

# DO UNIVERSITIES INVESTING IN TECHNOLOGY TRANSFER VIA PATENTING LOSE MONEY?

**ABSTRACT** Substantial investments are made in universities patenting new developments to pursue a return. To gauge the impact of the holistic costs of patenting at universities, this study provides a new methodology for quantifying the investment in intellectual property (IP) that includes not only technology transfer staff costs but also direct and opportunity faculty-related costs. It then uses the novel methodology and publicly accessible data on an average American research university case study. The results found all component costs were higher than the IP-related income, with the opportunity cost for writing patents instead of grants being more than 33 times the income realized through IP protection. Overall, the case study university loses over \$9 million per year on IP with a negative ROI of -97.6%. Research universities have opportunities to increase research income >10% by ignoring IP. It is clear that Bayh-Dole Act and similar national legislation, is harming university economics. It can be concluded that as generally practiced in the U.S. now, it is not rational to continue to support university technology transfer by patents. Instead, to improve the economic bottom lines of universities, as well as increase the good that research and development does for society, universities can open source all innovations.

## INTRODUCTION

The Patent and Trademark Law Amendments Act (known as the Bayh-Dole Act) standardized U.S. federal policy to encourage university grant recipients to patent inventions in order to encourage commercialization of tax-funded research (1980). One result of the Bayh-Dole Act was an explosion

of technology transfer offices (TTOs) to support the commercialization of research and development first in the U.S. and then throughout the rest of the world as there was early economic success from a handful of universities (Bertha, 1996; Siegel & Wright, 2007; Holgersson & Aaboen, 2019). Generally, TTOs focus on IP protection including patenting (Chapple, et al., 2005; Rothaermel, et al. 2007), licensing and in some case spin-off companies (Siegel, et al., 2007). Bayh-Dole proponents argue that academic patent licensing has created \$30 billion per year in the U.S. and created hundreds of thousands of new jobs (Pressman et al., 2017). Evidence for these claims is weak, however, as in general, research has found little impact from the Bayh-Dole Act for universities to actually increase technology commercialization (Henderson et al., 1998; Mowery et al., 2001; Mowery & Ziedonis, 2002). A constant stream of researchers critique the established view of IP being managed by universities (Sorensen & Chambers, 2008; Kenney & Patton, 2009; Greenbaum & Scott, 2010; Hall, et al., 2014; Kochenkova, et al., 2016; Holgersson & Aaboen, 2019) and even begun to reconsider the Bayh-Dole Act's impact on invention at universities as a whole (Kenney & Patton, 2009). In addition, in a detailed review of the evidence Ouellette & Weires (2019) found many authors argued that Bayh-Dole costs simply outweigh the benefits (e.g. monopolistic inefficiencies (Granstrand, 1999) including raising the price of knowledge goods for both consumers and follow-on innovators (Pearce, 2012), many of whom already paid for the initial research through taxes. This bridges into the wider debate over whether intellectual property or 'intellectual monopolies' (Boldrin & Levine, 2002; 2005; 2008; 2009) of

any kind are even a benefit to innovation (Takalo & Kannianen, 2000) or the public good are far from complete (Pagano, 2014).

The question of benefits from pursuing IP at the individual university level should be far clearer. What if university decision makers only consider the economics from the university point of view? Graphs provided by the Association of University Technology Managers (AUTM) surveys show massive aggregate revenues from licensing IP growing year after year with but tiny nearly flat legal fees over decades (Ouellette & Weires, 2019). A non-critical look at these simple graphs makes it appear that there is a financial gain for the universities in pursuing IP. Thus, it is not surprising to observe the proliferation of TTOs throughout the world. The AUTM survey data on the costs to the universities for IP, however, is woefully incomplete as it only considers legal fees. It does not include litigation expenses or the technology and transfer office operating expenses (Ouellette & Weires, 2019). There have been some indications of the actual economics of IP protection, as the survey of AUTM members found that just under half brought in more revenue than their operating costs (Abrams et al., 2009). These analyses are obviously potentially embarrassing to technology transfer offices and are no longer provided in the latest surveys by their Association (AUTM, 2020). Even these surface analyses, however, were incomplete as they ignored other real costs to universities for patenting such as the opportunity costs for faculty to participate in the time-consuming patenting process.

This leads to an important question: Do investments by universities including their technology transfer offices for patenting intellectual property developed by the university provide a rate of return? To provide a concrete answer to that question and begin to gauge the impact of a more holistic costs of university patenting this study provides a new methodology for quantifying the investment of universities in IP. It then uses the novel methodology on a case study using real numbers from the average research university in the U.S. The results are discussed in the context of appropriate research policy for

universities regardless of Bayh-Dole Act or similar national legislation in other countries.

## METHODS

A university investment in IP is determined by four parts. First, there is the cost of legal fees excluding litigation, which has already been shown to be trivial (Ouellette & Weires, 2019). Second the cost of litigation, which is highly variable. On average, a university accrues \$2 million in legal expenses (Merrill, Migliozi & Decker, 2016). The final two costs, however have not been quantified previously, which include the direct investment in technology transfer office staff and their overhead as well as the direct costs of faculty time as well as their opportunity costs. These values can all be determined from publicly-available data.

To calculate the technology transfer office staff costs ( $C_{staff}$ ) equation (1) is used:

$$C_{staff} = \sum_{k=1}^n s_k \times (1 + b_k + o)$$

[USD] (1)

Where  $s$  is the salary of a IP-focused staff member  $k$ ,  $n$  is the number of staff members in the technology transfer office,  $b_k$  is the fringe benefits rate (%) for staff member  $k$  and  $o$  is the overhead rate, which is also referred to the facilities and administrative (F&A) cost (%). The staff can generally be found on the university's public technology transfer website and for many publicly-funded universities their salaries, benefits and the university's F&A rates are available. It should also be noted that the often-inflated values of the executive team's salaries, which often oversee university IP were not included (Pearce, 2016a), again to be conservative.

Love (2014) points out that university patent programs reduce both the quantity and quality of university research by interfering with professors' ability to obtain research funding, to collaborate and to disseminate their work. Quantifying all of these costs will be left for future work, however, here the first of

these costs will be estimated. As a first approximation it is assumed that that IP related documents (DIP) that are public record including patent disclosures, nondisclosure agreements, patents and license agreements all took the equivalent amount of time for a professor to write as for a peer-reviewed article (DPR) each to produce. Similarly, it is assumed that the time to write an IP related document is equivalent to writing grant proposal.

The number of peer-reviewed articles for a given year for a particular university can be found from Google Scholar. Thus, as it is assumed that faculty research time in total is made up of generating documents for patents, papers and grants the percent of research time invested for all the faculty at a given university for generating IP ( $P_{IP}$ ) is given by:

$$P_{IP} = \frac{D_{IP}}{D_{IP} + D_{PR} + D_g}$$

[%] (2)

This value can then be used to determine the direct costs and opportunity costs related to IP protection by expending faculty research time. The direct costs for this IP generating investment from faculty ( $C_{fac}$ ) can be determined by:

$$C_{fac} = (S_{ave} \times (1 + b_{fac})) \times r \times P_{IP} \times n_{fac}$$

[USD] (3)

Where  $S_{ave}$  is the average faculty salary,  $b_{fac}$  is the average faculty benefits (%) and  $r$  is the research percent of the total faculty working time (normally divided between teaching, research and outreach). In addition to the direct cost ( $I_{fac}$ ), there is an opportunity cost to faculty writing patents instead of grants given by the average grant value times the average success rate and the number of IP related documents:

$$I_{fac} = \left( \frac{G}{D_g} \right) \times D_{IP} \times \frac{g_w}{D_g}$$

[USD] (4)

Where  $G$  is the total revenue in a year from grants in USD,  $g_w$  is the number of grants won and  $D_g$  is the number of grants submitted. The number of grants submitted, won and the value can normally be obtained from the research office of a university.

Thus, the overall cost of the investment in IP in a year for a university is given by:

$$I_{IP} = C_{staff} + C_{fac} + I_{fac} + \alpha + \beta$$

[USD] (5)

Where  $\alpha$  is the cost of legal fees and  $\beta$  is the cost of litigation. To be extremely conservative, these costs are often obscured by university administrators, and as some schools do not litigate around their IP, these legal costs will not be included in the representative case study here.

Finally, the direct economic benefits of university IP protection are given by:

$$B_{IP} = \sum_{i=1}^m s_i + \sum_{j=1}^o l_j$$

[USD] (6)

Where  $m$  is the total number of patents sold in a year,  $s_i$  is the value in USD for sales of patent  $i$ ,  $o$  is the total number of licenses in a year and  $l_j$  is the license income from  $j$  intellectual property.  $B_{IP}$  can generally be found in university marketing documents as this is a positive value.

Thus, the return on investment (ROI) for IP at universities is:

$$ROI = \frac{B_{IP} - I_{IP}}{I_{IP}}$$

[%] (7)

## CASE STUDY

Michigan Technological University (MTU) is a U.S. public research university founded in 1885. It was selected as it is about average for research expenditures for research universities in the U.S. as determined by the National Science Foundation (NSF, 2019). The performance of most research universities would be expected to be below it for IP income as would all non-research related universities.

The relevant staff were identified from the University's research staff page (MTU, 2021a). The salaries of the identified staff were determined from

the public posted annual salaries (MTU, 2021b). Note, to remain conservative again the secretarial staff were not included only the main IP-related staff. The research expenditures, IP-related income and costs were available from a Vice President of Research (VPR) Annual Report (Reed, 2020).

The values for the IP-related staff are summarized in *Table 1* and all other input parameters are shown in *Table 2* along with their sources. It should be noted that all data is for 2020 other than the grants received where 2019 was used to more realistically represent the income that generated the IP in 2020.

Staff Needed for IP	Salary
Associate Vice President for Research Administration	\$168,300
Manager of Agreements and Operations, Innovation & Commercialization	\$65,225
Director of Technology Commercialization, Innovation & Commercialization	\$79,549
Director of Technology Business Incubation	\$61,973
Total ( $\sum s_k$ )	\$375,047

**Table 1.** IP-related staff and salaries (MTU, 2021b).

Variable	2020 Values	Sources
Fringe rates faculty ( $b_k, b_{fac}$ )	0.426	(MTU, 2021c)
Overhead ( $o$ )	0.546	(MTU, 2021d)
IP output ( $D_{IP}$ )	164	(Reed, 2020)
Disclosures Received	25	(Reed, 2020)
Nondisclosure Agreements	97	(Reed, 2020)
Patents Filed or Issued	26	(Reed, 2020)
License Agreements	16	(Reed, 2020)
Grants submitted 2019 ( $D_g$ )	982	(Reed, 2020)
Non IP output - $D_{PR}$	2,250	(Google Scholar, 2022)
Average faculty salary ( $S_{ave}$ )	\$96,243	(UStats, 2021)
Percent of time on research ( $r$ )	0.4	Faculty performance review
Number of faculty ( $n_{fac}$ )	396	(UStats, 2021)
Research Income ( $G$ )	\$ 71,814,095	(Reed, 2020)
Grants written 2019 ( $D_g$ )	982	(Reed, 2020)
Grants won 2020 ( $g_w$ )	609	(Reed, 2020)
License income all sources ( $B_{IP}$ )	\$221,391	(Reed, 2020)

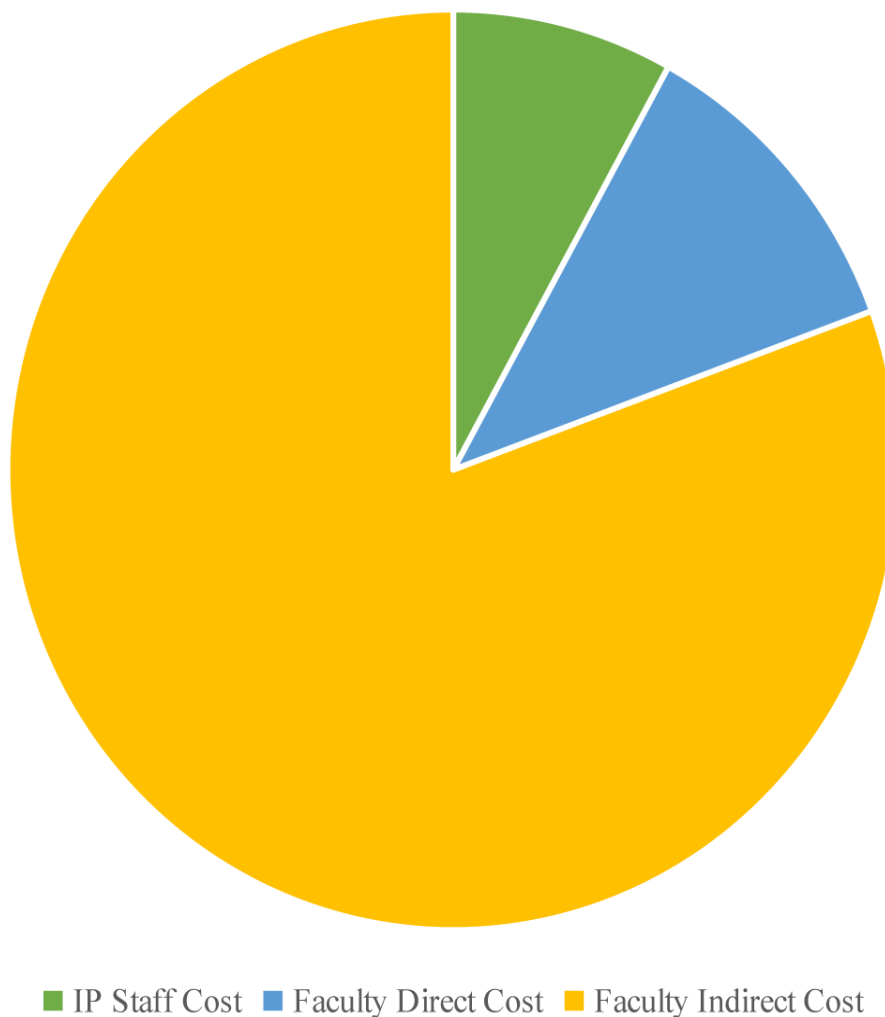
**Table 2.** Input data for MTU.

## RESULTS

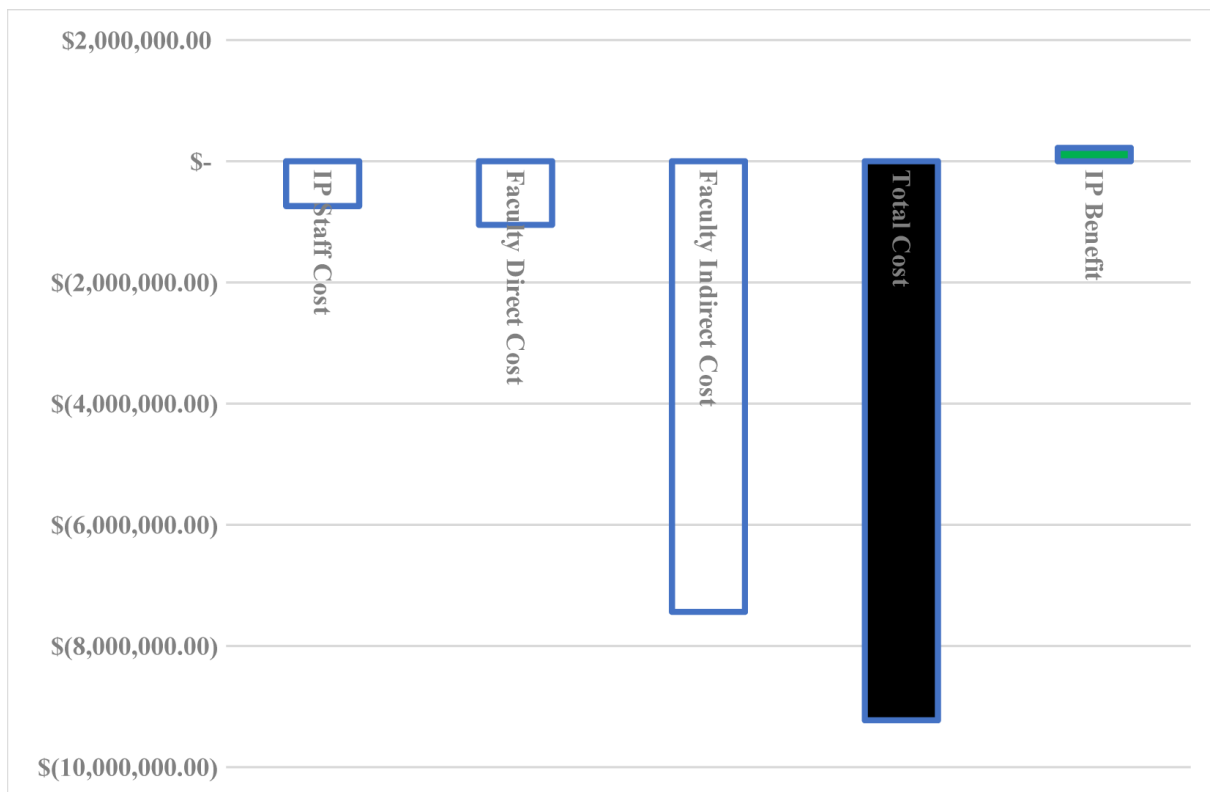
It is clear from a precursory evaluation of the input parameters that the economic gain from IP protection is dwarfed by the costs. The IP-related staff costs alone are more than 3 times what the case study university sees in IP-related income. A deeper look at the analysis shows that IP-economic performance is much worse than that because the staff costs are actually a smaller piece of the investment pie as the results of calculating equation 1, 3 and 4 show in *Figure 1*. Somewhat surprisingly, the direct cost of faculty investing their time in writing patents (blue area) is larger than the entire staff costs associated with intellectual property protection (green area). Perhaps even more striking

is that the indirect costs of faculty time associated with IP chasing dwarf all the other costs. This is the opportunity cost lost when faculty invest time in patents. Thus, the yellow area in *Figure 1* is the additional grant income the university would expect to receive if the faculty wrote grants instead of patents based on their current success rate. This value is more than 33 times the income realized through IP protection!

*Figure 2* shows the total cost of IP investments (black box) compared to the IP-related economic benefits (green box). As can be seen in *Figure 2*, the case study university loses more than \$9 million per year pursuing IP. The ROI for this investment is -97.6%.



**Figure 1.** The share of costs (investment) associated with university intellectual property in case study.



**Figure 2.** Investment costs and benefits for IP protection at case study university.

## DISCUSSION

It is clear from the results of this case study that it is not rational for the case study university to invest in IP at all. It can be inferred that at least half of the U.S. universities are in the same situation, where the investment costs completely overrun any form of IP related income. This study adds to the volume of literature that questions the utility of the Bayh-Dole Act. In addition, for the first time, this study showed how important the faculty costs (both direct and opportunity) are for making decisions about investing in IP. Future work is needed to apply the methods shown here to the top tier universities that demonstrate high patent-related incomes as well as universities throughout the globe that have emulated the IP-strategies championed in the U.S.

In addition, to the abysmal negative returns observed in the results here, there is also considerable evidence that even when universities do make some IP-

related net income, very little of it is useful for actual technology transfer. For example, Love et al., found that only 11% of academic U.S. patent sales bear the hallmarks of technology transfer (e.g. purchased with the intent to commercialize) and the other purchases appear to have been either defensive acquisitions by operating technology companies or purchases by nonpracticing entities (e.g. patent trolls) (2020). Future work is needed to determine the cost to society for universities providing IP to patent trolls.

There is also evidence that the entire incentive structure underpinning Bayh-Dole does not work. Although some studies had reported that higher inventor royalties lead to more university licensing income, Ouellette & Tutt (2020) found that the earlier results were driven by coding errors. In addition, they found “no compelling empirical evidence that increasing university inventors’ royalty share has a significant effect on any of the outcomes.” These results are supported by two recent interview

studies, one in the U.S. (Pearce et al., 2022) and one in Canada (Pearce, et al., 2022b) that showed the vast majority of university researchers would support giving away all of their IP for access to an open source endowed chair. Given the results shown here that appears to be a rational decision based on economic grounds alone.

For all the concerns about the negative implications of universities acting like corporations (Washburn, 2008), universities have so far remained blinded to the fact that pursuing patents is generally a money losing proposition (Merrill, Migliozi & Decker, 2016). Instead, VPR offices pretend that gaining IP rights is the success factor rather than generating revenue (like a business) or benefits to society (like a non-profit) (Kirchberger & Pohl, 2016). For example, using the case study university again, the annual reports proudly display the invention disclosures per \$10 million of research expenditures (Michigan Tech. 2022), which compares favorably to other universities. This ratio, is meaningless, not only because of the tiny fraction of invention disclosures that result in patents and the even smaller number that result in any form of revenue, but generating invention disclosures has no inherent value. As these invention disclosures are not peer-reviewed, using them to track innovation is of little more substance than quantifying TikTok or Instagram posts. Interestingly, the same cognitive error appears to be occurring among university administrators that has millions of teenagers hoping to become rich by becoming influencers on social media platforms (Fietkiewicz, et al., 2018), while only a tiny fraction will ever have enough followers to earn a real salary (Scipioni, 2021). Similarly, although a few universities have seen income from IP, the vast majority do not (Merrill, Migliozi & Decker, 2016; Abrams, et al., 2019), and as this study has shown are likely losing millions of dollars a year.

Abrams, et al., found that overall, universities spend only 0.59% of their research budgets, which exceed \$50 billion annually, on converting research to IP (2009). The results of this study are in line with this even though the constituents of IP investing were

different (here it was 0.3%) and it still does not make economic sense for universities to pursue IP. Abrams, et al., found that in the U.S. only 16% of universities kept enough of the income from IP they generated to cover their costs (2009). They did not, however, calculate the faculty direct and indirect costs as shown here, so their results were massively overly optimistic. Yet, despite these poor numbers even from optimistic estimates, gushing support of Bayh-Dole that was published in *Science* by Loise & Stevens actually arguing that these numbers “simply verifies the institutional mission of the research enterprise: getting science into the public’s hands.” (2010). They are literally arguing that is praise-worthy for universities to lose money creating money-losing locked-down IP. This is unfounded and incorrect in light of the overwhelming evidence that proprietary IP is not necessary to commercialize innovations and ‘get it into the public’s hands’ (Key, 2017). A plethora of studies, demonstrated business models and current IP management practices in the private sector that endorse alternative to patenting, such as openly publishing new inventions and releasing inventions with free and open source licenses (Goth, 2005; Krishnamurthy, 2005; Bonaccorsi, et al., 2006; Henkel, 2006; Chang, et al., 2007; Munga, et al., 2009; Perr et al., 2010; Holgersson, et al., 2018; Ziegler, et al., 2014; Pearce, 2017; Franz & Pearce, 2022). Open source strategies are particularly well-positioned for publicly-funded research (Parth & David, 1994; Bogers, et al., 2018; David, 2003) and can provide strategic national policy objectives (Heikkinen, et al., 2020). Finally, Greenbaum & Scott (2010) point out that most TTOs “will never turn a profit, drain limited university resources and potentially hinder innovation and knowledge transfer” (p. 55). The results of this study further bolster this conclusion, but shows that universities have the opportunity to increase their research income by more than 10% (case study showed 12.7%) by cutting costs (eliminating all IP protection-related investments). It is clear that following the U.S. lead to lock down university IP is an economic mistake. Universities in other countries should carefully do full cost accounting on their own IP investments.



Instead of investing in IP, for both their bottom line and the good of society universities can open source all innovations developed. Even for open hardware, based on downloaded substitution value alone (Pearce, 2015), the funding of open source development generally provides a very high return on investment (Pearce, 2016b) as compared to the deeply negative returns found here. For example, free and open source scientific hardware represents an 87% savings over proprietary offerings per instrument (Pearce, 2020) and its development can be scaled through lateral distributed manufacturing (Dupont et al., 2021).

## CONCLUSIONS

This study provided a new methodology for calculating the full costs of intellectual property protection at universities. The results of applying this methodology to an average research university in the U.S. showed that it is not economic to invest in IP protection and patents. As generally practiced in the U.S. now it is not economically rational to continue to support TTOs. Instead, to increase the economic bottom line of the university as well as increase the good that university research does for society universities can open source all their innovation.

**Availability of data and material:** Available upon Request

**Funding:** This study was supported by the Thompson Endowment.

**Acknowledgments:** None

**Declarations of interest:** None.

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**Author:**

**Joshua M. Pearce 1,\***

**1. Ivey Business School and Department of Electrical & Computer Engineering, Western University, London, ON, Canada N6A 3K7**

\* <https://orcid.org/0000-0001-9802-3056>