Does the law of innovation work against itself?
By Ron D. Katznelson, Ph.D.

A recent study suggests that patent litigation by Patent Assertion Entities causes reduced Venture Capital investments in entrepreneurial firms. This note demonstrates that the methods used in this study are fundamentally flawed for several reasons, including the reliance on grossly incorrect assumptions. It is shown that the study’s inferences and conclusions are therefore invalid.

1 Introduction

A recent research report by Professor Catherine Tucker, titled The Effect of Patent Litigation and Patent Assertion Entities on Entrepreneurial Activity1 has received wide publicity. The report purports to document suppression of Venture Capital (VC) investments due to litigation by so-called “patent trolls” – or Patent Assertion Entities (PAEs), which Professor Tucker identifies as “frequent patent litigators” – patentees that have caused more than 20 “instances of a patent being litigated” in a span of 17 years.2 Professor Tucker arrives at a startling conclusion: VC investment would have been about $22 billion higher over the course of five years “but for litigation brought by frequent patent litigators”3 – suggesting that enforcement of patents can frustrate the goal of the Patent Act. In other words, the law of innovation ostensibly works against itself.

A footnote in the report’s front page discloses that the source of funding for this particular study was provided by an organization that has a substantial interest in the study’s outcome – the Computers and Communication Industry Association (CCIA).4 It may come as no surprise that Professor Tucker’s conclusions happen to fall in line with this organization’s previously-articulated beliefs that patents block new technology development.5 It is also noteworthy that Google, a prominent member of the CCIA, has also provided Professor Tucker with $155,000 of funding since 2009.6 In a June 2014 press release announcing this study, CCIA attorney Matt Levy proclaimed:

“For the first time, we have an economic model proving patent reform is not a zero sum game between protecting intellectual property and reducing abusive patent litigation

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2 Tucker, at 31-32.
3 Tucker, at 36.
4 CCIA members can be found at www.ccianet.org/about/members/.
5 Patents, CCIA’s View. At www.ccianet.org/issues/patents (“High volumes of quality patenting can create national thickets that make entry difficult and entrench past innovators at the expense of future innovators.”)
6 Tucker’s CV, at 10.
... Professor Tucker’s research reveals the harms of skewing the patent system too far in favor of protecting low-quality patents.”

For her part in the press release, Professor Tucker stated:

“My analysis showed that litigation by patent trolls did not foster entrepreneurial investment at all. It is instead associated with significantly reduced venture capital investment in entrepreneurship, preventing startups from developing and suppressing job growth.”

If true, these purported economic findings are no trivial matter to be consigned to a mere working paper and an industry association press release – they must be of major significance and deserve substantial attention in our innovation policy discourse. For example, if true, perhaps it would justify establishing statutory litigation quotas prohibiting patent owners from “frequently” asserting their patents? If true, perhaps Professor Tucker’s “solution” should be taken seriously – “one way to reduce litigation would be to decrease the number of patents granted.”

There is nothing wrong with academics obtaining research funding from corporate sponsors, and to Professor Tucker’s credit, she fully discloses her funding sources. It is important, however, to fully vet and scrutinize the resulting work product of such sponsored studies. The underlying data and methodology should be independently verified by subject-matter researchers and experts. Yet, no peer review of this paper had been made before Professor Tucker’s “results” were broadcast to the world. Because of the publicity this paper received, it is the purpose of this note to fill that void.

Indeed, closer scrutiny of this article reveals that it can support none of the claims of the author or sponsors quoted above. This is because the study is fundamentally flawed and is fraught not only with methodology and analytical errors, but with fatal factual errors due to the assumption of false information.

Before exposing these fatal factual errors, it is important to note as a threshold matter that Professor Tucker’s study lacks information or evaluation of the merits of the patent infringement cases included in her study. The patents, or their “quality” are not identified and cases are categorized solely based on whether they were brought by “frequent patent litigators.” The author purports to study the “harmful” effects of PAEs and does so solely through categorizing cases by the patentees’ frequency of litigation. The report defines a “frequent litigator” as an entity that

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8 Id.

9 Tucker, at 38.
has filed twenty or more patent lawsuits during the 17-year study period, but admits that some cases were brought by practicing entities.\textsuperscript{11}

Professor Tucker introduces the motivation for her study by presenting what she calls three “case studies,” involving startups that were sued for patent infringement. The introduction recounts the alleged setbacks and harms that befell these startups as a consequence of the patent litigation against them, including reduced investments in their product development. The study apparently seeks to establish a broad-based relationship between the intensity of patent lawsuits against identified startups and the identified VC investment levels in these startups. This, however, the study fails to accomplish because of fatal flaws in methodology. The basic flaws are in two categories: assuming false information, and modeling. This is explained further below.

\section{Assuming false information}

In perhaps the most astonishing methodological failure, Professor Tucker’s study does not actually identify or connect any defendants in the lawsuit dataset with any of the small entity firms in the dataset that are potential recipients of VC investments. This is a basic relational infirmity at the firm level. The author goes to great length to isolate only small entities with 50 or fewer employees for the firm dataset. Yet, the paper provides no indication that any of these firms were in fact defendants in the patent suits collected in the dataset. For all we know, the patent suits in the study may have all been filed against entities with more than 50 employees – a class of defendants that is presumably out of the scope of the study.

\subsection{Flawed reliance on counterfactuals}

Realizing perhaps that there are relatively very few cases brought against startups and that she cannot make the connection on a firm level referred to above, Professor Tucker attempts instead a “regional” connection, but introduces a fatal methodology flaw by making a patently false assumption (pun intended): that the litigation venue and the defendant’s home district are one of the same; i.e. that a patent lawsuit filed in a given district names a defendant actually located in that district – a defendant that is potentially eligible for VC investments made in that district.

Professor Tucker actually acknowledges this flaw, explaining that “we are assuming there is a relation between the district where the patent lawsuit was filed and the region where VC investment is received by entrepreneurial start-ups.”\textsuperscript{12} However, nothing is done to rectify this flaw and it is instead summarily dismissed by making another counterfactual assumption: that by excluding only the Eastern District Court of Texas and the District Court of Delaware from analysis, this somehow leaves a dataset with correct relations for all other districts. This assumption is

\textsuperscript{10} Tucker, at 15.

\textsuperscript{11} Tucker, at 16 (this classification “could potentially cover firms that make products but who for whatever reason are litigious towards others infringing on their patents.”)

\textsuperscript{12} Tucker, at 17.
fatally incorrect. There is much evidence that the disconnected relationship of litigation venue and defendants’ home region pervades litigation in all districts.

The patent venue statute allows plaintiffs to file suit anywhere in the country where the defendant’s product is sold or used.13 The majority of patent lawsuits are filed specifically not in the defendants’ home district, in part for strategic reasons, including for avoiding a defendant-friendly jury pool. For example, lawsuits in two out of the three “case studies” listed in Professor Tucker’s introduction were filed far from the defendants’ home district. Laminar Research, the developer of X-Plane based in South Carolina was sued in the Eastern District of Texas14 and Ditto based in San Mateo, CA, was sued in the Central District of Utah.15 It is predominantly patentees that choose the venue in patent lawsuits, and 93% of patent cases remain in the venue chosen by plaintiffs.16

Motions for change of venue can be filed with the court under 28 U.S.C. § 1404, which provides that “[f]or the convenience of parties and witnesses, in the interest of justice, a district court may transfer any civil action to any other district or division where it might have been brought.” It is noteworthy, however, that only a minority of venue transfer motions are granted and that accused infringers movants that are small entities (on which this study focuses) are even less successful, with only 29% of venue change motions granted compared to 44% for large entity movants.17 In any event, even successful venue transfers to defendant’s home district are not reflected in the study because of the choice to systematically allocate transferred cases to the initial district court in which the case was first filed.18

The relation between the district where the patent lawsuit was filed and the region where VC investment is received by start-ups is a central predicate of this study – the results are invalid due to an incorrect relationship. We know that this relationship is certainly wrong for every case in a sizeable class of accused infringers – the class of foreign defendants with their domicile in none of the U.S. districts. Foreign entities were named defendants in 22% and 17% of patent suits filed in the U.S. in 2009 and 2012 respectively.19 Yet, Professor Tucker has totally ignored and failed to eliminate from her sample the cases against these foreign defendants – established firms that do not receive VC investments. The inclusion of these irrelevant “incidents of a patent being litigated” in the study’s statistical analysis

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17 Id., Table 9 at 1091 (59 of 160 motions granted for small entities and 88 out of 201 motions granted to large entities).
18 Tucker, at 12.
further renders the dataset unusable. In conclusion, Professor Tucker’s regional framework – the crux of her thesis – is based on false assumptions and incorrect information; it can only produce random results that have no bearing on her thesis.

2.2 Study framework that contradicts the operating framework of the patent system

Even if one were to assume that a relation between a patent lawsuit venue and the defendant’s home district exists in her dataset, which is not the case, Professor Tucker’s hypothesis that one could expect regional VC investment preferences to be affected by patent litigation intensity in the region is predicated on another illogical counterfactual: that a kind of a patent enforcement “regional deterrence” effect can be detected – that even if filed against established large firms in the district, patent suits filed in a given district deter VC investments in startups located in that district but not in other districts.

This implicit patent “regional deterrence” hypothesis has no business or legal basis because patent litigation threats are not regional – patent law is a Federal law that applies across the nation. A patent lawsuit against a firm in Silicon Valley would subsequently be as threatening to a firm in Boston as it would be to another firm in Silicon Valley. There are no regional barriers for patentees’ enforcement rights; a legal determination by one Federal district court on a given patent and on an infringing instrumentality is binding on users of the same instrumentality in all other districts. Professor Tucker’s implicit notion of “regional deterrence” may apply to some other wars but not to patent wars.

2.3 Grossly incomplete accounting of entrepreneurial investments

Finally, it is worth stepping back to note that Professor Tucker’s focus solely on purported attenuated investments by defendants accused of patent infringement misses a major component of the total investment in entrepreneurial innovation: it is the major investments in patentable inventions that are largely incentivized by the exclusive right under the patent law. In many instances, these are risk investments that would not occur but for the assurances under patent law that exclusivity can be maintained and infringers can be stopped. Without investigating the legal merits of the claims brought against alleged infringers, Professor Tucker appears to adopt an unsupported baseline hypothesis: that the defendants in her patent cases brought by “frequent litigators” are subject to “abusive patent litigation” rather than meritorious patent claims to stop infringement of valid patents.

Thus, Professor Tucker’s working premise is that these patent infringers in her study were unjustly discouraged from investing in development of infringing products; that they were denied opportunities to raise more capital and hire more employees to continue to develop and sell infringing products. It may come as a shock to Professor Tucker, but stopping infringement is precisely what the patent system is designed to do. The patent system is designed to reduce and suppress investments
in infringing products that are not coordinated with the patent holder; its purpose is to discourage infringement and encourage inventions around existing patents, thereby promoting the progress in useful arts.\textsuperscript{20} The patent system was created to do all that in order that investment capital continues to flow to develop and commercialize patentable inventions. Professor Tucker totally ignores this critical side of the entrepreneurial investment equation, ignoring the fact that much entrepreneurial investment is undertaken because of the power of patents to stop infringement.Apparently, some of Professor Tucker’s “case study” startup defendants are simply bona-fide infringers who carelessly failed to conduct the rudimentary patent due-diligence prior to entry and are consequently denying fair returns on these other investments made in entrepreneurial firms who hold patents.\textsuperscript{21}

3 Modeling flaws – designed to produce desired results

The fact that Professor Tucker’s factual dataset is fraught with the fatal false regional information problems described above necessarily renders her analysis invalid regardless of the model employed. However, a few comments on her modeling and identification flaws are worth making because they show further that this research was apparently designed to achieve desired predetermined results rather than fairly test various hypotheses.

It is ironic that Professor Tucker’s model essentially ascribes regional VC investment activities to a non-existent “regional deterrence” factor but totally ignores a real and well-documented regional factor in VC investment activities. This regional factor is the VCs own geographic proximity to the firm in which it invests – the “home territory preference.” Those of us who have raised venture capital investments are keenly aware of the benefits and rationales for this


\textsuperscript{21} The case of Ditto Technologies, Inc. is instructive. Ditto’s website, www.ditto.com, is an online store that lets customers use their computer’s camera to model eyewear on a rotating image of the customer’s face, allowing customers to virtually try-on glasses for fit and look. Customers can then order their choice of glasses directly on the site. Ditto’s website publically launched on April 17, 2012. Several months earlier, inventor Jonathan Coon, the CEO of 1-800 CONTACTS, filed a patent application on a key measurement step required for virtual try-on eyewear. See Publication No. 20130141468, claiming December 6, 2011 priority date. However, neither Ditto nor Coon were first to develop the web-based virtual try-on eyewear system, as this technology was patented a decade earlier (U.S. Patent No. 7,016,824) by a startup that had since gone out of business. As a liquid asset, the ’824 patent had been available for purchase and Coon had been aware of it through his extensive prior art research and his participation in the patent system (the ’824 patent was listed among more than 460 prior art references in his later Information Disclosure Statement filed with the PTO). In contrast, there is no record in the PTO public database that Ditto has filed any patent application required to participate in the patent system. According to PTO assignment records, Coon seized the opportunity and purchased the ’824 patent on May 23, 2012 in order to protect his own online virtual try-on business that he later launched at www.glasses.com. Coon sued Ditto for infringing the ’824 patent on February 26, 2013. It appears that at their own peril, Ditto and its investors had conducted no patent due diligence prior to service launch, were not aware of the ’824 patent, and are now resorting to baseless allegations that Coon engages in “abusive patent litigation.” See Jack Ellis, “Maybe blaming ’trolls’ is sometimes easier than accepting that you have messed up,” IAM Magazine, (30 May 2013); Mark Summerfield, “EFF Off the Mark With Latest ‘Abuse’ Allegations,” Patentology, (25 April 2013).
phenomenon. Geographic proximity facilitates for investors a strong post-investment involvement, i.e., attendance in board meetings, opportunities for monitoring and supervising the companies in their portfolio. Indeed, several studies suggest that identification of promising investment opportunities are often based on local knowledge and that involvement in business affairs of the portfolio firms may require intensive communication combined with frequent on-site visits and face-to-face contact – a close relationship that is more difficult to maintain over larger distances. These findings are similar to results for the proximity of lending institutions to their borrowing client firms.

Nevertheless, Professor Tucker totally ignored the highly skewed geographic distribution of VC investments, dominated by preferences of VCs to invest in their home territory – preferences that have nothing to do with patent litigation frequency in their district. Professor Tucker formulated her model using the following specification:

\[
EA_{ijt} = \beta_1 PL_{ijt} + \beta_2 PL_{ijt}^2 + \gamma_i + \omega_j + \delta_t
\]

where \(EA_{ijt}\) is the total VC investment, in region \(i\) in industry sector \(j\) at year \(t\), \(PL_{ijt}\) is the “instances of Patent Litigation” in region \(i\) in industry sector \(j\) at year \(t\) and \(\gamma_i\), \(\omega_j\), and \(\delta_t\) are the fixed effect coefficients for region \(i\), industry sector \(j\), and year \(t\) respectively. Thus, the only driver (or independent variable) for the variation in VC investments that Professor Tucker assumes is patent litigation activity, while ignoring the variations due to the most important endogenous regional driver – investors’ preference due to geographic proximity. It is important to recognize that the fixed effect coefficient \(\gamma_i\) only characterizes regional effects for the total investment in the region (coming from VCs located in all regions) without regards to the fraction coming from local VCs whose contribution to investment in the region may be primarily motivated by “home territory” considerations.

To appreciate the distinction between the missing variable and the fixed regional effects, consider for example two regions. Industry data shows that VC investments in the state of California are about 2,000 times greater than VC investments in Nevada. However, patent litigation data shows the number of patent cases litigated in California to be only about 21 times that of Nevada. One scenario that may explain the disproportionately low propensity for VC investment in Nevada is

\[23\text{ Colin Mason, “Venture Capital: A geographic perspective,” in }\textit{Handbook of Research on Venture Capital,}\text{ Hans Landström, Ed., pp86-112, Edward Elgar Publishing (2007) (Table 3.2 at 90 summarizes several studies on investors' geographic proximity distributions of investments as follows: invested within 50 miles (37% to 85% depending on study); invested within 50-300 miles (4% to 28% depending on study); and invested over 300 miles (11% to 36% depending on study).}
\[26\text{ Mark Lemley, “Where to file your patent case,”}\textit{38 AIPLA Quarterly Journal},\textit{ 1, 6 (2010) (Table 2, with summation of the number of cases in California’s districts).}
that only a few active VCs are located in Nevada and that many VCs are located in California and they prefer to invest mostly in their local region.

Alternatively, if we actually find that there are many VCs located in Nevada, but that they do not invest much locally and rather invest in other states, we may conclude that the low investment intensity in Nevada is due to factors other than “home preference” considerations - factors such as Professor Tucker’s notion of deterrence due to the relatively high patent litigation rates in Nevada. The point here, however, is that the only observables – the total investments in each region and the number of patent litigation instances in each region – are identical under the two alternatives just described and Professor Tucker’s formulation in Equation 1 cannot resolve among these differing causes for the relatively low investments in Nevada. The regression under her model of Equation 1 would produce the same result for $\gamma_i$ under both alternatives, a coefficient that provides no pertinent causal regional information.

Note that by Equation 1’s design, $PL_{ijt}$, the Patent Litigation activity, is the only independent variable that is structurally allowed to explain the variations in the regional investment intensities $EA_{ijt}$. Therefore, it will necessarily be the only variable doing so, but with whatever resulting spurious numerical regression artifacts. Indeed this is reflected by Professor Tucker’s very low Coefficient of Determination of $R^2 = 0.27$ in her regression results. Thus, Professor Tucker’s interpretation of the regression coefficients she obtains is highly suspect because these coefficients would have evaluated to radically different values (and possibly even having different signs) had she allowed their evaluation in the presence of an additional obvious independent variable that has a competing major explanatory power for the variations in $EA_{ijt}$. Such a model is presented below.

3.1 An objective model should have been used

It would have been straightforward for Professor Tucker to test and gage the robustness of her results by adding a competing explanatory variable. Professor Tucker’s model can be changed in several ways and the following is but one example of an alternative to Equation 1 that should lead to objective results.

Let $NV_{it}$ designate the number of active VCs having offices in region $i$ at year $t$. A reasonable determination that a VC office active in year $t$ is located in region $i$ might be to include VC offices that are within the metropolitan statistical area (MSA) or within a radius of, say, 100 miles of the region $i$’s center. These numbers serve as a proxy for the local investment propensity. To the extent that there are “home territory preference” controlling effects, the following expanded specification would capture those through an additional coefficient $\beta_3$:

\[
EA_{ijt} = \beta_1 PL_{ijt} + \beta_2 PL^2_{ijt} + \beta_3 NV_{it} + \gamma_i + \omega_j + \delta_t
\]
The additional coefficient $\beta_3$ permits resolution of the “home territory preference” effect that is not explainable by the fixed-effect regional coefficient $\gamma_l$. By the operation of the regression, the results for the relative magnitudes of the coefficients $\beta_1$ and $\beta_2$ as compared to that of $\beta_3$ will reveal the relative power of $PL_{ijt}$ and $NV_{lt}$ to explain the observed variations in $EA_{ijt}$. By definition, the magnitude of the estimated coefficients $\beta_1$ and $\beta_2$ would be reduced compared to those obtained in Equation 1; the Coefficient of Determination $R^2$ would be increased due to the improved explanatory power of the model. It is also more likely than not that the sign of either $\beta_1$ or $\beta_2$ will differ from that obtained by Professor Tucker. In any event, this will likely result in vastly different conclusions as to the effects of $PL_{ijt}$ on VC investments, if any.

3.2 Instrumental Variable analysis is unavailing

In an effort to counter potential criticism such as the one above about not accounting for latent endogenous variables, Professor Tucker introduces the Instrumental Variable (IV) Estimation method that some economists use to address these “identification” problems. However, the choice of the number of patent cases that were transferred from or to other court districts for IVs is rather poor and renders the results unreliable for the following reasons.

It is generally known that an IV should be uncorrelated with the outcome variable (VC investments in this case) for reasons beyond its effect on the endogenous regressor (patent lawsuits in this case), but well-correlated with that endogenous regressor for reasons that the researcher can explain and verify. While Professor Tucker has made a good case for the former, she has not properly established or verified the latter. The correlation to be considered is that between the IVs (the number of patent cases transferred) and all instances of patents being litigated. The argument that Figure 4 shows that these IVs “are highly positively correlated with instances of patents being litigated” is unavailing and numerically incorrect. Figure 4 does not show the full ensemble correlation – it deals only with the conditional correlation, conditioned on courts having non-zero cases transferred to or from them. The reality is that because most instances of patents being litigated occur without any court transfers, the unconditional correlation between the IVs and instances of patents being litigated is necessarily very low. It is the unconditional correlation across the full ensemble that must be sufficiently high for an IV estimate to be consistent.

It can be shown that the bias term of such IV estimates includes the correlation value in the denominator, making it large when correlations are poor, as in this case. Studies have shown that despite huge sample sizes, these estimates are not only inconsistent but may suffer from finite sample bias as well. In any event,

\[ \text{93\% of cases are not transferred; See note 16 supra.} \]
there should be no reason why Professor Tucker would not calculate, *verify* and *disclose* her actual numerical correlation — all the data to compute this single numerical value is available and Figure 4 is confusingly unavailing. Also missing from the paper are elements that are normally disclosed under generally accepted scholarly practices: the IV model specification, defining its vector specification matrix and the full results of the first-stage regression in obtaining these IV-based estimates. Finally, it can hardly be said that the results in Table 6 with $p$ values bounded by 0.1 are a reliable proof of Professor Tucker’s hypothesis. The statistical analysis literature is replete with papers showing that even inferences with $p < 0.05$ have been proven unreliable.

4 Conclusion

Professor Tucker’s study makes no distinction among patent lawsuits, the merit of their underlying claims, or whether they were ruled abusive. It focuses instead on *patent owners* — whether they are “frequent patent litigator.” It inexplicably presumes that alleged infringers sued by “frequent patent litigator” were somehow victims of baseless patent suits, despite the fact that all patents are presumed valid\(^{28}\) whether litigated once, 20 times, or never. Professor Tucker’s effort to detect adverse patent litigation effects on VC investments is flawed because there is no relationship in her dataset between the defendants and startups eligible for the VC investments in her dataset. Nor is there even a relationship in her dataset between the district where the patent lawsuit was filed and the region where VC investment is received by start-ups. The results are invalid because they are based on a false assumption that the litigation venue and the defendant’s home district are one of the same. In addition, model employed is designed to produce a predetermined desired result because it does not include a key independent variable related to VCs preference for investment in their local region.

Professor Tucker concludes that she observed “high levels of patent litigation” — a “problem” for which she appears to have a solution — “one way to reduce litigation would be to decrease the number of patents granted.”\(^{29}\) Based on her purported findings, Professor Tucker suggests that legislation with “policies directed at repressing the activities of PAEs or frequent litigators” may encourage VCs to increase investments in entrepreneurial activity.\(^{30}\) It is perhaps significant that the VCs themselves strongly disagree with this notion: the National Venture Capital Association (NVCA) objected to patent “reforms” along the lines suggested by Professor Tucker or by her research sponsor the CCIA, *precisely because they would harm* investors’ portfolio companies.\(^{31}\) These objections arise perhaps because the NVCA and other innovation industry stakeholders recognize that, contrary to Professor Tucker’s thesis, the law of innovation does *not* work against itself.

\(^{28}\) 35 U.S.C. § 282 (“A patent shall be presumed valid. ... The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.”)

\(^{29}\) Tucker, at 38.

\(^{30}\) Tucker, at 40-41.