteristics of Licensed and Unlicensed Patents in A Research-Oriented University.

Using a patent licensing dataset provided by a prominent research-oriented U.S. university, we report the distribution of lifetime revenue, maximum royalty rate (in percentage), license fee, exclusivity, number of technologies (patented and unpatented) in the licensing agreement/package, number of patents in the agreement/package, number of inventors, patent quality, patent generality, patent originality, patent basicness, and number of claims of licensed patents in Panel A, and the distribution of number of inventors, patent quality, patent generality, patent originality, patent basicness, and number of claims of unlicensed patents in Panel B. Sample period: 1976-2010.

Panel A: Licensed Patents

	Mean	Std	Min	Q1	Median	Q3	Max	#Obs
Lifetime Revenue	184,630	724,685	14	5,769	16,667	58,202	11,255,913	765
Max Royalty Rate	3.44	3.49	0.00	0.75	3.00	5.00	25.00	765
License Fee	11,303	51,855	0	0	1,316	6,667	625,000	765
Exclusitivity	0.61	0.49	0	0	1	1	1	765
#IP in package	17.45	26.87	1	3	7	19	99	765
#Patent in package	13.14	18.53	1	2	6	17	68	765
#Inventor	2.73	1.43	1	2	2	3	16	765
Quality	7.34	9.19	0	1	4	11	98	765
Generaility	0.41	0.31	0.00	0.00	0.50	0.64	1.00	765
Originality	0.33	0.31	0.00	0.00	0.33	0.59	1.00	765
Basicness	0.55	0.31	0.00	0.31	0.55	0.83	1.00	765
Claims	15.90	13.20	1	7	12	21	104	765

Panel B: Unlicensed Patents

	Mean	Std	Min	Q1	Median	Q3	Max	#Obs
#Inventor	2.44	1.21	1	2	2	3	12	821
Quality	3.11	5.68	0	0	1	4	93	821
Generaility	0.32	0.33	0.00	0.00	0.28	0.60	1.00	821
Originality	0.27	0.33	0.00	0.00	0.00	0.58	1.00	821
Basicness	0.48	0.36	0.00	0.13	0.50	0.83	1.00	821
Claims	14.60	11.69	1	6	12	20	86	821

Table III: Patent Characteristics and Actual University Patent Revenue.

We execute OLS regressions to examine the explanatory powers of patent characteristics for patent revenue. Our sample of patent revenue, including 765 licensed and 821 unlicensed patents, is obtained from a prominent research-oriented U.S. university. The dependent variable is the actual patent lifetime revenue in Panel A or the natural logarithm of one plus the patent lifetime revenue in Panel B, and the independent variable is one of the four patent characteristics (i.e., quality, generality, originality, basicness, and number of claims in Panel A and the natural logarithm of one plus quality, generality, originality, basicness, and the natural logarithm of one plus number of claims in Panel B). Lifetime revenue is split evenly to each patent in the same licensed agreement/package. If a patent is not licensed, we set its lifetime revenue as zero. Lifetime revenue is in $ millions and adjusted for inflation.

Panel A: A Linear-Linear Form							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Quality	0.0650***	----	----	----	----	0.0525**	0.0425*
	(0.0195)	----	----	----	----	(0.0206)	(0.0231)
Generality	----	1.3176***	----	----	----	0.9250*	1.3409**
	----	(0.4730)	----	----	----	(0.5051)	(0.5547)
Originality	----	----	0.2255	----	----	-0.1210	-0.1401
	----	----	(0.4794)	----	----	(0.5038)	(0.5532)
Basicness	----	----	----	-0.5250	----	-0.3556	-0.6932
	----	----	----	(0.4529)	----	(0.4676)	(0.5716)
Claims	----	----	----	----	-0.0021	-0.0072	-0.0051
	----	----	----	----	(0.0123)	(0.0126)	(0.0136)
Constant	0.8123***	0.6674***	1.0791***	1.4163***	1.1783***	0.8683**	----
	(0.1825)	(0.2299)	(0.2088)	(0.2791)	(0.2422)	(0.4241)	----
#Obs	1,586	1,586	1,586	1,586	1,586	1,586	1,586
R2	0.0070	0.0049	0.0001	0.0008	0.0000	0.0096	0.0685
Year FE	NO	NO	NO	NO	NO	NO	YES
SubCat FE	NO	NO	NO	NO	NO	NO	YES
Panel B: A Log-Log Form							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Quality	0.1270***	----	----	----	----	0.1308***	0.1148***
	(0.0152)	----	----	----	----	(0.0175)	(0.0209)
Generality	----	0.1980***	----	----	----	0.0108	0.1036*
	----	(0.0502)	----	----	----	(0.0570)	(0.0598)
Originality	----	----	-0.0313	----	----	-0.0777	-0.1583***
	----	----	(0.0510)	----	----	(0.0528)	(0.0568)
Basicness	----	----	----	0.0063	----	0.0538	-0.0183
	----	----	----	(0.0482)	----	(0.0492)	(0.0587)
Claims	----	----	----	----	0.0102	0.0038	0.0084
	----	----	----	----	(0.0211)	(0.0214)	(0.0233)
Constant	0.1077***	0.1938***	0.2749***	0.2624***	0.2400***	0.0846	----
	(0.0248)	(0.0244)	(0.0222)	(0.0297)	(0.0555)	(0.0673)	----
#Obs	1,586	1,586	1,586	1,586	1,586	1,586	1,586
R2	0.0421	0.0097	0.0002	0.0000	0.0001	0.0447	0.1347
Year FE	NO	NO	NO	NO	NO	NO	YES
SubCat FE	NO	NO	NO	NO	NO	NO	YES

Table IV: Distributions of Value of Patents Granted to Public Firms and Universities.

We benchmark the patent value of U.S. universities based on the value of patents granted to U.S. public firms. First, we follow Kogan et al. (2017) and calculate the value of a patent granted to a U.S. listed firm using its stock market's reaction – we proxy a public firm's patent value (*PatVal*) with the 3-day appreciation of market capitalization of this firm around the announcement of the patent, adjusted for measurement noise and various fixed effects. Second, based on the finding in Table III, we construct a matching model to estimate university patent value using quality and generality. Specifically, the value of a university patent is equal to that of a corporate patent which has the shortest sum of distances to the focal university patent in terms of quality and generality in the same grant year and in the same patent sub-category. The distance along a patent characteristic is measured by the absolute value of the difference between two values divided by their sum. For example, if a university patent has its quality as 4 and its generality as 0.3, and a corporate patent has its quality as 6 and its generality as 0.1, then their distance is equal to

$$\frac{|4-6|}{4+6} + \frac{|0.3-0.1|}{0.3+0.1} = 0.7.$$

The university patent value takes the median value if the focal patent is matched to multiple corporate patents. Patent value is in $ millions. This table reports the summary statistics of the estimated university patent values using the matching method as compared to the distribution of corporate patent values.

	PatVal(Match) **for Universities**	***PatVal*** **for Public Firms**
Mean	$14.77	$12.09
Median	$5.33	$3.62
Standard Deviation	$34.95	$36.92
Minimum	$0.00	$0.00
1st Percentile	$0.01	$0.01
5th Percentile	$0.10	$0.03
25th Percentile	$1.91	$0.58
75th Percentile	$13.41	$10.36
95th Percentile	$57.87	$46.15
99th Percentile	$162.49	$146.68
Maximum	$1,157.72	$3,401.84
#Obs	77,880	1,361,771

Table V: Market-Based Patent Value and Actual University Patent Revenue.

We execute OLS regressions to examine the explanatory power of estimated patent value for patent revenue. Our sample of patent revenue, including 765 licensed and 821 unlicensed patents, is obtained from a large patent office in a prominent U.S. university. The dependent variable is the actual patent lifetime revenue in Panel A or the natural logarithm of one plus the patent lifetime revenue in Panel B, and the independent variable of interest is the estimated patent value (*PatVal(Match)*, using the matching methodology discussed in Table IV) in Panel A and the natural logarithm of one plus the estimated patent value in Panel B. We also control for patent originality, patent basicness, number of claims, grant year fixed effects, and patent sub-category fixed effects. Lifetime revenue and estimated patent value are in $ millions and adjusted for inflation. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Panel A: A Linear-Linear Form					**Panel B: A Log-Log Form**				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
PatVal(Match)	0.1484***	0.0819***	0.0949***	0.0843***	0.0608**	0.2921***	0.1325***	0.1514***	0.1321***	0.0692***
	(0.0244)	(0.0253)	(0.0256)	(0.0254)	(0.0268)	(0.0155)	(0.0213)	(0.0210)	(0.0214)	(0.0235)
Originality	----	----	6.0782**	-1.1031	-2.4355	----	----	0.1488	0.0839	-0.0781
	----	----	(2.9042)	(3.1703)	(3.3836)	----	----	(0.0986)	(0.0992)	(0.1036)
Basicness	----	----	6.0337***	-5.5744*	-3.6269	----	----	0.1724**	-0.0343	-0.2713**
	----	----	(2.0558)	(2.9603)	(3.5176)	----	----	(0.0797)	(0.0927)	(0.1075)
Claims	----	----	0.0735	-0.1309	-0.1235	----	----	0.1041***	-0.0366	0.0061
	----	----	(0.0708)	(0.0797)	(0.0847)	----	----	(0.0239)	(0.0404)	(0.0428)
Constant	----	8.2396***	----	13.3963***	----	----	0.4527***	----	0.5379***	----
	----	(1.0251)	----	(2.4781)	----	----	(0.0431)	----	(0.1250)	----
#Obs	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586	1,586
R2	0.0228	0.0066	0.0473	0.0102	0.1524	0.1834	0.0238	0.2284	0.0247	0.3387
Year FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
SubCat FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES

Table VI: Association between Patent Value and License Income/Startups Formed in U.S. Universities.

In this table, we examine the explanatory power of our estimated university patent value (*Average PatVal(Match)*) for future license income and number of startups formed at the university level. To do so, we run cross-sectional regressions of future license income (in Panel A) and future number of startups formed (in Panel B) on patent value. We first define a university's patent value in year *t* as the sum of estimated values of all patents granted to the university in year *t*. We then calculate the time-series average of each university's patent value to be the main explanatory variable, *Average PatVal(Match)*. Second, since patents are valid up to 20 years and thus generate licensing income for multiple years, we calculate a university's total license income in a year using a straight line depreciation plan to discount its annual inflation-adjusted license income in the following 20, 15, and 10 years. We then calculate the time-series average of each university's total license income to be the dependent variable. Last, we regress universities' average total license income on *Average PatVal(Match)* in Panel A. In Panel B, we use the similar approach to calculate the total number of startups. License income and patent value are in $ millions and adjusted for inflation. The data of license income and number of startups formed are from the annual reports of the Association of University Technology Managers (AUTM) 1991-2010. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

Panel A: Total License Income						
	Panel A1: 20-Year License Income		Panel A2: 15-Year License Income		Panel A3: 10-Year License Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Average PatVal(Match)	0.0904***	0.7201***	0.0689***	0.6823***	0.0474***	0.6278***
	(0.0097)	(0.0489)	(0.0074)	(0.0473)	(0.0051)	(0.0449)
Constant	8.2084	-1.1894***	6.2540	-1.2042***	4.2996	-1.1993***
	(5.8678)	(0.2364)	(4.4707)	(0.2284)	(3.0736)	(0.2168)
Obs	167	167	167	167	167	167
R2	0.3451	0.5677	0.3451	0.5581	0.3451	0.5428
Specification	Linear-Linear	Log-Log	Linear-Linear	Log-Log	Linear-Linear	Log-Log
Panel B: Startups Formation						
	Panel B1: 20-Year Startup Formation		Panel B2: 15-Year Startup Formation		Panel B3: 10-Year Startup Formation	
	(1)	(2)	(3)	(4)	(5)	(6)
Average PatVal(Match)	0.0440***	10.2957***	0.0335***	7.8443***	0.0230***	5.3930***
	(0.0023)	(1.0327)	(0.0018)	(0.7869)	(0.0012)	(0.5410)
Constant	10.3974***	-23.8240***	7.9218***	-18.1516***	5.4462***	-12.4792***
	(1.4027)	(4.9919)	(1.0687)	(3.8034)	(0.7347)	(2.6148)
Obs	167	167	167	167	167	167
R2	0.6855	0.3759	0.6855	0.3759	0.6855	0.3759
Specification	Linear-Linear	Linear-Log	Linear-Linear	Linear-Log	Linear-Linear	Linear-Log

Table VII: Production Function of Patent Value in U.S. Universities

After finding that university patent value is economically relevant to both patent licensing and startup formation, we analyze the production function of patent value to analyze what inputs are important correlates of valuable patents. Panel A reports the correlation matrix of five university characteristic variables, the five-year cumulative R&D expenditure (*R&D*, with a 20% obsolescence rate per year), a dummy variable indicating whether the sample university is a Carnegie-ranked research university or not (*Carnegie*), the number of full-time faculties (*Faculty*), the full-time equivalents (*FTE*) in a technology transfer office or not (*TTO*) in that year, and a dummy variable indicating whether the sample university has a medical school or not (*MedicalSchool*). In Panel B, we run pooled OLS regressions in a log-log form to estimate the Cobb-Douglas production function of patent value in universities:

$$ln(PatVal_{i,t}) = Constant + \beta_1 \cdot ln(R\&D_{i,t}) + \beta_2 \cdot Carnegie_{i,t} + \beta_3 \cdot ln(Faculty_{i,t}) + \beta_4 \cdot TTO_i + \beta_5 \cdot FTE_{i,t} + \beta_6 \cdot MedicalSchool_i + ln(\alpha_t) + ln(\varepsilon_{i,t}),$$

where $PatVal_{i,t}$ is the total value of patents (measured by *PatVal(Match)*) applied by (and later granted to) university *i* in year *t* and α_t is the year fixed effect. Standard errors are clustered by university to correct for errors in autocorrelation. In Panel C, we run cross-sectional regressions in which variables are averaged across sample years for each university. *PatVal* and *R&D* are in $ millions and adjusted for inflation. *R&D* and *FTE* come from the annual reports of the Association of University Technology Managers (AUTM) 1991-2010. The number of full-time faculties and research doctorates are collected from the Carnegie reports (1994, 2000, 2005, and 2010). All other variables are collected from online searches. We follow Chan et al. (2001) and use an obsolescence rate of 20% to compute patent value capital, following. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

Panel A: Correlation Matrix of University Characteristic Variables

	R&D	Faculty	FTE	Carnegie Research	Medical School
R&D	1	----	----	----	----
Faculty	0.8907***	1	----	----	----
FTE	0.9283***	0.9062***	1	----	----
Carnegie Research	0.2965***	0.3133***	0.2341***	1	----
Medical School	0.2390***	0.2152***	0.2001**	0.2375***	1

Panel B: Pooled Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
R&D	0.9973***	----	----	----	----	0.5489***
	(0.0661)	----	----	----	----	(0.0958)
Faculty	----	1.0202***	----	----	----	0.3305***
	----	(0.1025)	----	----	----	(0.1011)
FTE	----	----	1.0246***	----	----	0.4200***
	----	----	(0.0598)	----	----	(0.0803)
Carnegie Research	----	----	----	1.2543***	----	-0.1781
	----	----	----	(0.2882)	----	(0.2081)
Medical School	----	----	----	----	1.0224*	-0.1335
	----	----	----	----	(0.5357)	(0.3416)
#Obs	1,716	1,608	1,716	1,716	1,716	1,608
R-squared	0.5972	0.5346	0.5736	0.3567	0.3060	0.6319
Year FE	YES	YES	YES	YES	YES	YES
Cluster Error by	Univ	Univ	Univ	Univ	Univ	Univ

Panel C: Cross-Sectional Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
R&D	0.9759***	----	----	----	----	0.6357***
	(0.0868)	----	----	----	----	(0.1735)
Faculty	----	1.0555***	----	----	----	0.2986**
	----	(0.1282)	----	----	----	(0.1414)
FTE	----	----	1.0479***	----	----	0.2475
	----	----	(0.0862)	----	----	(0.1913)
Carnegie Research	----	----	----	1.6085***	----	-0.0152
	----	----	----	(0.3054)	----	(0.2611)
Medical School	----	----	----	----	0.3800	-0.3356
	----	----	----	----	(0.4857)	(0.3046)
Constant	-0.0245	-0.6584	3.3842***	3.5457***	4.3587***	0.1903
	(0.4796)	(0.7168)	(0.1784)	(0.2764)	(0.4661)	(0.9457)
#Obs	158	147	158	158	158	147
R2	0.6193	0.4590	0.5137	0.1825	0.0016	0.6316

Supplemental Appendix

Benchmarking U.S. University Patent Value and Commercialization Efforts: A New Approach

Patent Value Estimation Technique of Kogan et al. (2017)

We use estimates of the value of patents granted to U.S. public firms to proxy for the value of patents granted to U.S. universities. First, we use the economic value of each patent (*PatVal*) assigned to a public firm estimated by Kogan et al. (2017), which is the 3-day change in market capitalization of this firm around the announcement of the patent, adjusted for measurement noise and various fixed effects. The technical details of the estimation technique from Kogan et al. (2017) are provided below:

A firm's three-day announcement return for patent j (denoted as r_j) is the sum of two underlying distributions: (i) the value of newly granted patent j as a fraction of the firm's market capitalization (denoted as p_j), which is assumed to follow a truncated normal distribution with a mean equal to zero and a variance equal to σ_p^2; and (ii) the noise component in the three-day stock return unrelated to the newly granted patent (denoted as ε_j), which follows a normal distribution with a mean zero and a variance σ_ε^2. With both $\sigma_p^2$and σ_ε^2known, Kogan et al. compute the expected patent value following Bayes' rule:

$$E\left[p_j|r_j\right] = \delta r_j + \sqrt{\delta}\frac{\emptyset\left(-\sqrt{\delta}\frac{r_j}{\sigma_\varepsilon}\right)}{1-\Phi\left(-\sqrt{\delta}\frac{r_j}{\sigma_\varepsilon}\right)}\sigma_\varepsilon, \tag{S.1}$$

where $\emptyset$ and Φ denote the probability density function and cumulative distribution function of a standard normal distribution, respectively, and δ is the ratio of signal to noise as defined below:

$$\delta = \frac{\sigma_p^2}{\sigma_p^2 + \sigma_\varepsilon^2}.$$

In calculating $E\left[p_j|r_j\right]$ in Equation (S.1), the values of two variables are vital: δ and σ_ε^2. Kogan et al. assume δ to be constant across firms and time but allow σ_ε^2 to vary across firms and time. To estimate δ, they execute the following panel regression to compute the increase in volatility of firm returns around announcement days of newly granted patents:

$$\ln\left(r_{fd}\right)^2 = \gamma I_{fd} + cZ_{fd} + u_{fd},$$

where r_{fd} is the three-day market-adjusted return of firm *f*, starting from day *d*. I_{fd} is a dummy for the day when there is any newly granted patent(s). *Z* is a vector of controls including the day-of-week fixed effects and the firm-year joint fixed effects. The calculation based on the above equation produces the estimate $\hat{\gamma} = 0.0146$. Using the value of $\hat{\gamma}$, $\hat{\delta}$ is estimated by the following equation:

$$\hat{\delta} = \left(e^{\hat{\gamma}} - 1\right)\left(1 - 2{C_0}^2 + e^{\hat{\gamma}}{C_0}^2\right)^{-1},$$

where $C_0 = \phi(0)/(1 - \Phi(0))$. The resulting estimate of $\hat{\delta} = 0.0145$.

To estimate the firm- and year-specific σ_ε^2 (we use the notation $\sigma_{\varepsilon,ft}^2$ instead), Kogan et al. first follow Anderson and Terasvirta (2009) to non-parametrically estimate the market-adjusted daily return variance, $\widehat{\sigma_{ft}^2}$, for each firm and each year. With the estimate of $\widehat{\sigma_{ft}^2}$, the fraction of trading days that are announcement days for a firm in a year, d_{ft}, and the estimate of $\hat{\gamma}$, they compute the variance of the measurement error in the following equation:

$$\hat{\sigma}_{\varepsilon,ft}^2 = 3\hat{\sigma}_{ft}^2\left(1 + 3d_{ft}\hat{\gamma}/(1 - \hat{\gamma})\right)^{-1}.$$

Inserting the previously estimated $\hat{\delta}$ and $\hat{\sigma}_{\varepsilon,ft}^2$, they calculate the value of $E\widehat{[p_j|r_j]}$ in Equation (S.7).[1] Finally, they employ the following equation to compute the market value of patent *j*, θ_j, as the product of the estimated stock return associated with the patent, $E\widehat{[p_j|r_j]}$, multiplied by the market capitalization, M_j, of the firm granted with patent *j* on the day prior to the patent issuance announcement:

$$\theta_j = (1 - \pi)^{-1}\frac{1}{N_j}E\widehat{[p_j|r_j]}M_j,$$

Where π is the unconditional probability of a successful patent application (estimated to be 0.56 in Carley et al. (2015)), and N_j is the number of patents granted to the same firm on the same day.

[1] $E\widehat{[p_j|r_j]}$ is not always positive in Kogan et al. (2017). Negative estimates are excluded.

Simulations to Check the Sensitivity of Patent Value Matches for Corporate Patents

We design a simulation process to verify our matching method based on the estimated patent value of Kogan et al. (2017). In each simulation, we randomly choose 5% of corporate patents as the out-of-sample from the universe of corporate patents. The ratio of 5% approximates the relative size of university patents to corporate patents. For each patent of the out-of-sample (the focal patent), we estimate its value by benchmarking it to similar patents from the remaining 95% (in-sample). Specifically, the value of the focal patent is set to that of an in-sample patent that is in the same patent sub-category, granted in the same year, and has the shortest sum of distances to the focal patent in terms of quality and generality.[2] If there are multiple in-sample patents satisfying the above criteria, we set the focal patent value to be the median value of those in-sample patents. After we finish the matching for each patent, we collect the simulated value for the 5% out-of-sample patents, we calculate their median and mean and then calculate the absolute percentage deviation between the median (mean) and the full-sample median (mean). By repeating the aforementioned procedure 500 times, we collect 500 absolute percentage deviations of median and mean and plot their frequency in a histogram presented in Figure OA.I. Overall, we find that the deviation is modest as most of them are within a 2% range.

[2] The distance along a patent characteristic is measured by the absolute value of the difference between two values divided by their sum. For example, if the focal patent has its forward citation as 4 and its generality as 0.3 and an in-sample patent has it forward citation as 6 and its generality as 0.1, then their distance is equal to 0.7, calculated as

$$\frac{|4-6|}{4+6}+\frac{|0.3-0.1|}{0.3+0.1}=0.7.$$

Figure OA.I: Accuracy of the Estimation Method of Patent Value.

We examine the accuracy of our matching method in estimating patent value. To do so, we randomly draw 5% of the corporate patents by their grant years and subcategories as focal patents. We benchmark the value of each focal corporate patent with the full sample of corporate patents using the matching method described in Table IV. We choose 5% of the corporate patents as focal because the number of corporate patents is 20 times the number of university patents in the full sample, as shown in Table IV. We repeat this simulation procedure 500 times. After each simulation run, we calculate the absolute percentage deviation of the median and mean estimated value of focal corporate patents from their median and mean true value, respectively. This distribution is shown in the blue and red histograms, respectively.

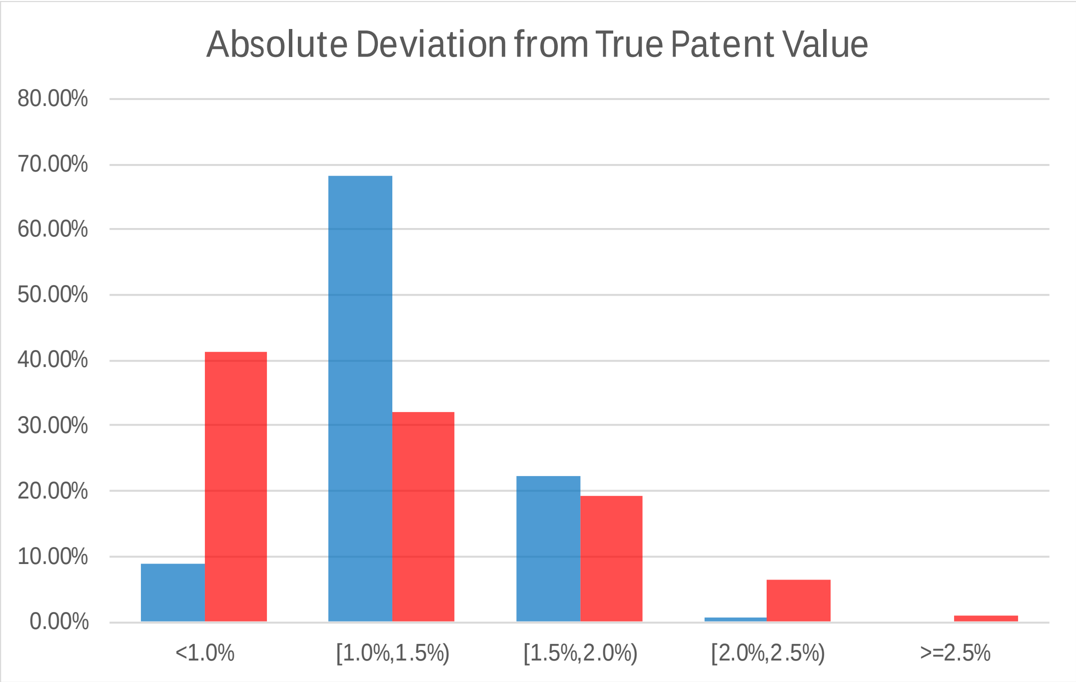


Table OA.I: Distributions of Characteristics of Patents Granted to Listed Firms and Universities in the U.S.

We compare the distribution of patent quality/importance (i.e., the citations received in five years after the patent is granted), patent originality (i.e., one minus the Herfindahl-Hirschman Index (HHI) of citations given to other patents over patent subcategories), patent generality (i.e., one minus the HHI of citations received from other patents over patent subcategories), and patent basicness (i.e., the ratio of the number of references to prior "non-patent documents" divided by the total references) of patents granted to listed public firms and universities. The definitions of patent originality, generality, and basicness follow Trajtenberg, Henderson, and Jaffe (1997). We also compare their distributions in the following three periods: 1976-1985, 1986-1995, and 1996-2010. We split our whole sample period (1976-2010) into three almost equal sub-periods to examine the evolution of patent forward citation, patent originality, and patent generality over time. We split our sample at 1985-1986 due to the adoption of the Bayh–Dole Act at 1980 and the surge of personal computer industry at early 1980s. We also split our sample at 1995-1996 for the ".com bubble" started around 1996-1997. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively, when comparing the mean of universities' patents with the mean of listed firms' patents.

Panel A

Panel A reports summary statistics for patent quality/importance (number of forward citations within 5 years) (A1), patent generality (A2), patent originality (A3), patent basicness (A4), and number of claims (A5) in the following three periods: 1976-1985, 1986-1995, and 1996-2010.

Panel A1: Summary Statistics of Forward 5yr Citations

	Universities			Public Firms		
	1976-1985	1986-1995	1996-2010	1976-1985	1986-1995	1996-2010
Mean	3.97***	6.76***	5.34	2.88	5.63	5.28
Median	2.00	4.00	2.00	2.00	3.00	2.00
Standard Deviation	6.45	9.96	10.63	4.09	8.29	10.03
Minimum	0.00	0.00	0.00	0.00	0.00	0.00
1st Percentile	0.00	0.00	0.00	0.00	0.00	0.00
5th Percentile	0.00	0.00	0.00	0.00	0.00	0.00
25th Percentile	1.00	1.00	0.00	0.00	1.00	0.00
75th Percentile	5.00	8.00	6.00	4.00	7.00	6.00
95th Percentile	14.00	24.00	23.00	10.00	19.00	21.00
99th Percentile	29.00	47.00	52.00	19.00	39.00	48.00
Maximum	109.00	173.00	213.00	152.00	286.00	539.00
#Obs	4,646	15,915	57,319	213,285	262,794	885,692

Panel A (continued)

Panel A2: Summary Statistics of Patent Generality						
	Universities			Public Firms		
	1976-1985	1986-1995	1996-2010	1976-1985	1986-1995	1996-2010
Mean	0.46***	0.48***	0.43***	0.42	0.43	0.35
Median	0.51	0.53	0.50	0.47	0.48	0.33
Standard Deviation	0.29	0.29	0.33	0.31	0.30	0.33
Minimum	0.00	0.00	0.00	0.00	0.00	0.00
1st Percentile	0.00	0.00	0.00	0.00	0.00	0.00
5th Percentile	0.00	0.00	0.00	0.00	0.00	0.00
25th Percentile	0.22	0.26	0.00	0.07	0.16	0.00
75th Percentile	0.68	0.70	0.69	0.67	0.67	0.63
95th Percentile	0.87	0.86	1.00	0.90	0.87	1.00
99th Percentile	1.00	1.00	1.00	1.00	1.00	1.00
Maximum	1.00	1.00	1.00	1.00	1.00	1.00
#Obs	4,646	15,915	57,319	213,285	262,794	885,692

Panel A (continued)

Panel A3: Summary Statistics of Patent Originality						
	Universities			**Public Firms**		
	1976-1985	**1986-1995**	**1996-2010**	**1976-1985**	**1986-1995**	**1996-2010**
Mean	0.27***	0.37***	0.44***	0.25	0.35	0.38
Median	0.00	0.40	0.50	0.00	0.33	0.40
Standard Deviation	0.37	0.35	0.33	0.36	0.34	0.32
Minimum	0.00	0.00	0.00	0.00	0.00	0.00
1st Percentile	0.00	0.00	0.00	0.00	0.00	0.00
5th Percentile	0.00	0.00	0.00	0.00	0.00	0.00
25th Percentile	0.00	0.00	0.00	0.00	0.00	0.00
75th Percentile	0.62	0.67	0.70	0.56	0.67	0.66
95th Percentile	1.00	1.00	1.00	1.00	1.00	0.87
99th Percentile	1.00	1.00	1.00	1.00	1.00	1.00
Maximum	1.00	1.00	1.00	1.00	1.00	1.00
#Obs	4,646	15,915	57,319	213,285	262,794	885,692

Panel A (continued)

Panel A4: Summary Statistics of Patent Basicness						
	Universities			Public Firms		
	1976-1985	1986-1995	1996-2010	1976-1985	1986-1995	1996-2010
Mean	0.25***	0.411***	0.50***	0.07	0.10	0.12
Median	0.05	0.38	0.54	0.00	0.00	0.00
Standard Deviation	0.33	0.35	0.34	0.17	0.19	0.20
Minimum	0.00	0.00	0.00	0.00	0.00	0.00
1st Percentile	0.00	0.00	0.00	0.00	0.00	0.00
5th Percentile	0.00	0.00	0.00	0.00	0.00	0.00
25th Percentile	0.00	0.00	0.18	0.00	0.00	0.00
75th Percentile	0.50	0.73	0.81	0.00	0.13	0.17
95th Percentile	1.00	1.00	1.00	0.44	0.50	0.59
99th Percentile	1.00	1.00	1.00	1.00	0.88	0.89
Maximum	1.00	1.00	1.00	1.00	1.00	1.00
#Obs	4,646	15,915	57,319	213,285	262,794	885,692

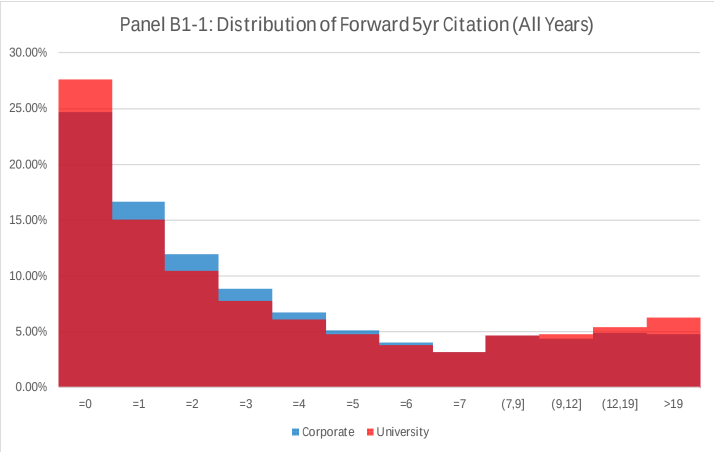
Panel A (continued)

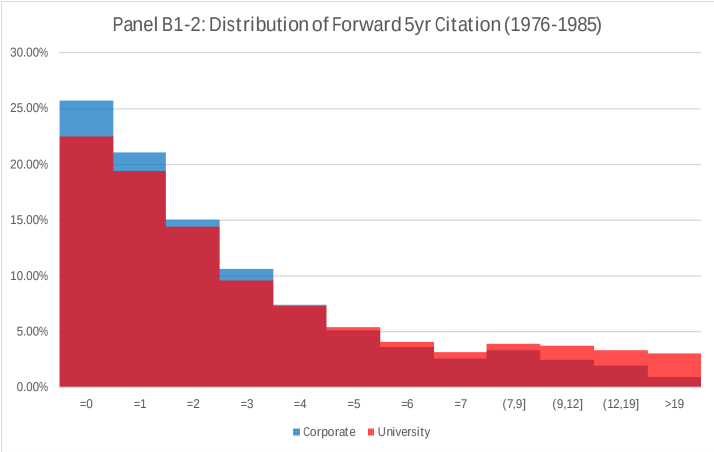
Panel A5: Summary Statistics of Number of Claims						
	Universities			Public Firms		
	1976-1985	1986-1995	1996-2010	1976-1985	1986-1995	1996-2010
Mean	14.65***	16.71***	22.22***	10.96	13.77	18.35
Median	11.00	14.00	18.00	9.00	11.00	16.00
Standard Deviation	15.83	13.28	18.39	9.41	11.31	13.74
Minimum	0.00	0.00	0.00	1.00	1.00	1.00
1st Percentile	1.00	1.00	1.00	1.00	1.00	1.00
5th Percentile	2.00	3.00	4.00	2.00	2.00	4.00
25th Percentile	7.00	8.00	10.00	5.00	6.00	9.00
75th Percentile	19.00	21.00	28.00	14.00	18.00	23.00
95th Percentile	36.00	40.00	55.00	27.00	33.00	42.00
99th Percentile	62.00	63.00	90.00	46.00	54.00	68.00
Maximum	642.00	219.00	309.00	298.00	868.00	683.00
#Obs	4,646	15,915	57,319	213,285	262,794	885,692

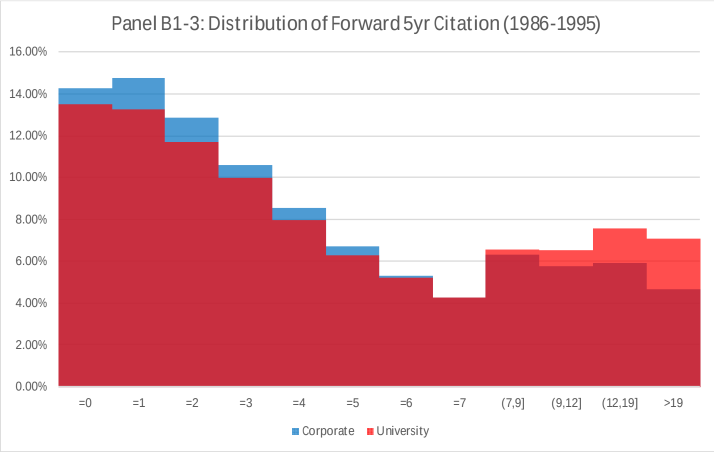
Panel B

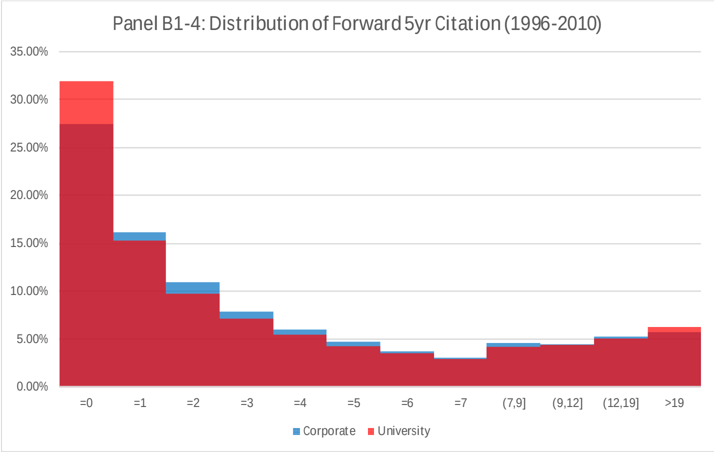
Panel B shows the distributions of patent quality/importance (number of forward citations within 5 years), patent originality, patent generality, and patent basicness of listed public firms and universities. For quality/importance, we compute the frequency of observations within each category of entities for twelve intervals (citation equal to 0 (5th-20th percentile), citation equal to 1 (25th-40th percentile), citation equal to 2 (45th-50th percentile), citation equal to 3 (55th-60th percentile), citation equal to 4 (65th percentile), citation equal to 5 (70th percentile), citation equal to 6 (75th percentile), citation equal to 7 (80th percentile), citation larger than 7 and smaller than or equal to 9 (85th percentile), citation larger than 9 and smaller than or equal to 12 (90th percentile), citation larger than 12 and smaller than or equal to 19 (95th percentile), and citation larger than 19). For the distributions of patent originality, generality, and basicness (all bounded from 0 to 1), we report their frequencies in each equal bin between 0 to 1. For number of claims, we compute the frequency of observations within each category of entities for ten intervals (smaller than 4 (10th percentile), larger than 4 and smaller than 7 (20th percentile), larger than 7 and smaller than 9 (30th percentile), larger than 9 and smaller than 11 (40th percentile), larger than 11 and smaller than 14 (50th percentile), larger than 14 and smaller than 17 (60th percentile), larger than 17 and smaller than 20 (70th percentile), larger than 20 and smaller than 23 (80th percentile), larger than 23 and smaller than 31 (90th percentile), and larger than 31). We also compare their distributions in the following four periods: 1976-1985, 1986-1995, 1996-2010, and 1976-2010 (all years).

Panel B (continued)



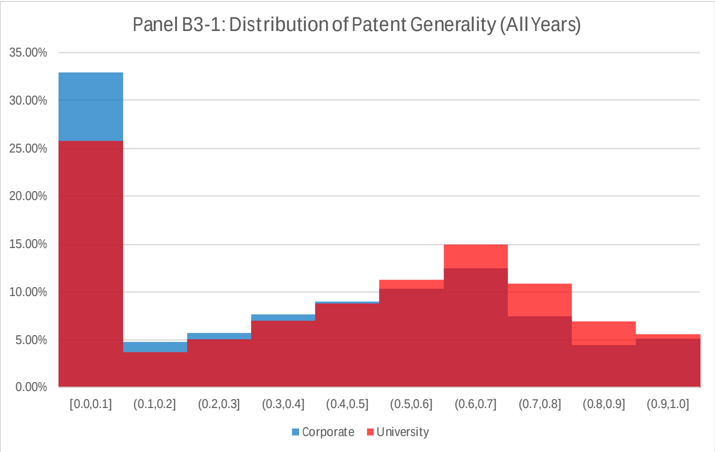


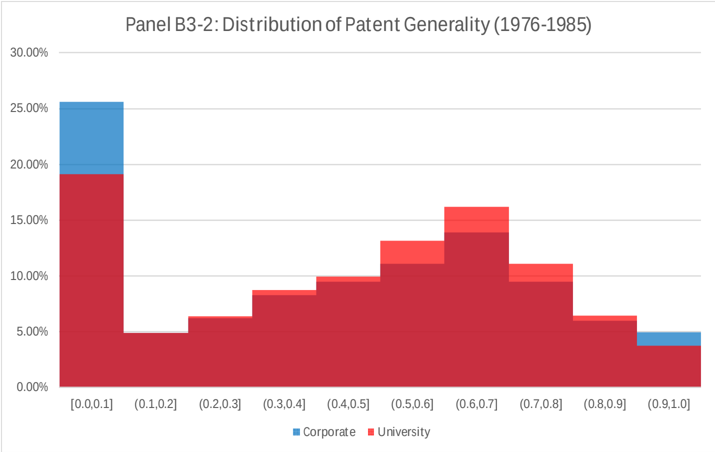


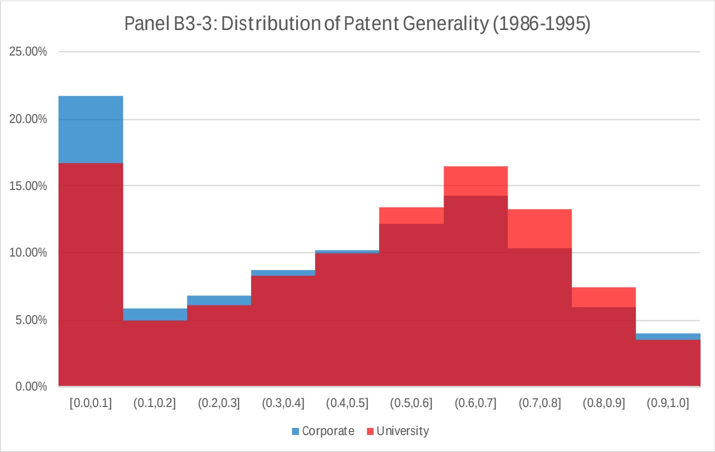


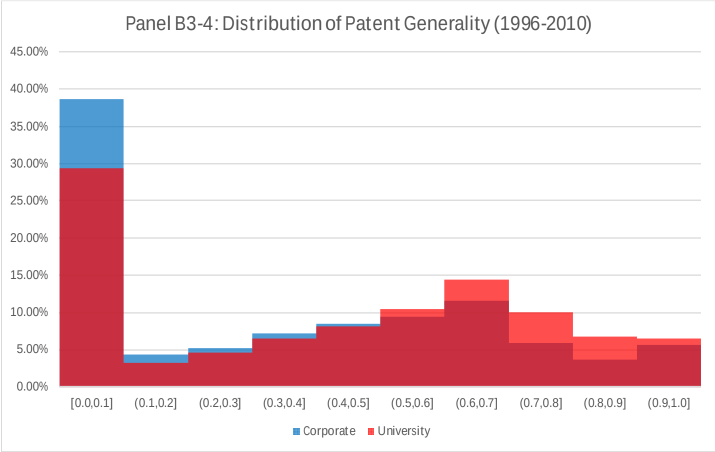
Panel B (continued)

Panel B (continued)

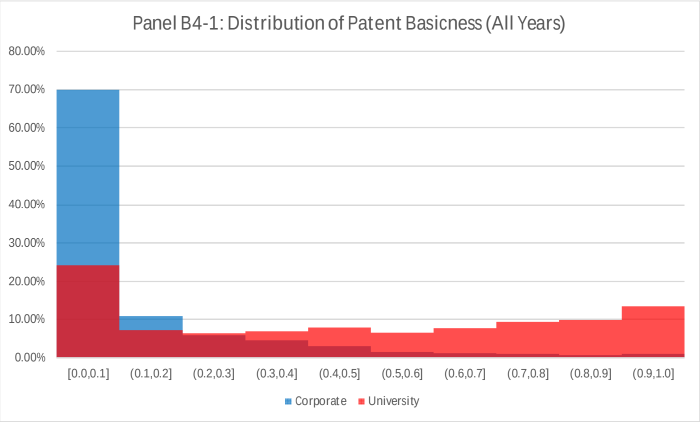


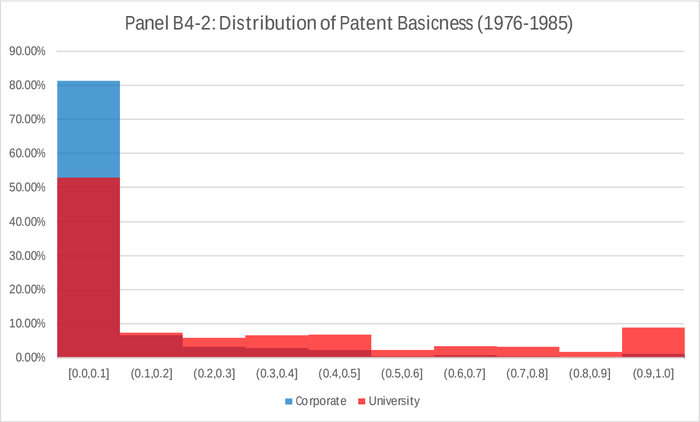


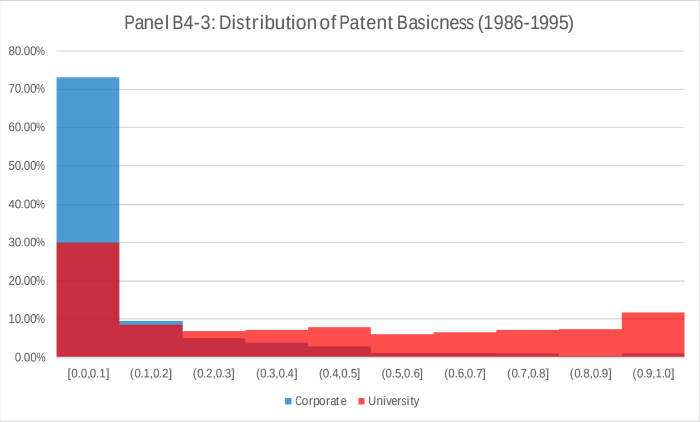


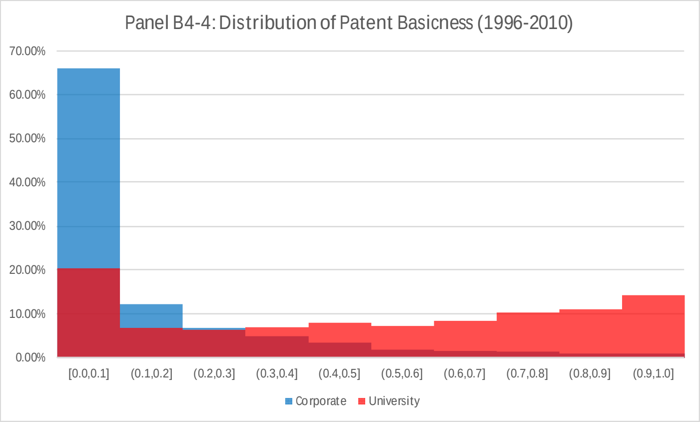


Panel B (continued)

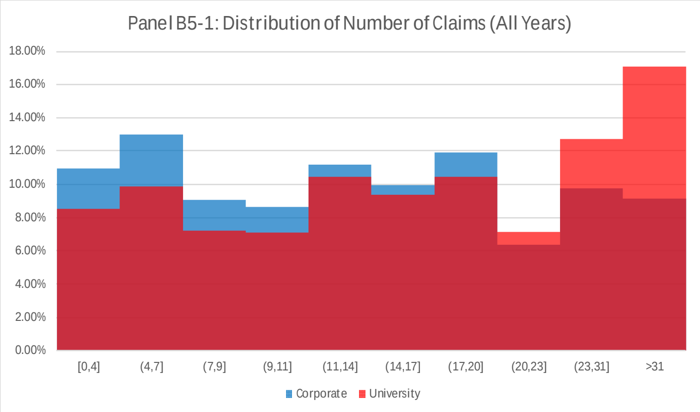


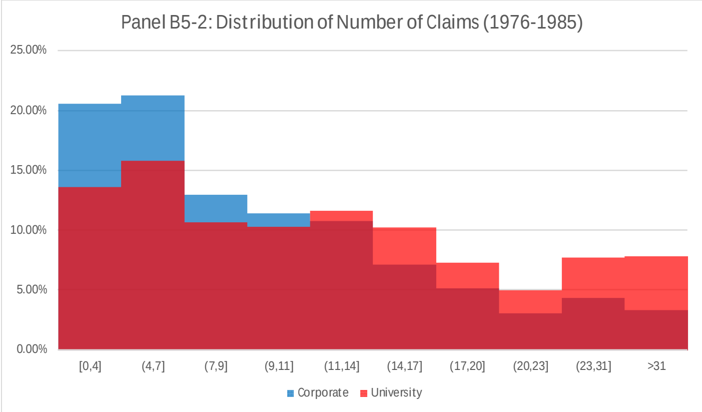


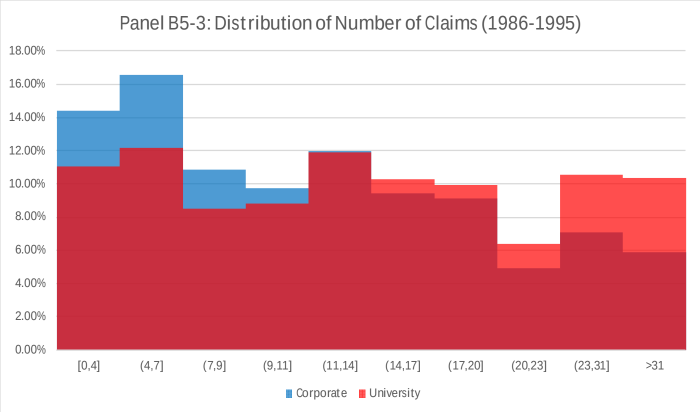


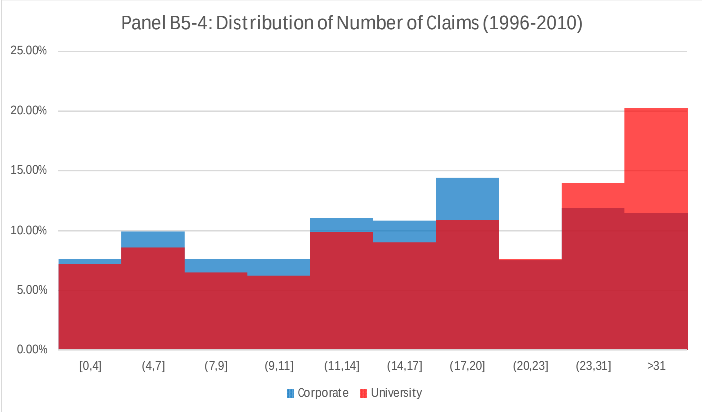


Panel B (continued)



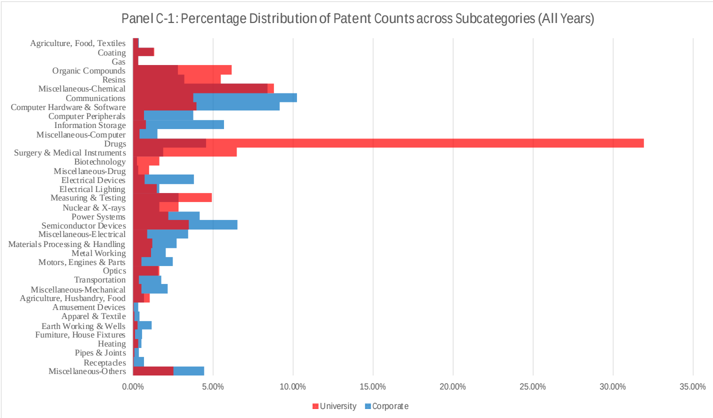


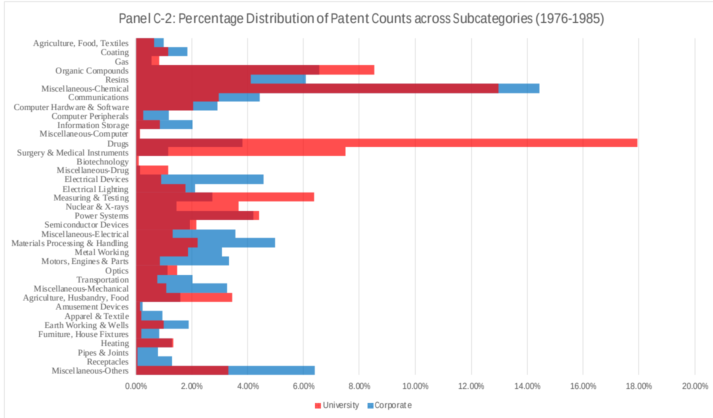


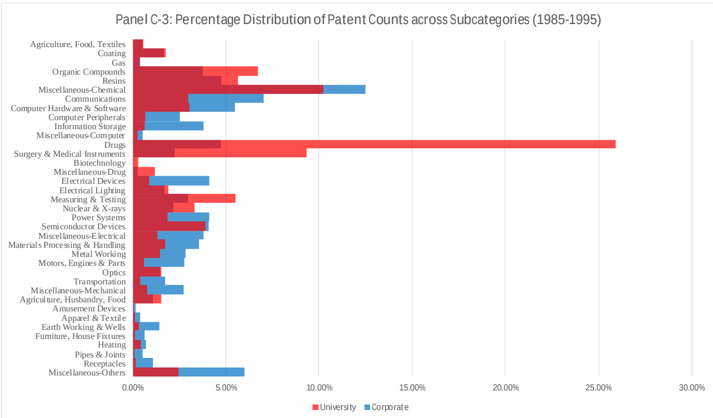


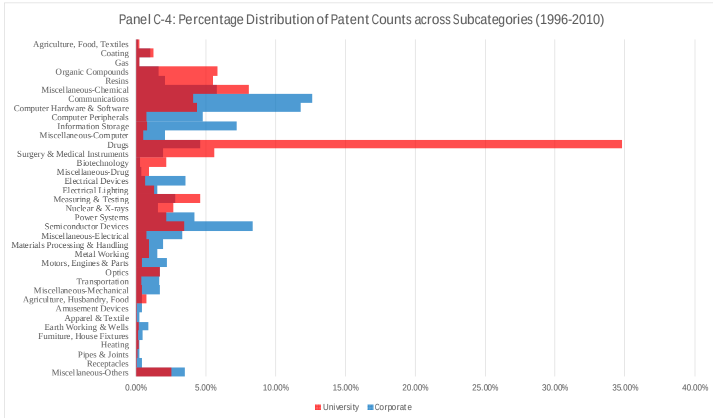
Panel C

Panel C compares the number of patents granted in each subcategory of listed public firms and universities. Percentages are reported within each category of entities. We also compare their distributions in the following four periods: 1976-1985, 1986-1995, 1996-2010, and 1976-2010 (all years). A Kolmogorov-Smirnov test confirms that distributions of patent counts across subcategories are statistically different (p-value<0.01) between universities and public firms.



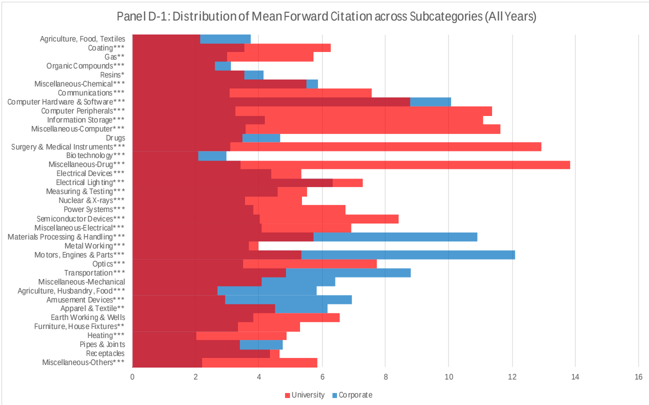


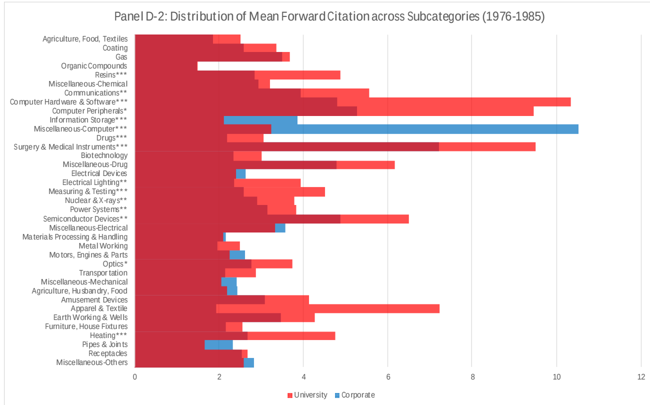


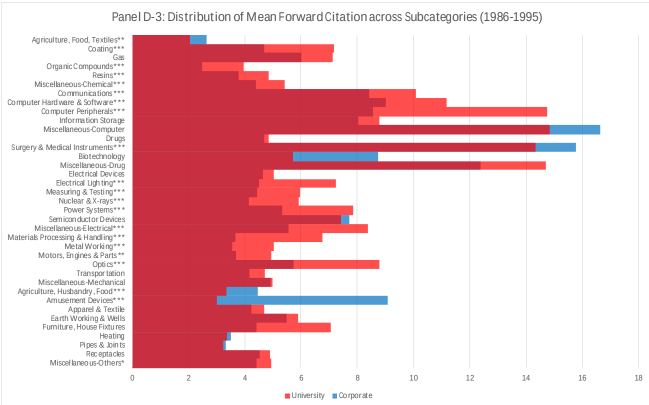


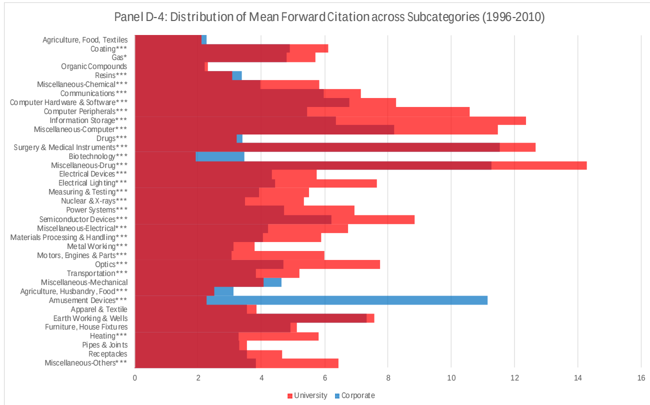
Panel D

Panel D reports the mean patent quality/importance (number of forward citations within 5 years) in each subcategory within each category of entities (i.e., public firm and university). We report the statistical significance of the difference between corporates and universities in each subcategory with two-sample t-test. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. We also compare their distributions in the following four periods: 1976-1985, 1986-1995, 1996-2010, and 1976-2010 (all years).



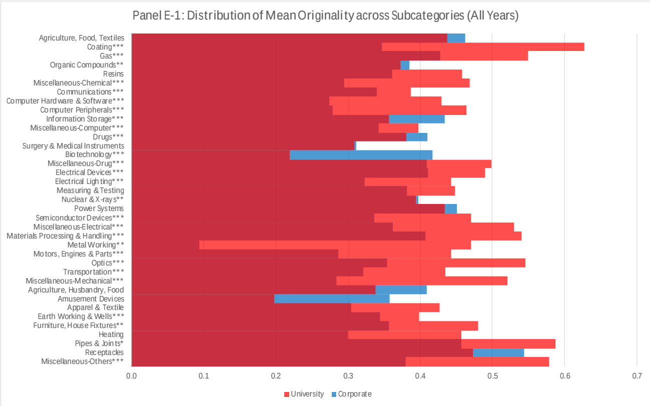


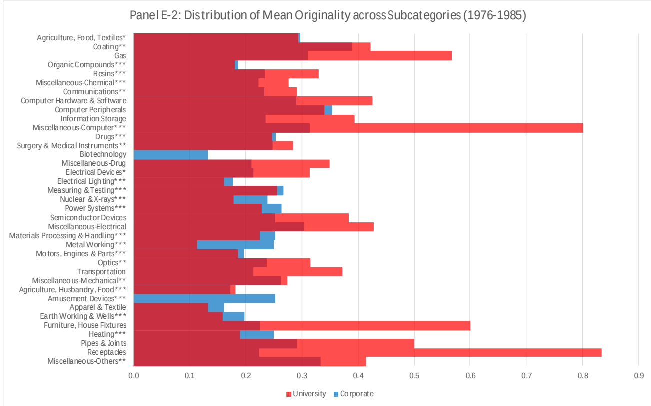


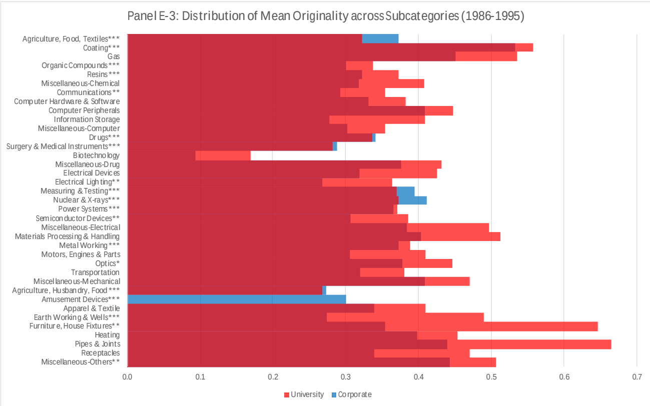


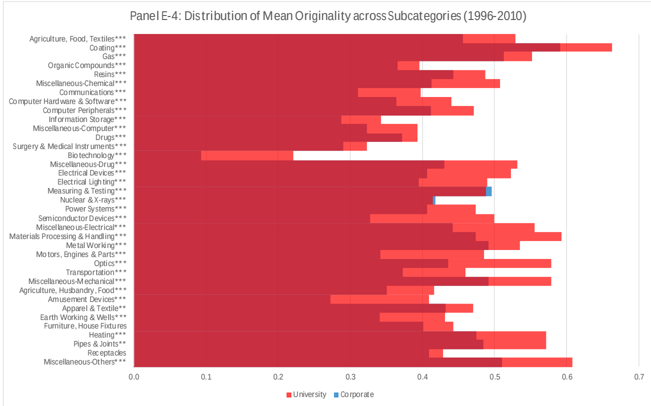
Panel E

Panel E reports the mean patent originality (one minus the HHI of citations given to other patents over patent subcategories) in each subcategory within each category of entities (i.e., corporate and university). We test the statistical significance of the difference between corporates and universities in each subcategory with two-sample t-test. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. We also compare their distributions in the following four periods: 1976-1985, 1986-1995, 1996-2010, and 1976-2010 (all years).



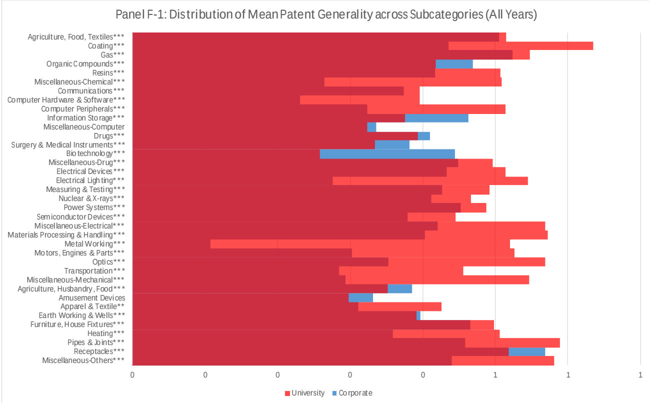


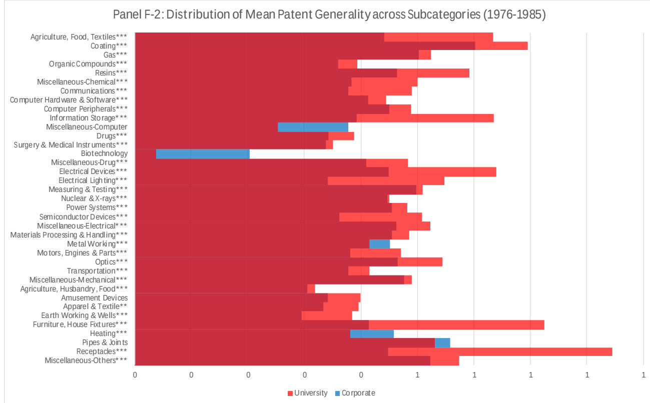


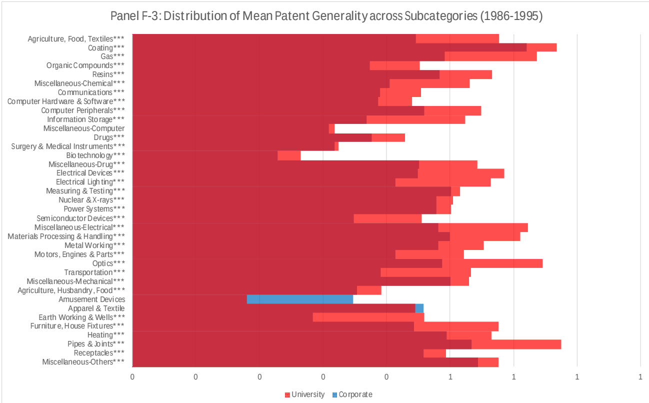


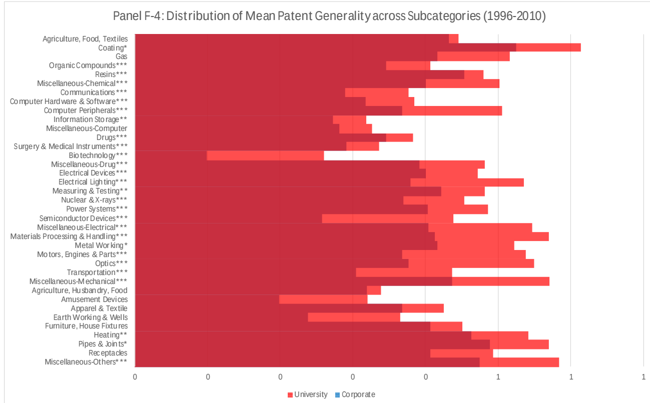
Panel F

Panel F reports the mean patent generality (one minus the HHI of citations received from other patents over patent subcategories) in each subcategory within each category of entities (public firm and university). We report the statistical significance of the difference between public firms and universities in each subcategory with two-sample t-test. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. We also report their distributions in the following four periods: 1976-1985, 1986-1995, 1996-2010, and 1976-2010 (all years).



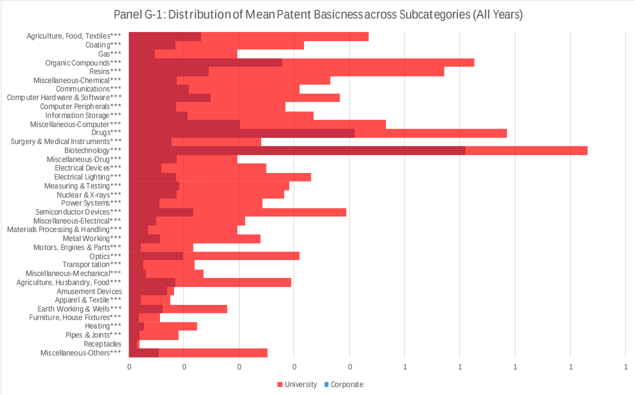


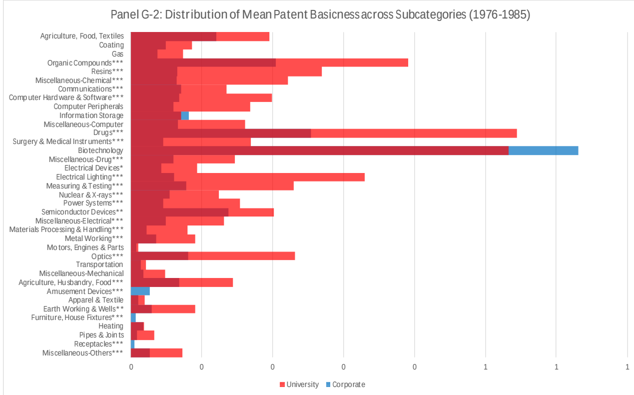


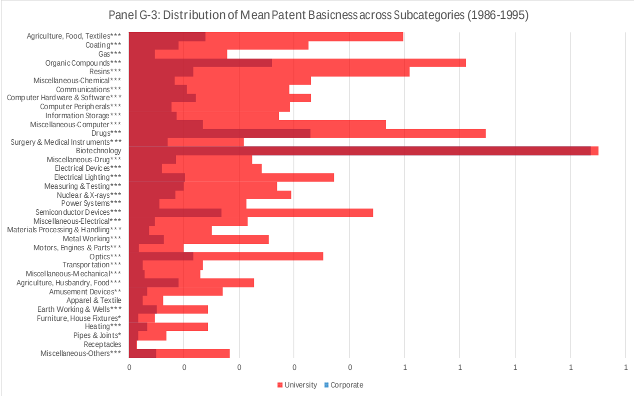


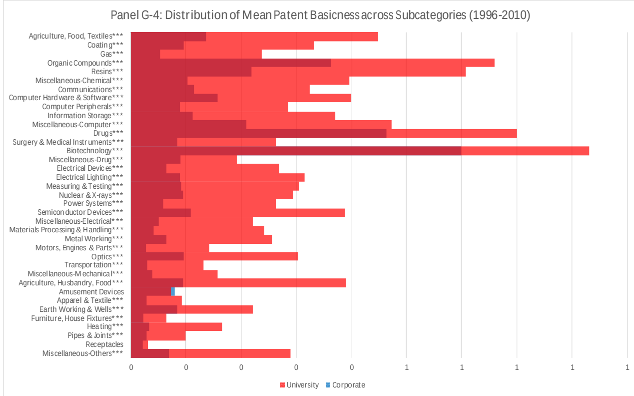
Panel G

Panel G reports the mean patent basicness (the ratio of the number of references to prior "non-patent documents" divided by the total references) in each subcategory within each category of entities (public firm and university). We report the statistical significance of the difference between public firms and universities in each subcategory with two-sample t-test. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. We also report their distributions in the following four periods: 1976-1985, 1986-1995, 1996-2010, and 1976-2010 (all years).



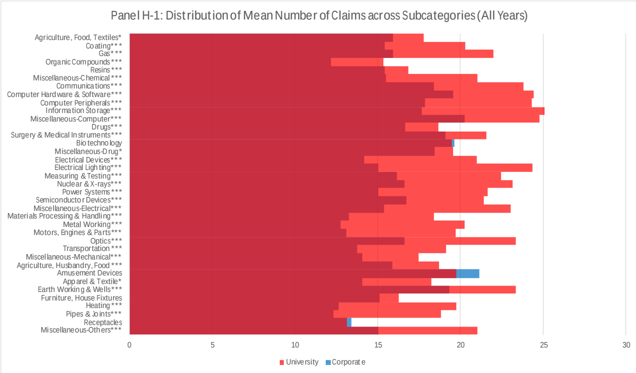


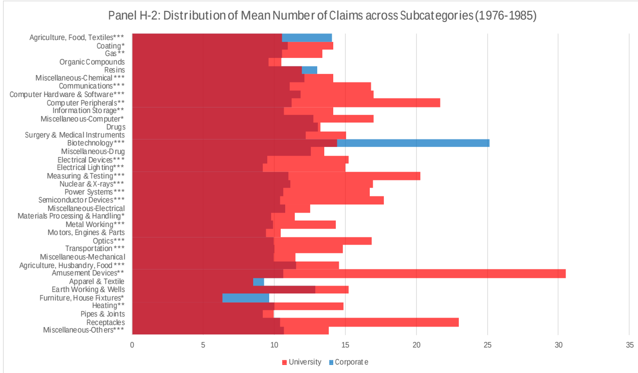


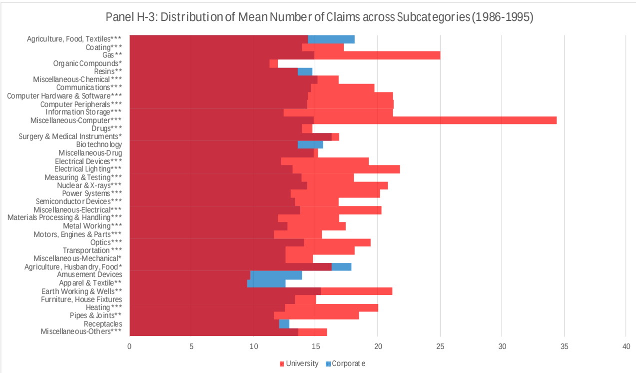


Panel H

Panel H reports the mean number of claims in each subcategory within each category of entities (public firm and university). We report the statistical significance of the difference between public firms and universities in each subcategory with two-sample t-test. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively. We also report their distributions in the following four periods: 1976-1985, 1986-1995, 1996-2010, and 1976-2010 (all years).







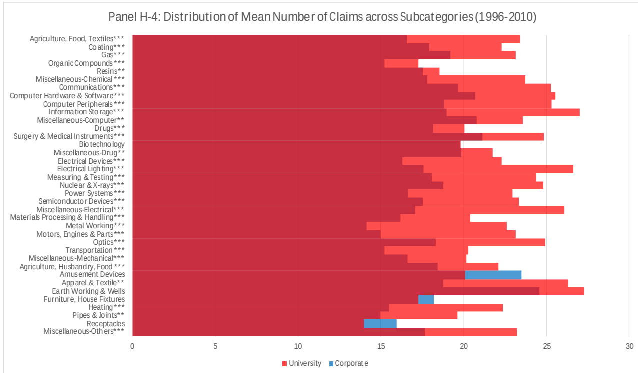


Table OA.II: Market-Based Patent Value and Actual University Patent Revenue in the Sub-category of Drug.

We run the same regressions as in Table V but in the sample of patents in the drug subcategory.

	Panel A: A Linear-Linear Form					**Panel B: A Log-Log Form**				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
PatVal(Match)	0.1257***	0.0732**	0.0818***	0.0745**	0.0707**	0.3300***	0.1332***	0.1555***	0.1298***	0.0680*
	(0.0282)	(0.0293)	(0.0296)	(0.0294)	(0.0328)	(0.0229)	(0.0309)	(0.0306)	(0.0309)	(0.0352)
Originality	----	----	7.1332	-2.5401	-0.6788	----	----	0.3328**	0.1318	0.0918
	----	----	(4.7958)	(5.4978)	(5.7697)	----	----	(0.1631)	(0.1691)	(0.1726)
Basicness	----	----	7.3647**	-8.7723	-5.6456	----	----	0.0469	-0.3583**	-0.3828**
	----	----	(2.9846)	(5.4723)	(5.8622)	----	----	(0.1359)	(0.1689)	(0.1757)
Claims	----	----	0.0172	-0.1249	-0.0977	----	----	0.1806***	-0.0025	-0.0123
	----	----	(0.1283)	(0.1335)	(0.1398)	----	----	(0.0484)	(0.0666)	(0.0662)
Constant	----	8.8002***	----	16.6618***	----	----	0.6134***	----	0.8230***	----
	----	(1.6542)	----	(4.7528)	----	----	(0.0689)	----	(0.2078)	----
#Obs	663	663	663	663	663	663	663	663	663	663
R2	0.0292	0.0093	0.0567	0.0145	0.1298	0.2394	0.0273	0.3119	0.0376	0.4046
Year FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
SubCat FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES

Table OA.III: U.S. Universities and Their PDPASSs.

We manually match the university names with their PDPASSs using the assignee file (1976-2006) of the NBER patent data. We first examine the NBER patent assignee name file, focus on the assignees in the category of "U.S. University," and manually harmonize the PDPASSs for each university. To ensure full coverage, we search the university names in other categories and extract their PDPASSs. For example, Purdue Research Foundation of the Purdue University is in the category of "U.S. Institute." Our resulting sample is 362 universities.

uni_code	Name	PDPASS	uni_code	Name	PDPASS
U1	ACAD OF APPLIED SCI	10205990	U223	SPELMAN COLLEGE	12847735
U1	ACAD OF APPLIED SCI	12177703	U224	SPRINGFIELD COLLEGE	11833736
U2	ALABAMA A&M UNIV	13099221	U225	ST JOHNS UNIV	10597806
U3	ALCORN STATE UNIV	13218771	U226	ST LOUIS UNIV	10383391
U4	ALFRED UNIV	10262334	U226	ST LOUIS UNIV	12224461
U4	ALFRED UNIV	11071946	U226	ST LOUIS UNIV	12307452
U5	ALKANSAS STATE UNIV	12905751	U227	STANFORD UNIV	10052880
U6	ALVERNO COLLEGE	12751071	U227	STANFORD UNIV	10085770
U7	AMBASSADOR COLLEGE	11367305	U227	STANFORD UNIV	12589299
U9	AMERICAN LANGUAGE ACAD	11110495	U227	STANFORD UNIV	12959736
U10	AMERICAN UNIV	10562759	U227	STANFORD UNIV	13083418
U11	AMERICAN UNIV OF TECHNOLOGY	10287189	U227	STANFORD UNIV	13141479
U12	AMHERST COLLEGE	12598036	U227	STANFORD UNIV	21027770
U13	APPALACHAIN STATE UNIV	11883123	U227	STANFORD UNIV	21478343
U14	ARIZONA STATE UNIV	10586414	U227	STANFORD UNIV	22274727
U14	ARIZONA STATE UNIV	10916444	U228	STARMARK ANIMAL BEHAVIOR CENTER	12706967
U14	ARIZONA STATE UNIV	11750489	U229	STATE UNIV OF NEW YORK	10457174
U14	ARIZONA STATE UNIV	13118987	U229	STATE UNIV OF NEW YORK	10506876
U15	ART CENT COLLEGE OF DESIGN	12846166	U229	STATE UNIV OF NEW YORK	12494736
U16	ASSOCIATION OF AMERICAN UNIVERSITIES	11678831	U229	STATE UNIV OF NEW YORK	13107693
U17	AT STILL UNIV OF HEALTH SCI	12672896	U229	STATE UNIV OF NEW YORK	13117389
U18	AUBURN UNIV	10206900	U229	STATE UNIV OF NEW YORK	21917944
U18	AUBURN UNIV	10996882	U230	STEPHEN F AUSTIN STATE UNIV	-16787
U18	AUBURN UNIV	11012600	U231	STEVENS INST OF TECH	11021612
U19	AVIATION SUPPLIES & ACADEMICS	10931538	U231	STEVENS INST OF TECH	22918193
U20	BALL STATE UNIV	12544684	U232	SYRACUSE UNIV	10230164
U21	BAYLOR COLLEGE OF MEDICINE	11671697	U232	SYRACUSE UNIV	10625734
U22	BAYLOR UNIV	11130200	U233	TEMPLE UNIV	10843583
U22	BAYLOR UNIV	11141078	U233	TEMPLE UNIV	22503640
U22	BAYLOR UNIV	12374742	U233	TEMPLE UNIV	22912002
U22	BAYLOR UNIV	12840679	U234	TENNESSEE TECHNOLOGICAL UNIV	12667795
U23	BEMIDJI STATE UNIV	11414638	U235	TEXAS A&M UNIV	10834168
U24	BLIND FAITH SCHOOL OF MUSIC & ART	13121340	U235	TEXAS A&M UNIV	11616790
U25	BOISE STATE UNIV	12792627	U235	TEXAS A&M UNIV	21698632
U26	BOSTON COLLEGE	11266208	U235	TEXAS A&M UNIV	21991443
U27	BOSTON UNIV	10676948	U235	TEXAS A&M UNIV	22579636

U27	BOSTON UNIV	11282111	U236	TEXAS CHRISTIAN UNIV	12881011
U27	BOSTON UNIV	12923205	U237	TEXAS LUTHERAN UNIV	13060087
U28	BOWIE STATE UNIV	23055717	U238	TEXAS STATE UNIV	23152176
U29	BOWLING GREEN STATE UNIV	10931188	U239	TEXAS TECH UNIV	10666462
U30	BRADLEY UNIV	11765786	U239	TEXAS TECH UNIV	12864691
U31	BRANDEIS UNIV	11614407	U239	TEXAS TECH UNIV	12970897
U32	BRIGHAM YOUNG UNIV	11208780	U239	TEXAS TECH UNIV	13003183
U33	BROWN UNIV	10659299	U239	TEXAS TECH UNIV	22359003
U33	BROWN UNIV	10810030	U239	TEXAS TECH UNIV	22400311
U33	BROWN UNIV	12039323	U239	TEXAS TECH UNIV	22464759
U34	BRYN MAWR COLLEGE	12172060	U240	TEXAS WESLEYAN UNIV	11255546
U35	CALIFORNIA INST OF TECH	10212849	U241	THOMAS JEFFERSON UNIV	12233242
U35	CALIFORNIA INST OF TECH	10968828	U242	TOURO COLLEGE	11068476
U35	CALIFORNIA INST OF TECH	11532066	U243	TOWSON UNIV	21216599
U35	CALIFORNIA INST OF TECH	12756450	U244	TRINITY UNIV	11402737
U35	CALIFORNIA INST OF TECH	12962121	U245	TROY UNIV	12127624
U35	CALIFORNIA INST OF TECH	13108675	U246	TRUMAN STATE UNIV	12676105
U35	CALIFORNIA INST OF TECH	13208934	U247	TUFTS UNIV	10178972
U35	CALIFORNIA INST OF TECH	20961588	U247	TUFTS UNIV	11184034
U36	CALIFORNIA POLYTECHNIC STATE UNIV	10266866	U247	TUFTS UNIV	11598631
U37	CALIFORNIA STATE UNIV	10932917	U247	TUFTS UNIV	11880040
U37	CALIFORNIA STATE UNIV	11328517	U247	TUFTS UNIV	21959307
U37	CALIFORNIA STATE UNIV	11635555	U248	TULANE UNIV	10893927
U37	CALIFORNIA STATE UNIV	21564750	U248	TULANE UNIV	11014189
U38	CALVIN COLLEGE	12084416	U248	TULANE UNIV	11487378
U39	CARGENIE MELLON UNIV	10545965	U248	TULANE UNIV	22101801
U40	CARROLL COLLEGE	22293949	U248	TULANE UNIV	22495964
U41	CASE WESTERN RESERVE UNIV	11702110	U249	TUSKEGEE UNIV	10960490
U41	CASE WESTERN RESERVE UNIV	11991624	U250	UNIFORMED SERVICES UNIV OF HEALTH SCI	12454297
U41	CASE WESTERN RESERVE UNIV	21727241	U250	UNIFORMED SERVICES UNIV OF HEALTH SCI	22680937
U41	CASE WESTERN RESERVE UNIV	22823322	U250	UNIFORMED SERVICES UNIV OF HEALTH SCI	22743534
U41	CASE WESTERN RESERVE UNIV	23106232	U251	UNION UNIV	10971488
U42	CATHOLIC UNIV OF AMERICA	11381523	U252	UNITY SCHOOL OF CHRISTIANITY	11313193
U43	CENT MICHIGAN UNIV	12906223	U253	UNIV ADVANCED BIO IMAGING ASSOCIATES	11979661
U44	CENTENARY COLLEGE OF LOUISIANA	22391824	U254	UNIV CENT DEL CARIBE	22589357
U45	CHAPMAN COLLEGE	10829901	U255	UNIV CORP FOR ATMOSPHERE RES	11451045
U46	CITY UNIV OF NEW YORK	10878585	U256	UNIV HEALTHSYSTEM CONSORTIUM	13103470
U46	CITY UNIV OF NEW YORK	11242285	U257	UNIV OF AKRON	11037269
U46	CITY UNIV OF NEW YORK	11370797	U258	UNIV OF ALABAMA	10049068
U46	CITY UNIV OF NEW YORK	11736050	U258	UNIV OF ALABAMA	10685560
U46	CITY UNIV OF NEW YORK	13138208	U258	UNIV OF ALABAMA	11185055
U47	CLARK UNIV	11748183	U258	UNIV OF ALABAMA	13060486
U48	CLARKSON UNIV	11418797	U258	UNIV OF ALABAMA	20728027
U49	CLEMSON UNIV	12487493	U258	UNIV OF ALABAMA	21259067

U49	CLEMSON UNIV	12648438	U258	UNIV OF ALABAMA	22090093
U50	CLEVELAND STATE UNIV	12475096	U259	UNIV OF ALASKA	11456796
U51	COCKERILL SAMBRE CAMPUS UNIV DU SART TILMAN	22132506	U260	UNIV OF ARIZONA	10298599
U52	COLLEGE OF AMERICAN PATHOLOGISTS	12538533	U260	UNIV OF ARIZONA	10586414
U53	COLLEGE OF HOLY CROSS	12462375	U260	UNIV OF ARIZONA	11043586
U54	COLLEGE OF MEDICINE & DENTISTRY OF NEW JERSEY	10429743	U260	UNIV OF ARIZONA	11750489
U55	COLLEGE OF NEW JERSEY	11597056	U260	UNIV OF ARIZONA	11821347
U56	COLLEGE OF WILLIAM & MARY	12230512	U260	UNIV OF ARIZONA	12975849
U57	COLLEGE PARK IND INC	11258570	U260	UNIV OF ARIZONA	13092071
U58	COLLEGE SAVINGS BANK	10822055	U260	UNIV OF ARIZONA	22358845
U59	COLORADO SCHOOL OF MINES	11039458	U261	UNIV OF ARKANSAS	-19842
U60	COLORADO STATE UNIV	10703054	U261	UNIV OF ARKANSAS	-18135
U60	COLORADO STATE UNIV	22142825	U261	UNIV OF ARKANSAS	10320721
U60	COLORADO STATE UNIV	23194527	U261	UNIV OF ARKANSAS	11210319
U61	COLUMBIA UNIV	-3449	U261	UNIV OF ARKANSAS	11979879
U61	COLUMBIA UNIV	10561876	U261	UNIV OF ARKANSAS	13183790
U61	COLUMBIA UNIV	12510710	U262	UNIV OF BALTIMORE	13030169
U61	COLUMBIA UNIV	13060440	U263	UNIV OF CALIFORNIA	10207181
U61	COLUMBIA UNIV	21275191	U263	UNIV OF CALIFORNIA	10574877
U61	COLUMBIA UNIV	21708108	U263	UNIV OF CALIFORNIA	11275757
U61	COLUMBIA UNIV	21841668	U263	UNIV OF CALIFORNIA	11403026
U61	COLUMBIA UNIV	22032616	U263	UNIV OF CALIFORNIA	11491547
U61	COLUMBIA UNIV	22745935	U263	UNIV OF CALIFORNIA	11835845
U62	CORNELL UNIV	10061102	U263	UNIV OF CALIFORNIA	12965526
U62	CORNELL UNIV	10075544	U263	UNIV OF CALIFORNIA	13011309
U62	CORNELL UNIV	13114994	U263	UNIV OF CALIFORNIA	13031273
U62	CORNELL UNIV	22439140	U263	UNIV OF CALIFORNIA	13096429
U63	CREIGHTON UNIV	11404632	U263	UNIV OF CALIFORNIA	13130981
U63	CREIGHTON UNIV	11483474	U263	UNIV OF CALIFORNIA	13153610
U63	CREIGHTON UNIV	22870461	U263	UNIV OF CALIFORNIA	21880971
U64	DARTMOUTH COLLEGE	10398824	U263	UNIV OF CALIFORNIA	22128483
U64	DARTMOUTH COLLEGE	13074801	U263	UNIV OF CALIFORNIA	23213594
U64	DARTMOUTH COLLEGE	23184628	U263	UNIV OF CALIFORNIA	23253509
U65	DAVIDSON COLLEGE	10510509	U264	UNIV OF CENT FLORIDA	11719517
U66	DENVER PUBLIC SCHOOLS	11622732	U264	UNIV OF CENT FLORIDA	13073164
U67	DOWLING COLLEGE	11963203	U264	UNIV OF CENT FLORIDA	13099239
U68	DREXEL UNIV	10954865	U265	UNIV OF CHICAGO	10154594
U68	DREXEL UNIV	11315969	U265	UNIV OF CHICAGO	11423007
U68	DREXEL UNIV	11765555	U265	UNIV OF CHICAGO	12796484
U68	DREXEL UNIV	11940708	U265	UNIV OF CHICAGO	13062601
U68	DREXEL UNIV	13118803	U265	UNIV OF CHICAGO	21343459
U68	DREXEL UNIV	21467059	U266	UNIV OF CINCINNATI	10041121
U69	DUGUESNE UNIV	11269645	U266	UNIV OF CINCINNATI	10622190
U70	DUKE UNIV	10381645	U266	UNIV OF CINCINNATI	21616788

U70	DUKE UNIV	10811240	U267	UNIV OF COLORADO	11023299
U70	DUKE UNIV	11118479	U267	UNIV OF COLORADO	11481253
U70	DUKE UNIV	11914519	U267	UNIV OF COLORADO	12265471
U70	DUKE UNIV	22672650	U267	UNIV OF COLORADO	13125454
U70	DUKE UNIV	31462732	U267	UNIV OF COLORADO	13131054
U71	EAST CAROLINA UNIV	12187351	U268	UNIV OF CONNECTICUT	10685585
U71	EAST CAROLINA UNIV	22093804	U268	UNIV OF CONNECTICUT	11231993
U72	EAST TENNESSEE STATE UNIV	10799878	U268	UNIV OF CONNECTICUT	12551316
U73	EASTERN MICHIGAN UNIV	11659189	U269	UNIV OF DAYTON	11580808
U74	EASTERN VIRGINIA MED SCHOOL	10776979	U270	UNIV OF DELAWARE	10967975
U74	EASTERN VIRGINIA MED SCHOOL	11290554	U271	UNIV OF DENVER	10531434
U74	EASTERN VIRGINIA MED SCHOOL	11568736	U272	UNIV OF DETROIT MERCY	22210580
U74	EASTERN VIRGINIA MED SCHOOL	13248021	U273	UNIV OF FLORIDA	10062206
U74	EASTERN VIRGINIA MED SCHOOL	21158600	U273	UNIV OF FLORIDA	11645650
U74	EASTERN VIRGINIA MED SCHOOL	21940531	U273	UNIV OF FLORIDA	11914084
U74	EASTERN VIRGINIA MED SCHOOL	22381251	U273	UNIV OF FLORIDA	12304022
U75	EASTERN WASHINGTON UNIV	12794799	U273	UNIV OF FLORIDA	12940121
U76	EMORY UNIV	11907114	U273	UNIV OF FLORIDA	13067084
U76	EMORY UNIV	12952537	U273	UNIV OF FLORIDA	21531655
U76	EMORY UNIV	13153100	U273	UNIV OF FLORIDA	22795882
U76	EMORY UNIV	21940314	U274	UNIV OF GEORGIA	10709716
U77	ERSKINE COLLEGE	12208271	U274	UNIV OF GEORGIA	10743899
U78	FAIRFIELD UNIV	10326534	U274	UNIV OF GEORGIA	20980632
U79	FERRIS STATE UNIV	12744811	U274	UNIV OF GEORGIA	21024097
U80	FLORIDA A&M UNIV	10688530	U274	UNIV OF GEORGIA	31292804
U81	FLORIDA ATLANTIC UNIV	11374602	U275	UNIV OF HARTFORD	11289490
U81	FLORIDA ATLANTIC UNIV	11397556	U276	UNIV OF HAWAII	10643212
U82	FLORIDA INST OF TECH	11653616	U276	UNIV OF HAWAII	11798517
U82	FLORIDA INST OF TECH	21264587	U277	UNIV OF HEALTH SCI	10832755
U83	FLORIDA INT UNIV	11351849	U278	UNIV OF HOUSTON	10359318
U84	FLORIDA STATE UNIV	10572253	U278	UNIV OF HOUSTON	11083253
U85	FORDHAM UNIV	12483494	U278	UNIV OF HOUSTON	11826512
U86	FORMAN SCHOOL	12512261	U278	UNIV OF HOUSTON	11973901
U87	FORT VALLEY STATE COLLEGE	10945959	U278	UNIV OF HOUSTON	12008832
U88	FRANCISCAN UNIV OF STEUBENVILLE	12857699	U278	UNIV OF HOUSTON	12950314
U89	GEORGE MASON UNIV	12053388	U278	UNIV OF HOUSTON	21504424
U89	GEORGE MASON UNIV	13160830	U279	UNIV OF IDAHO	10495969
U90	GEORGE WASHINGTON UNIV	10643340	U280	UNIV OF ILLINOIS	10041842
U90	GEORGE WASHINGTON UNIV	11232401	U280	UNIV OF ILLINOIS	10568328
U91	GEORGETOWN UNIV	10420768	U280	UNIV OF ILLINOIS	13082277
U91	GEORGETOWN UNIV	23160283	U280	UNIV OF ILLINOIS	13176072
U92	GEORGIA INST OF TECH	10245256	U280	UNIV OF ILLINOIS	13209235
U92	GEORGIA INST OF TECH	11201574	U280	UNIV OF ILLINOIS	21997696
U92	GEORGIA INST OF TECH	11907114	U280	UNIV OF ILLINOIS	23017867

U92	GEORGIA INST OF TECH	12242425	U281	UNIV OF IOWA	10062450
U92	GEORGIA INST OF TECH	13168377	U281	UNIV OF IOWA	10430486
U92	GEORGIA INST OF TECH	13189746	U281	UNIV OF IOWA	13108782
U92	GEORGIA INST OF TECH	21544042	U281	UNIV OF IOWA	13212573
U93	GEORGIA REGENTS UNIV	10495486	U281	UNIV OF IOWA	21559317
U94	GEORGIA STATE UNIV	11063676	U281	UNIV OF IOWA	21619052
U94	GEORGIA STATE UNIV	13058237	U281	UNIV OF IOWA	22019136
U94	GEORGIA STATE UNIV	31917686	U281	UNIV OF IOWA	22148979
U94	GEORGIA STATE UNIV	32072969	U282	UNIV OF KANSAS	10077203
U95	GLOBAL PETROLEUM RESOUCES INST	10834168	U282	UNIV OF KANSAS	10144154
U96	GONZAGA UNIV	10148287	U282	UNIV OF KANSAS	10764366
U97	GOSHEN COLLEGE	10490341	U282	UNIV OF KANSAS	11157105
U98	GRAND VALLEY STATE UNIV	11530764	U282	UNIV OF KANSAS	11652313
U99	HAMPSHIRE COLLEGE	12134308	U282	UNIV OF KANSAS	12422786
U100	HAMPTON UNIV	12750799	U283	UNIV OF KENTUCKY	10367449
U101	HARVARD UNIV	10441766	U283	UNIV OF KENTUCKY	11623208
U101	HARVARD UNIV	10669916	U283	UNIV OF KENTUCKY	13166469
U101	HARVARD UNIV	11644197	U283	UNIV OF KENTUCKY	21124944
U101	HARVARD UNIV	13092079	U283	UNIV OF KENTUCKY	22503627
U101	HARVARD UNIV	21754150	U283	UNIV OF KENTUCKY	22630049
U101	HARVARD UNIV	21836318	U283	UNIV OF KENTUCKY	22731487
U101	HARVARD UNIV	22120144	U284	UNIV OF LOUISIANA	10906343
U101	HARVARD UNIV	23194752	U284	UNIV OF LOUISIANA	12681831
U101	HARVARD UNIV	31904374	U285	UNIV OF LOUISVILLE	10317341
U102	HATHAWAY BROWN SCHOOL	12723620	U285	UNIV OF LOUISVILLE	11059353
U103	HOFSTRA UNIV	21517215	U285	UNIV OF LOUISVILLE	11298212
U104	HONOLULU UNIV	12479573	U285	UNIV OF LOUISVILLE	13062808
U105	HOWARD UNIV	11630148	U286	UNIV OF MAINE	10640468
U106	HUMBOLDT STATE UNIV	12503249	U287	UNIV OF MARYLAND	11191953
U107	IDAHO STATE UNIV	12717588	U287	UNIV OF MARYLAND	11358284
U108	ILLINOIS INST OF TECH	11788448	U287	UNIV OF MARYLAND	11632204
U109	ILLINOIS STATE UNIV	10949075	U287	UNIV OF MARYLAND	11714398
U110	INDIANA UNIV	10592322	U287	UNIV OF MARYLAND	12256952
U110	INDIANA UNIV	11793501	U287	UNIV OF MARYLAND	13133766
U110	INDIANA UNIV	12961647	U287	UNIV OF MARYLAND	13138078
U110	INDIANA UNIV	21779511	U287	UNIV OF MARYLAND	23091698
U111	IOWA STATE UNIV	-19842	U288	UNIV OF MASSACHUSETTS	10644545
U111	IOWA STATE UNIV	10241419	U288	UNIV OF MASSACHUSETTS	11043142
U111	IOWA STATE UNIV	12637792	U288	UNIV OF MASSACHUSETTS	11078564
U111	IOWA STATE UNIV	13166241	U288	UNIV OF MASSACHUSETTS	11159519
U111	IOWA STATE UNIV	21589443	U288	UNIV OF MASSACHUSETTS	11249757
U111	IOWA STATE UNIV	22014247	U288	UNIV OF MASSACHUSETTS	11533895
U112	ITHACA COLLEGE	32157288	U288	UNIV OF MASSACHUSETTS	11947081
U113	JACKSON STATE UNIV	12641196	U288	UNIV OF MASSACHUSETTS	11979607

U114	JACKSONVILLE STATE UNIV	12606791	U288	UNIV OF MASSACHUSETTS	12673072
U115	JAMES MADISON UNIV	12217658	U288	UNIV OF MASSACHUSETTS	22669651
U116	JIT INST OF TECH INC	11540480	U288	UNIV OF MASSACHUSETTS	32465352
U117	JOHN COSTANZA INST OF TECH	-19842	U289	UNIV OF MEDICINE & DENISTRY OF NEW JERSEY	10805756
U117	JOHN COSTANZA INST OF TECH	12298980	U289	UNIV OF MEDICINE & DENISTRY OF NEW JERSEY	13081942
U118	JOHNS HOPKINS UNIV	10272382	U289	UNIV OF MEDICINE & DENISTRY OF NEW JERSEY	13179673
U118	JOHNS HOPKINS UNIV	11701894	U289	UNIV OF MEDICINE & DENISTRY OF NEW JERSEY	22823702
U118	JOHNS HOPKINS UNIV	21796135	U290	UNIV OF MEMPHIS	11618897
U119	JOHNSON & WALES UNIV	11079610	U290	UNIV OF MEMPHIS	11701534
U120	JORDAN COLLEGE	10335223	U291	UNIV OF MIAMI	10488380
U121	KANSAS STATE UNIV	10144154	U291	UNIV OF MIAMI	10759815
U121	KANSAS STATE UNIV	11312062	U291	UNIV OF MIAMI	12362255
U121	KANSAS STATE UNIV	22576010	U291	UNIV OF MIAMI	22730154
U122	KENT STATE UNIV	11421533	U292	UNIV OF MICHIGAN	10633647
U123	KIRKWOOD COMMUNITY COLLEGE	11093484	U292	UNIV OF MICHIGAN	10986768
U124	LAWRENCE TECHNOLOGICAL UNIV	11231979	U293	UNIV OF MINNESOTA	10088481
U124	LAWRENCE TECHNOLOGICAL UNIV	12267391	U293	UNIV OF MINNESOTA	11296379
U124	LAWRENCE TECHNOLOGICAL UNIV	12890518	U293	UNIV OF MINNESOTA	12952537
U125	LE TOURNEAU UNIV	10926566	U293	UNIV OF MINNESOTA	13174559
U126	LEHIGH UNIV	11235848	U293	UNIV OF MINNESOTA	13243336
U126	LEHIGH UNIV	12652233	U293	UNIV OF MINNESOTA	21341069
U127	LIFE CHIROPRACTIC COLLEGE WEST	10343025	U293	UNIV OF MINNESOTA	22906363
U128	LOMA LINDA UNIV	11515547	U294	UNIV OF MISSISSIPPI	10973250
U128	LOMA LINDA UNIV	11564411	U294	UNIV OF MISSISSIPPI	12115690
U128	LOMA LINDA UNIV	12803206	U295	UNIV OF MISSOURI	11007415
U129	LOUISANA STATE UNIV	10140805	U295	UNIV OF MISSOURI	21097646
U129	LOUISANA STATE UNIV	11062023	U296	UNIV OF MONTANA	10691564
U129	LOUISANA STATE UNIV	11627788	U297	UNIV OF NEBRASKA	10109390
U129	LOUISANA STATE UNIV	11947081	U297	UNIV OF NEBRASKA	12997875
U129	LOUISANA STATE UNIV	12966870	U297	UNIV OF NEBRASKA	13156532
U129	LOUISANA STATE UNIV	13009436	U297	UNIV OF NEBRASKA	33202059
U129	LOUISANA STATE UNIV	13166469	U298	UNIV OF NEVADA	10237009
U129	LOUISANA STATE UNIV	13209300	U298	UNIV OF NEVADA	11703838
U129	LOUISANA STATE UNIV	21195745	U298	UNIV OF NEVADA	13071491
U129	LOUISANA STATE UNIV	21685347	U298	UNIV OF NEVADA	13109172
U129	LOUISANA STATE UNIV	21735512	U298	UNIV OF NEVADA	21844711
U129	LOUISANA STATE UNIV	21952168	U298	UNIV OF NEVADA	21958662
U129	LOUISANA STATE UNIV	22154284	U298	UNIV OF NEVADA	22186847
U129	LOUISANA STATE UNIV	22637947	U298	UNIV OF NEVADA	22808133
U129	LOUISANA STATE UNIV	43036639	U298	UNIV OF NEVADA	22814869
U130	LOUISIANA TECH UNIV	10126534	U298	UNIV OF NEVADA	22887683
U130	LOUISIANA TECH UNIV	12813408	U298	UNIV OF NEVADA	23202059
U130	LOUISIANA TECH UNIV	13190783	U299	UNIV OF NEW HAMPSHIRE	11724210
U130	LOUISIANA TECH UNIV	23072046	U299	UNIV OF NEW HAMPSHIRE	22689966

U131	LOYOLA UNIV CHICAGO	11947185	U300	UNIV OF NEW MEXICO	10913424
U132	LOYOLA UNIV MARYLAND	11561939	U300	UNIV OF NEW MEXICO	12773626
U133	MACOMB INTERMEDIATE SCHOOL DISTRICT	12317057	U300	UNIV OF NEW MEXICO	22240157
U134	MARION COUNTY SCHOOL BOARD	11775373	U301	UNIV OF NEW ORLEANS	11437146
U135	MARQUETTE UNIV	10660599	U301	UNIV OF NEW ORLEANS	12416380
U136	MARSHALL UNIV	11841525	U301	UNIV OF NEW ORLEANS	12452671
U137	MASSACHUSETTS INST OF TECH	10669916	U302	UNIV OF NORTH CARLOINA	10478431
U137	MASSACHUSETTS INST OF TECH	11527095	U302	UNIV OF NORTH CARLOINA	11068582
U137	MASSACHUSETTS INST OF TECH	11947081	U302	UNIV OF NORTH CARLOINA	21292761
U137	MASSACHUSETTS INST OF TECH	12641479	U302	UNIV OF NORTH CARLOINA	21616739
U137	MASSACHUSETTS INST OF TECH	12991382	U302	UNIV OF NORTH CARLOINA	21946714
U137	MASSACHUSETTS INST OF TECH	13006194	U302	UNIV OF NORTH CARLOINA	22104572
U137	MASSACHUSETTS INST OF TECH	13106289	U302	UNIV OF NORTH CARLOINA	22160569
U137	MASSACHUSETTS INST OF TECH	22536443	U302	UNIV OF NORTH CARLOINA	23027322
U137	MASSACHUSETTS INST OF TECH	22576921	U302	UNIV OF NORTH CARLOINA	23126469
U137	MASSACHUSETTS INST OF TECH	22955839	U303	UNIV OF NORTH DAKOTA	11031073
U138	MCNEESE STATE UNIV	12702967	U303	UNIV OF NORTH DAKOTA	11354521
U139	MED COLLEGE OF WISCONSIN	10580239	U303	UNIV OF NORTH DAKOTA	11877098
U139	MED COLLEGE OF WISCONSIN	10820459	U303	UNIV OF NORTH DAKOTA	12520107
U140	MED UNIV OF SOUTH CAROLINA	10995833	U304	UNIV OF NORTH FLORIDA	12458745
U141	MEHARRY MED COLLEGE	13126305	U305	UNIV OF NORTH TEXAS	10740277
U142	MERCER UNIV	12595514	U305	UNIV OF NORTH TEXAS	11784144
U142	MERCER UNIV	12655110	U305	UNIV OF NORTH TEXAS	12290304
U143	MIAMI UNIV	10834376	U306	UNIV OF NORTHERN IOWA	10669932
U143	MIAMI UNIV	12555248	U307	UNIV OF NOTRE DAME	10098786
U144	MICHIGAN STATE UNIV	10194972	U307	UNIV OF NOTRE DAME	11206968
U144	MICHIGAN STATE UNIV	13020373	U308	UNIV OF OKLAHOMA	10699216
U144	MICHIGAN STATE UNIV	13205811	U309	UNIV OF OREGON	10199918
U145	MICHIGAN TECH UNIV	10077900	U309	UNIV OF OREGON	10461110
U146	MILWAUKEE SCHOOL OF ENG	12409581	U309	UNIV OF OREGON	21141378
U147	MINNESOTA STATE UNIV	11729349	U309	UNIV OF OREGON	22250176
U148	MISSISSIPPI STATE UNIV	11300457	U310	UNIV OF PACIFIC	10069498
U148	MISSISSIPPI STATE UNIV	11640190	U311	UNIV OF PENNSYLVANIA	10553405
U148	MISSISSIPPI STATE UNIV	12603782	U311	UNIV OF PENNSYLVANIA	21448010
U148	MISSISSIPPI STATE UNIV	22458885	U311	UNIV OF PENNSYLVANIA	22163973
U149	MISSOURI STATE UNIV	12562207	U311	UNIV OF PENNSYLVANIA	22529353
U150	MONTANA STATE UNIV	10309530	U311	UNIV OF PENNSYLVANIA	41937492
U150	MONTANA STATE UNIV	10442746	U312	UNIV OF PITTSBURGH	10816904
U150	MONTANA STATE UNIV	10507582	U312	UNIV OF PITTSBURGH	11580909
U150	MONTANA STATE UNIV	12730146	U312	UNIV OF PITTSBURGH	13038211
U151	MONTCLAIR STATE COLLEGE	10998921	U312	UNIV OF PITTSBURGH	13098395
U152	MOREHOUSE SCHOOL OF MEDICINE	22229917	U312	UNIV OF PITTSBURGH	13157514
U153	NEW JERSEY INST OF TECH	10367156	U312	UNIV OF PITTSBURGH	13159719
U153	NEW JERSEY INST OF TECH	10630367	U312	UNIV OF PITTSBURGH	22651595

U154	NEW MEXICO HIGHLANDS UNIV	13174959	U312	UNIV OF PITTSBURGH	22834880
U156	NEW MEXICO STATE UNIV	10477157	U313	UNIV OF PORTLAND	12519096
U156	NEW MEXICO STATE UNIV	11784545	U314	UNIV OF PUERTO RICO	11159294
U155	NEW MEXICO TECH	10707696	U315	UNIV OF RHODE ISLAND	10211036
U155	NEW MEXICO TECH	10710305	U315	UNIV OF RHODE ISLAND	10332373
U157	NEW YORK CHIROPRACTIC COLLEGE	11001730	U315	UNIV OF RHODE ISLAND	11401123
U158	NEW YORK INST OF TECH	10323560	U316	UNIV OF ROCHESTER	10813351
U159	NEW YORK MED COLLEGE	11880029	U316	UNIV OF ROCHESTER	21383171
U160	NEW YORK UNIV	10225626	U316	UNIV OF ROCHESTER	23216874
U160	NEW YORK UNIV	10935256	U316	UNIV OF ROCHESTER	32265471
U160	NEW YORK UNIV	11038949	U317	UNIV OF SCI IN PHILADELPHIA	12403630
U160	NEW YORK UNIV	11853445	U318	UNIV OF SCRANTON	11695871
U160	NEW YORK UNIV	12839335	U319	UNIV OF SOUTH ALABAMA	10685560
U160	NEW YORK UNIV	13241582	U320	UNIV OF SOUTH CAROLINA	10464990
U161	NICHOLLS STATE UNIV	12274275	U320	UNIV OF SOUTH CAROLINA	11249621
U162	NORTH CAROLINA A&T STATE UNIV	12268714	U320	UNIV OF SOUTH CAROLINA	12753388
U163	NORTH CAROLINA CENT UNIV	11099366	U320	UNIV OF SOUTH CAROLINA	23046248
U164	NORTH CAROLINA STATE UNIV	10559924	U321	UNIV OF SOUTH FLORDIA	11233875
U164	NORTH CAROLINA STATE UNIV	11506123	U321	UNIV OF SOUTH FLORDIA	22073133
U164	NORTH CAROLINA STATE UNIV	13226041	U321	UNIV OF SOUTH FLORDIA	22669149
U164	NORTH CAROLINA STATE UNIV	23129971	U322	UNIV OF SOUTHERN CALIFORNIA	10578763
U165	NORTH DAKOTA STATE UNIV	10566870	U322	UNIV OF SOUTHERN CALIFORNIA	12328900
U165	NORTH DAKOTA STATE UNIV	10923756	U322	UNIV OF SOUTHERN CALIFORNIA	12758297
U165	NORTH DAKOTA STATE UNIV	11143192	U322	UNIV OF SOUTHERN CALIFORNIA	21438481
U165	NORTH DAKOTA STATE UNIV	12042637	U323	UNIV OF SOUTHERN MISSISSIPPI	11695908
U165	NORTH DAKOTA STATE UNIV	22032783	U323	UNIV OF SOUTHERN MISSISSIPPI	13039998
U166	NORTHEASTERN OHIO MED UNIV	11520028	U324	UNIV OF TENNESSEE	10395128
U167	NORTHEASTERN UNIV	11750270	U324	UNIV OF TENNESSEE	11073675
U168	NORTHERN ARIZONA UNIV	10586414	U324	UNIV OF TENNESSEE	11302430
U168	NORTHERN ARIZONA UNIV	11750489	U324	UNIV OF TENNESSEE	12727218
U168	NORTHERN ARIZONA UNIV	13126467	U324	UNIV OF TENNESSEE	12955536
U169	NORTHERN ILLINOIS UNIV	11371840	U324	UNIV OF TENNESSEE	21028705
U169	NORTHERN ILLINOIS UNIV	22044652	U324	UNIV OF TENNESSEE	21683109
U170	NORTHWEST MISSOURI STATE UNIV	12249694	U325	UNIV OF TEXAS	10179127
U171	NORTHWESTERN POLYTECHNIC UNIV	10901441	U325	UNIV OF TEXAS	11586204
U172	NORTHWESTERN UNIV	10265747	U325	UNIV OF TEXAS	12098212
U172	NORTHWESTERN UNIV	10935258	U325	UNIV OF TEXAS	13056214
U172	NORTHWESTERN UNIV	11495704	U325	UNIV OF TEXAS	13094961
U172	NORTHWESTERN UNIV	12057950	U325	UNIV OF TEXAS	13143500
U172	NORTHWESTERN UNIV	21478822	U325	UNIV OF TEXAS	20941968
U172	NORTHWESTERN UNIV	21802904	U325	UNIV OF TEXAS	21683220
U173	NOVA SOUTHEASTERN UNIV	10706233	U325	UNIV OF TEXAS	21722946
U173	NOVA SOUTHEASTERN UNIV	12380965	U325	UNIV OF TEXAS	22038636
U174	OAK RIDGE ASSOC UNIVERSITIES	10926602	U325	UNIV OF TEXAS	22101963

U174	OAK RIDGE ASSOC UNIVERSITIES	10933394	U325	UNIV OF TEXAS	22232724
U175	OAKLAND UNIV	12935463	U325	UNIV OF TEXAS	22265484
U176	OHIO NORTHERN UNIV	11589089	U325	UNIV OF TEXAS	22656893
U177	OHIO STATE UNIV	10875627	U325	UNIV OF TEXAS	22727731
U177	OHIO STATE UNIV	11671339	U325	UNIV OF TEXAS	31946946
U177	OHIO STATE UNIV	13062757	U326	UNIV OF TOLEDO	10651445
U177	OHIO STATE UNIV	13085082	U326	UNIV OF TOLEDO	11209129
U177	OHIO STATE UNIV	22412940	U327	UNIV OF TULSA	11783568
U177	OHIO STATE UNIV	22662337	U328	UNIV OF UTAH	10266457
U178	OHIO UNIV	11132407	U328	UNIV OF UTAH	10424292
U178	OHIO UNIV	23101755	U328	UNIV OF UTAH	11973831
U179	OKLAHOMA STATE UNIV	10042480	U328	UNIV OF UTAH	12979735
U179	OKLAHOMA STATE UNIV	10708257	U328	UNIV OF UTAH	13058323
U179	OKLAHOMA STATE UNIV	21419483	U329	UNIV OF VERMONT	10941045
U180	OLD DOMINION UNIV	10367573	U329	UNIV OF VERMONT	11313813
U180	OLD DOMINION UNIV	12618692	U329	UNIV OF VERMONT	21128253
U181	OREGON HEALTH SCI UNIV	11075430	U329	UNIV OF VERMONT	22014112
U181	OREGON HEALTH SCI UNIV	11223730	U330	UNIV OF VIRGINIA	-19842
U181	OREGON HEALTH SCI UNIV	11602038	U330	UNIV OF VIRGINIA	10170460
U181	OREGON HEALTH SCI UNIV	21729163	U330	UNIV OF VIRGINIA	10261198
U181	OREGON HEALTH SCI UNIV	21752368	U330	UNIV OF VIRGINIA	11045478
U182	OREGON STATE UNIV	-19842	U331	UNIV OF WASHINGTON	10239303
U182	OREGON STATE UNIV	10242939	U331	UNIV OF WASHINGTON	10886396
U182	OREGON STATE UNIV	10382255	U331	UNIV OF WASHINGTON	11277015
U182	OREGON STATE UNIV	10461110	U331	UNIV OF WASHINGTON	11534084
U182	OREGON STATE UNIV	13150579	U331	UNIV OF WASHINGTON	13062709
U182	OREGON STATE UNIV	21632142	U331	UNIV OF WASHINGTON	21940712
U182	OREGON STATE UNIV	21710031	U332	UNIV OF WEST FLORIDA	11606937
U182	OREGON STATE UNIV	22595588	U333	UNIV OF WISCONSIN	-18138
U183	PACE UNIV	12564893	U333	UNIV OF WISCONSIN	10758279
U184	PENN STATE UNIV	10126251	U333	UNIV OF WISCONSIN	11011139
U184	PENN STATE UNIV	10880590	U333	UNIV OF WISCONSIN	11091862
U184	PENN STATE UNIV	11381814	U333	UNIV OF WISCONSIN	11186941
U184	PENN STATE UNIV	12069216	U333	UNIV OF WISCONSIN	13174902
U184	PENN STATE UNIV	12242850	U333	UNIV OF WISCONSIN	13205491
U184	PENN STATE UNIV	12547753	U333	UNIV OF WISCONSIN	13241558
U184	PENN STATE UNIV	13142419	U333	UNIV OF WISCONSIN	22391743
U184	PENN STATE UNIV	21368573	U333	UNIV OF WISCONSIN	52256503
U185	PEPPERDINE UNIV	11608189	U334	UNIV OF WYOMING	11661065
U186	PHILADELPHIA COLLEGE OF OSTEOPATHIC MEDICINE	10268206	U334	UNIV OF WYOMING	11835948
U186	PHILADELPHIA COLLEGE OF OSTEOPATHIC MEDICINE	11687112	U335	UNIVERSITIES SPACE RES ASSOC	12108009
U187	PITTSBURG STATE UNIV	12673354	U336	UTAH STATE UNIV	10102878
U188	POLYTEC PACKAGING	11348040	U336	UTAH STATE UNIV	11777166
U189	PORTLAND STATE UNIV	10547299	U337	VALDOSTA STATE UNIV	12122456

U189	PORTLAND STATE UNIV	12059871	U338	VANDERBILT UNIV	10427180
U189	PORTLAND STATE UNIV	13142317	U338	VANDERBILT UNIV	11800654
U190	PRINCETON UNIV	10982333	U338	VANDERBILT UNIV	12958157
U190	PRINCETON UNIV	12941661	U338	VANDERBILT UNIV	13241160
U190	PRINCETON UNIV	13051753	U338	VANDERBILT UNIV	22085597
U190	PRINCETON UNIV	13153412	U338	VANDERBILT UNIV	22540680
U190	PRINCETON UNIV	13202451	U339	VAUGHN COLLEGE OF AERONAUTICS AND TECHNOLOGY	10967685
U190	PRINCETON UNIV	21645396	U340	VILLANOVA UNIV	10113411
U191	PURDUE UNIV	10035219	U341	VIRGINIA COMMONWEALTH UNIV	11421012
U191	PURDUE UNIV	10366981	U341	VIRGINIA COMMONWEALTH UNIV	11710180
U191	PURDUE UNIV	10398726	U342	VIRGINIA STATE UNIV	11788508
U191	PURDUE UNIV	10537031	U343	VIRGINIA TECH	10039044
U191	PURDUE UNIV	11901537	U343	VIRGINIA TECH	11187277
U191	PURDUE UNIV	32065493	U343	VIRGINIA TECH	11198954
U192	REED COLLEGE	23011649	U343	VIRGINIA TECH	12551167
U193	REGIS COLLEGE	10943971	U343	VIRGINIA TECH	12790182
U194	RENSSELAER POLYTECHIN INST	10403068	U343	VIRGINIA TECH	12942141
U194	RENSSELAER POLYTECHIN INST	22673373	U343	VIRGINIA TECH	21187277
U195	RICE UNIV	12224373	U343	VIRGINIA TECH	21231411
U195	RICE UNIV	12969084	U343	VIRGINIA TECH	21542029
U195	RICE UNIV	13148999	U343	VIRGINIA TECH	21917775
U195	RICE UNIV	13238100	U343	VIRGINIA TECH	22113740
U195	RICE UNIV	22555676	U344	WABASH COLLEGE	10622914
U196	ROANOKE COLLEGE	10866925	U345	WAKE FOREST UNIV	10806683
U197	ROCHESTER INST OF TECH	12641750	U345	WAKE FOREST UNIV	11643499
U198	ROCKEFELLER UNIV	11196703	U345	WAKE FOREST UNIV	12301988
U199	ROCKHURST UNIV	12065608	U345	WAKE FOREST UNIV	12624616
U200	ROSALIND FRANKLIN UNIV	21741747	U345	WAKE FOREST UNIV	13108395
U201	ROSE HULMAN INST OF TECH	12759972	U346	WASHINGTON STATE UNIV	11522428
U202	RUSH UNIV	12713330	U347	WASHINGTON UNIV ST LOUIS	10035548
U202	RUSH UNIV	13101393	U347	WASHINGTON UNIV ST LOUIS	10775140
U203	RUTGERS UNIV	10045993	U347	WASHINGTON UNIV ST LOUIS	12448185
U203	RUTGERS UNIV	10088481	U347	WASHINGTON UNIV ST LOUIS	12941559
U203	RUTGERS UNIV	11102710	U347	WASHINGTON UNIV ST LOUIS	22526196
U203	RUTGERS UNIV	11231993	U348	WAYNE STATE UNIV	10427180
U203	RUTGERS UNIV	13133618	U348	WAYNE STATE UNIV	10847404
U203	RUTGERS UNIV	13156493	U348	WAYNE STATE UNIV	31739712
U203	RUTGERS UNIV	13178411	U349	WEBER STATE UNIV	11896922
U203	RUTGERS UNIV	22265502	U350	WELLESLEY COLLEGE	12407978
U204	SACRAMENTO CITY UNIFIED SCHOOL DISTRICT	13118155	U351	WEST VIRGINIA UNIV	11146459
U205	SAGINAW VALLEY STATE UNIV	10883133	U351	WEST VIRGINIA UNIV	12644624
U206	SALEM INT UNIV	12840486	U352	WESTERN ILLINOIS UNIV	13033405
U207	SALISBURY UNIV	11612069	U353	WESTERN KENTUCKY UNIV	12663898
U208	SAN DIEGO STATE UNIV	12407625	U354	WESTERN MICHIGAN UNIV	11903740

U209	SAN JOSE STATE UNIV	11643621	U355	WESTERN UNIV OF HEALTH SCI	12859058
U209	SAN JOSE STATE UNIV	22947749	U355	WESTERN UNIV OF HEALTH SCI	12949269
U210	SANTA CLARA UNIV	21273474	U356	WESTERN WASHINGTON UNIV	10149309
U211	SETON HALL UNIV	12105148	U356	WESTERN WASHINGTON UNIV	10487689
U212	SHAW UNIV	10183841	U356	WESTERN WASHINGTON UNIV	12740543
U213	SIENA COLLEGE	10577917	U357	WHEELING JESUIT UNIV	12481346
U214	SMITH COLLEGE	10817258	U358	WICHITA STATE UNIV	11029736
U215	SOUTH DAKOGA SCHOOL OF MINES & TECH	11214687	U359	WIDNER UNIV	10162939
U216	SOUTH DAKOTA STATE UNIV	11777429	U360	WRIGHT STATE UNIV	10182806
U217	SOUTHEASTERN ILLINOIS COLLEGE	10960577	U361	YALE UNIV	11892773
U218	SOUTHEASTERN UNIV	11118387	U361	YALE UNIV	22196517
U218	SOUTHEASTERN UNIV	13086585	U361	YALE UNIV	22362025
U219	SOUTHERN COLLEGE OF OPTOMETRY	12759985	U361	YALE UNIV	23141298
U220	SOUTHERN ILLINOIS UNIV	10988029	U362	YESHIVA UNIV	10062715
U220	SOUTHERN ILLINOIS UNIV	13254608	U362	YESHIVA UNIV	10302665
U221	SOUTHERN METHODIST UNIV	11672060	U362	YESHIVA UNIV	12941547
U221	SOUTHERN METHODIST UNIV	13225986	U362	YESHIVA UNIV	20518059
U222	SOUTHERN UNIV & A&M COLLEGE	10988029	U362	YESHIVA UNIV	22793193