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Monetization Strategies of University Patents through PAEs: an Analysis of US Patent Transfers

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Abstract

The pressure to extract rents from academic research results has led many universities to file more patents and to rely on a growing range of monetization strategies including selling patents to Patent Assertion Entities (PAEs).

We build a database of university patents granted by the USPTO and, for each of them, we collect information about the change of ownership. A first analysis of these data shows that about 12% of university patents have been transferred at least once (including reassignments to universities, hospitals, public research centres and governmental institutions) and only a minor part has been acquired by PAEs (the 0.3% of university patents). However, we also find that most transfers of university patents to PAEs occurred in the last ten years (3.4% of transfers). These acquisitions are largely concentrated in two large PAEs that acquired about 80% of all PAEs-acquired university patents: *Intellectual Ventures* and *Intellectual Discovery*.

An econometric analysis on the characteristics of university patents transferred to PAEs shows that patents transferred to PAEs are of high quality, suggesting that PAEs cherry pick good patents for monetization purposes. PAEs acquire also older university patents than those transferred to producing companies. This fact suggests that these transfers are not linked to technology transfer.

Introduction

Since the passage of the Bayh-Dole Act in 1980, which assigns the IP of patentable results from government-funded research to universities, the number of university patents has increased significantly in the United States (Merrill & Mazza, 2011). Moreover, in recent years, similar legislative acts have been adopted in other countries to strengthen institutional ownership controls and promote commercialization and technology transfer. Consequently, the number of university patents has increased in other countries as well.

Universities are also progressively more active in the patent market. Recent figures from USPTO show that universities are among the entities with the highest volume of outbound patent assignment transactions. Four universities (University of Pennsylvania, University of Alabama, University of Michigan and University of Colorado) are in the top five of patent assignors by number of transactions in the first two months of 2019 (IAM, 2019).

In addition to the increase in university patenting activity and the participation of universities in the patent market, there has also been a significant increase in the monetization activity of the relative patents. Universities have been engaged in technology transfer for decades, but studies seem to indicate that they have recently become more aggressive in trying to monetize their patents through enforcement actions, licensing and transfers of their patents to other entities.

Specifically, some concerns have arisen about the possibility of using auctions and patent intermediaries such as Patent Assertion Entities (PAEs) for monetizing university patents.

Auctions are becoming more and more a way of commercialization chosen by universities. For example, university patents represent 20% of the business for Ocean Tomo, an IP merchant bank that organizes patent auctions (Ledford, 2013). Moreover, in 2014, Penn State University launched the first online auction of patent rights resulting from university research in the United States, offering about 70 patents to the highest bidder (Cahoy et al. 2016).

Transfers of university patents to PAEs, that is, companies whose exclusive business activity is to monetize patents through sales, licensing and litigation, have been also under scrutiny (Ewing & Feldman, 2012). PAEs have been accused by some observers to make new technology more expensive and using the patent system in a way that is contrary to the purpose for its creation. Contrary to universities and practicing entities (such as manufacturing companies), a PAE generally does not engage in research activity nor does it produce the goods or services covered by the intellectual property it controls. Several examples of transfers to PAEs have been publicly debated. One of the most notorious cases is the 2008 exclusive license of 50 patents of Caltech to a subsidiary of Intellectual Ventures (Ledford, 2013).

There could be several reasons for the increase in the university monetization activity mentioned above. In the U.S. context, Firpo and Meriles (2018) point out the fact that there have been reductions in the research funding provided to universities by the U.S. government; thus, universities need to finance research activities through other sources of income including the monetization of their patents. Moreover, they emphasize that university technology transfer offices are often not self-sufficient and that the enforcement of patents held by their universities helps them to increase revenues. Finally, based on Rai and Eisenberg (2003), a shifting of norms in the academia may have occurred, with universities becoming more inclined to hire professors who focus on applied research and whose results can be patented, as opposed to those engaging in basic research. The result of such hiring practices is a higher number of patents held by universities that ultimately leads to a higher level of monetization activity and, thus, to the development of patent thickets or an anticommons in relative fields (Firpo & Meriles 2018).

Since universities play an important role in both producing and disseminating knowledge, the way in which they monetize their patents might have a significant impact on society. Specific concerns have emerged in relation to access to university-created inventions that in many cases are funded by the public (Drivas et al., 2017; Thompson et al., 2018). Thus, it is important to

study this phenomenon thoroughly. This research addresses this issue by providing a full analysis of the newly available data on transfers of university patents granted by the United States Patent and Trademark Office (USPTO) between 1990 and 2017 (Graham et al., 2018).
How often universities do transfer their patents to PAEs? Which are the characteristics of these patents? Our research is the first to address these questions in a detailed and systematic way. It covers the transfer of university patents granted by the USPTO over 28 years and reveals that such transfers are a growing phenomenon and do not seem to be associated to an increasing technology transfer to the private sector.

Data construction

We exploit information from the US Patent Assignment Dataset (PAD, Version 2017), which allows for identifying patent transfers registered at the USPTO. We then match the relevant patent data to those contained in the PatentViews database (www.patentsview.org) to retrieve important characteristics of the patents subject to a transfer, such as technological classes, citations, and age.
The exploitation of PAD data presents three main challenges. First, the patent applicants' names are not harmonized. Second, often the sector of the patent holder (private business enterprises, universities / higher education institutions, governmental agencies, individuals, etc.) is not reported. Third, changes in patent ownership may be the result of events that are not patent trades (mergers and acquisitions, collaterals, etc).
To address the first issue, we develop an algorithm to clean and consolidate patent applicants' names (disambiguation). Regarding the allocation of assignees by type of sector, we exploit the information from EEE-PAT to define the categories/sectors relevant for our subjects. Then, we list the identified assignees by sector and create an extensive list of PAEs in the private company category. Finally, patent applicant names from PAD are assigned to specific sectors when a similarity between the applicant name and a name on our list from EEE-PAT is found. These steps take care of the second challenge too.
To address the third issue, we select only records that PAD considers as new assignments; this leads to the exclusion of transfers of ownership deriving from mergers and acquisitions and transactions in which patents are used as collateral. For the purpose of our research, a patent is considered as "transferred" if and only if two unique disambiguated applicants have been registered consecutively on two different dates. We further clean the identified transactions by excluding those transfers in which the seller and the buyer have very similar names indicating that they may be the same entity and have escaped our initial disambiguation efforts.
By restricting/limiting our investigation to granted patents filed between 1990 and 2013, we create a sample of 3,515,648 patents, 19.8% of which transferred at least once. Then, we select only patents with a university as first assignee, for a total of 106,075 (3% of USPTO patents).

University patenting at USPTO: key figures

Over the past 30 years, we have assisted to a strong growth in university patent filings at the USPTO, which was due first to US institutions increasing their activity in response to the Bayh-Dole Act (up until the early 2000s) and then to the sharp rise of foreign ones (see Figure A1 in Appendix). University patents granted by the USPTO were about 2% of the total number of issued patents at the beginning of the 1990s and now they stand at around 4%.
US universities obtain the majority of university patents in our study, representing two-thirds of the sample (68,819, corresponding to 64.9% of all USPTO university patents). Other countries with more than 3,000 university patents are Japan (5645), Taiwan (4058 patents), China (3988), South Korea (3883), and Canada (3469).

Among the top universities, the University of California is the institution with more granted patents (7,537), followed by MIT (3,327), the University of Florida (3,026), Stanford University (2,374) and California Institute of Technology (2,347). Among the foreign universities, Tsinghua University is on the top (with 1287 patents), followed by the National Taiwan University (688) and the University of Hong Kong (676).
About 12.3% of these patents are transferred at least once, and in most cases they are subject to only one transfer: only 1.9% of patents are transferred more than twice. Most university patents are sold to companies (7,959 patents, representing the 7.5% of all university patents - See Table 1).

Table 1. Transfers of university patents, by buyer sector

Buyer's sector	**# of patents** **(a)**	**(%)**	**# of patents [only first transfer]** **(b)**	**(%)**
PAE	383	0.4%	326	0.3%
COMPANY	8,357	7.9%	7,959	7.5%
UNIVERSITY	3,379	3.2%	2,969	2.8%
HOSPITAL	120	0.1%	114	0.1%
GOV NON-PROFIT	1,407	1.3%	1,321	1.2%
INDIVIDUAL	855	0.8%	766	0.7%
Total patents	*106,074*			
Transferred patents	*13,077 (12.3%)*			

Note. A patent is counted more than once when it has been transferred to two (or more) applicants of a different sector during its life. Column (a) shows the number of patents bought by type of buyer considering both direct (first) transfers and indirect transfers. Column (b) shows only the number of patents by type of buyer that have been *directly* transferred from universities. Years of filing: 1990-2013. Granted patents only.

However, a few of them (326 patents, representing the 0.3% of the sample) are directly transferred to PAEs. It is noticeable that almost all the transfers to PAEs occurred in the last ten years (see Figure 1), suggesting a new rising phenomenon. About 3% of university patents are transferred to other universities. This could be due to a real transfer between two institutions, especially when university co-assignees sell their part to other university co-assignees, to reallocate shares, reflecting a false change of ownership.

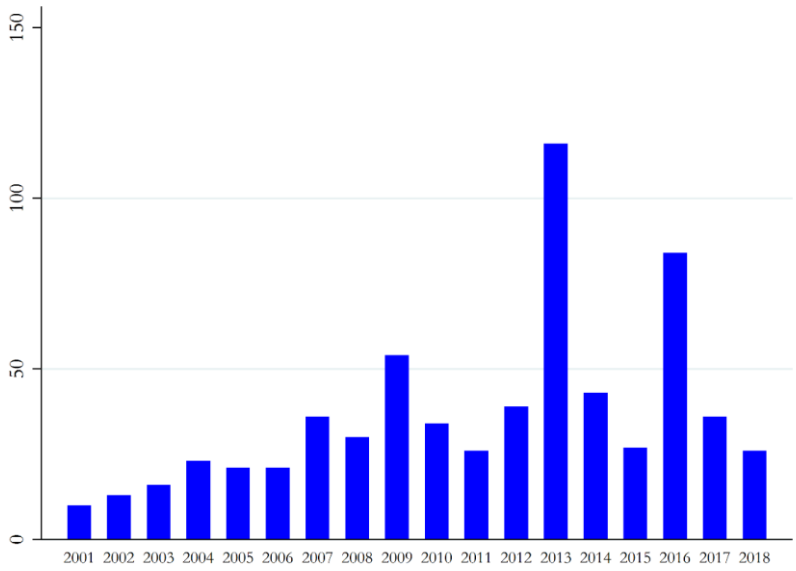

Figure 1. Transfers to PAEs, by transfer year

Note. The figure shows the number of university patents transferred to PAEs by transfer year.

Not surprisingly, most of the university patents acquired by PAEs are related to the high-tech sector. Following the international patent classification (IPC), eight macro sections, we find that more than the 80% of the transfers regard *Physics* and *Electricity*.

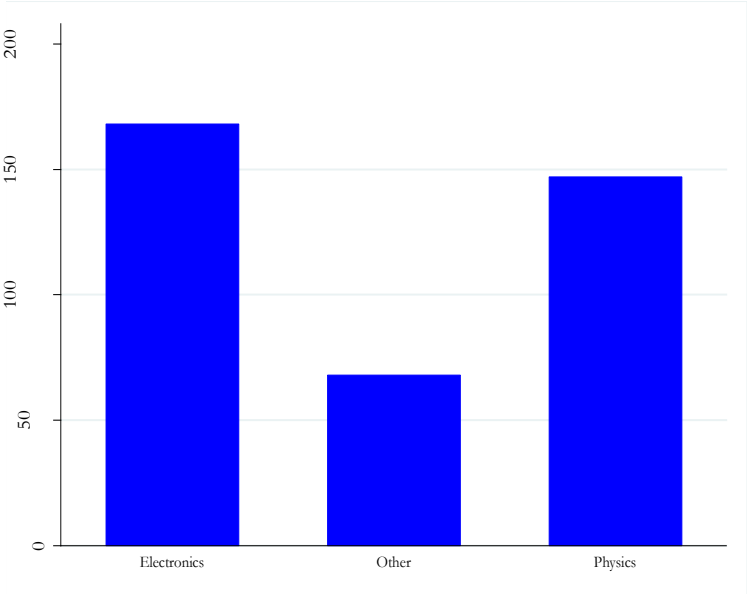

Figure 2. Transfers to PAEs, by technology

Note. IPC section ("Other" includes A = Human Necessitites, B = Performing Operations; Transporting, C = Chemistry; Metallurgy, D = Textiles; Paper, E = Fixed Constructions, F = Mechanical Engineering; Lighting; Heating; Weapons; Blasting)

Among the universities that transfer more patents to PAEs, we identify North Carolina State University (with 38 patents transferred to PAEs), Sungkyunkwan University (36), University of Texas System (24), Yonsei University (17) and Duke University (11). In total, the PAD-USPTO records indicates that 92 universities (33 of which are based in US, 13 in South Korea and 10 in UK) directly transfer patents to a PAE. Regarding PAEs as buyers of universities patents, two entities account for around 60% of transfers: Intellectual Ventures (with 188 patents, of which 161 as first transfer) and Intellectual Discovery (with 72 patents, of which 72 as first transfer) (See Table 3).

Table 2. TOP 5 Universities, by number of patents transferred to PAEs (direct transfer).

PAE	Direct Transfers
North Carolina State University (US)	38 (11.7%)
Sungkyunkwan University (KR)	36 (11.0%)
University of Texas System (US)	24 (7.4%)
Yonsei University (KR)	17 (5.2%)
Duke University (US)	11 (3.4%)

Note. Years of filing: 1990-2013. Granted patents only.

Table 3. TOP 5 PAEs, by number of university-transferred patents.

PAE	Acquired patents (a)	Acquired patents (directly from universities) (b)
INTELLECTUAL VENTURES	188 (49.3%)	161 (49.5%)
INTELLECTUAL DISCOVERY	72 (18.8%)	72 (22.2%)
TESSERA	16 (4.2%)	6 (1.9%)
RPX	16 (4.2%)	4 (1.2%)
ROCKSTAR	10 (2.6%)	0 (0.0%)
All PAEs	383	326

Note. Column (a) shows the number of patents bought by PAE as buyer considering both direct (first) transfers and indirect transfers. Column (b) shows only the number of patents by PAE that have been *directly* transferred from universities. Years of filing: 1990-2013. Granted patents only.

Characteristics of PAE-acquired university patents

In this section, we look at the characteristics of university patents acquired by PAEs to investigate whether to what extent these transfers are similar to transfers involving producing companies.

As proxy of patent quality, we consider the number of citations received in the first 3 years from the filing date (3-yrs Citations), the number of claims in the patent (Claims) and the age of the patent (Age) at the time of the patent.
Figure 2 shows the average values of these variables for the different types of buyers. What does emerge from the simple descriptive statistics is that PAE-acquired are of higher quality and older with respect to those transferred to other types of entities. On average, patents transferred to PAEs are eight years old, while those transferred to producing companies are almost 3 years younger.
Of course, to the extent that the heterogeneity in the distribution across technological fields and years is important, these statistics may be biased. To control for this possibility, we perform an econometric analysis that relates the characteristics of the patent to the probability of observing a transfer to PAEs.
In particular, we estimate two models.
In the first model (model 1), we estimate the probability that a patent is transferred to a PAE against the alternative of no-transfer: that is, we exclude from the analysis all patents transferred to other types of entities different from PAEs, so that we may investigate whether those transferred to PAEs do differ from those kept by universities.

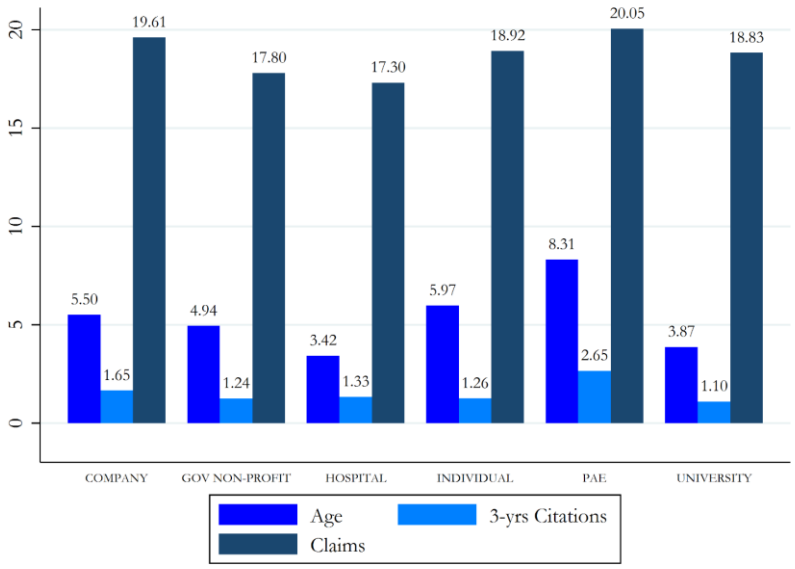

Figure 2. Characteristics of university patents, by type of buyer

We thus estimate the following empirical model:

$$Dummy_{PAE} = \alpha_i + \alpha_1 3 - \text{yrs citations} + \alpha_2 Claims_i + X_i'\delta + \varepsilon_{i,t} \qquad (1)$$

The matrix X does include dummies to control for time invariant characteristics such as technological classes, the application year and the country of the patent owner.
We estimate model 1 by using Probit models (Logit models provide similar results). We cluster standard errors at the university level to control for possible serial correlations (Bertrand et al., 2004).
Summary statistics of the variables used in the econometric exercises are reported in Appendix (Table A1). Table 4 shows the estimation results. In column (1) we do not control for baseline

patent characteristics, such as technological field, application year, and country of the university. These controls are added to the specification in column (2). Controlling for observable patent characteristics, patents that receive more citations and with a larger number of claims are more likely to be transferred to PAEs rather than to remain in the university patent portfolio.

Table 4. PAEs-Acquired vs Non –Transferred University Patents

	(1) PROBIT Dummy PAE	(2) PROBIT Dummy PAE
3-yrs citations	0.012***	0.015***
	(0.005)	(0.004)
Claims	0.002	0.002*
	(0.002)	(0.001)
Technological Field FEs	No	Yes
Application Year FEs	No	Yes
Country FEs	No	Yes
Observations	93’320	83’198
Pseudo-R2	0.0087	0.1899

Note. Cluster standard error (at the applicant/university level) in parenthesis; *** p<0.01, ** p<0.05, * p<0.1. Dummy_*PAE* is a dummy variable equals to one if the first buyer is a PAE and 0 if the patent has not been transferred.

In a second model we estimate the probability that a patent is (directly) transferred to PAEs *rather than* to producing companies. We replicate the empirical analysis of model 1 but including among the regressors a new variable (age), indicating the age of the patent at the time of the transfer.

Table 5. PAEs-Acquired vs Producing Companies-Acquired University Patents

	(1) PROBIT Dummy PAE	(2) PROBIT Dummy PAE
3-yrs citations	0.01**	0.01**
	(0.006)	(0.006)
Claims	-0.0006	0.002
	(0.004)	(0.002)
Age	0.065***	0.101***
	(0.025)	(0.014)
Technological Field FEs	No	Yes
Application Year FEs	No	Yes
Country FEs	No	Yes
Observations	7’994	7’321
Pseudo-R2	0.0509	0.2248

Note. Cluster standard error (at the applicant/university level) in parenthesis; *** p<0.01, ** p<0.05, * p<0.1. *Dummy_PAE* is a dummy variable equals to one if the first buyer is a PAE and 0 if it is a producing company.

We thus estimate the following empirical model:

$$Dummy_{PAE} = \alpha_i + \alpha_1 3 - \text{yrs citations} + \alpha_2 Claims_i + \alpha_3 Age_i + X_i'\delta + \varepsilon_{i,t} \qquad (2)$$

Table 5 shows the estimation results. University patents transferred to PAEs differ from those transferred to producing companies for number of citations received in the first three years from the filing date and for the age. In term of marginal effect, one year more increases the probability to observe a transfer to a PAE (instead to a producing company) by 0.009. Corroborating the results of Orsatti and Sterzi (2018) and Abrams et al. (2019), this result seems to suggest that PAEs are particularly active in the business of patent monetization but less involved in technology transfer and intermediation activities since the technology they buy is already relatively old to the market. The poor activity of intermediation is also confirmed by the fact that only 10% of the patents acquired are sold to producing companies.

Conclusions

Our study provides a first extensive evidence of transfers of university patents to Patent Assertion Entities (PAEs) at the USPTO. PAEs have been accused of making new technology more expensive and of using the patent system in a way that is contrary to the purpose for its creation. For this reason, considering the role traditionally performed by universities in the production and dissemination of knowledge, transfers to PAEs alarm policy makers and academics. Not surprisingly, commentators have already highlighted a possible conflict between the stated purpose of the Bayh-Dole Act-like legislative acts and certain university monetization strategies that make societal access to university inventions more difficult and expensive (Eisenberg & Cook-Deegan, 2019).

In our study we find that only a small share (0.3%) of university patents has been transferred to PAEs. However, most transfers occur in the last years. Two PAEs only seem to be particularly interested in university inventions (Intellectual Ventures and Intellectual Discovery), buying more than the 80% of PAEs-acquired university patents. Moreover, non-surprisingly, most of the transfers occur in the high-tech sector.

PAEs target patents that are, on average, of high quality and quite old, suggesting that PAEs are particularly active in the business of patent monetization but less involved in technology transfer and intermediation activities.

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Appendix

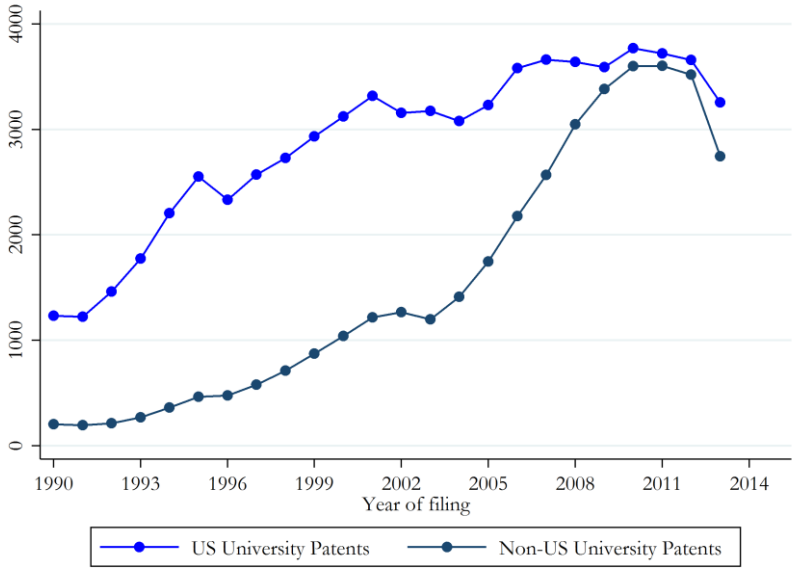

Figure A1. Number of university patents at the USPTO: US vs. Foreign Universities

Note. Number of University patents at USPTO by year of application. Co-applications with other types of sectors (COMPANY, INDIVIDUAL, …) are not considered.

Table A1. Summary Statistics

	Mean	Std. Dev.	Min	Max
Model (1) - Obs. 93'320				
3-yrs citations	1.10	3.16	0	189
Claims	18.19	13.95	1	333
Model (2) - Obs. 7'994				
3-yrs citations	1.69	3.96	0	98
Claims	19.63	15.00	1	172
Age	5.62	3.96	1	20