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March 24, 2016

Brett Maranjian
National Bureau of Economic Research
1050 Massachusetts Avenue
Cambridge, MA 02138

Dear Brett Maranjian:

I am writing to express my interest in attending this year's NBER Entrepreneurship Research Boot Camp (ERBC). I am a Ph.D. candidate in finance at UCLA Anderson School of Management, and currently working on research related to corporate investments in innovation and patent policy. Through ERBC, I hope to develop a better understanding of how intellectual property rights affect corporate strategy, investments, and financing of early-stage firms and start-ups.

In my most recent research paper, I study how patent term extensions affect investment strategy for innovating firms. Within the attached Statement of Purpose, I explain how I estimate the causal effect of term extensions given to expiring patents on corporate profits, investments, and capital structure decisions using an unanticipated provision resulting from a major change in U.S. patent law. Although my current research mostly concerns publicly traded firms, my ultimate goal is to find ways to empirically explore how technology or intellectual property is shared and created among both new ventures and large mature firms.

Professor **Mark Garmaise** (mark.garmaise@anderson.ucla.edu) is my recommendation letter writer. Thank you for considering my application.

Sincerely,



Shenje Hshieh

encl: CV, list of Ph.D. courses, and Statement of Purpose

SHENJE HSHIEH

CURRICULUM VITAE

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EDUCATION

2017	Ph.D. in Finance, **UCLA Anderson School of Management** (expected). Committee: Mark J. Garmaise (Chair), Antonio Bernardo, William G. Mann, Ivo Welch, Moshe Buchinsky
2008	B.A. in Mathematics and Economics, University of California, San Diego. *Magna Cum Laude*, *Phi Beta Kappa*

HONORS, AWARDS, AND FELLOWSHIPS

2016	Center for Global Management Research Doctoral Grant, UCLA Anderson
2011–2015	UCLA Anderson Fellowship
2012–2015	Fink Center Summer Research Grant, UCLA Anderson
2008	Departmental Award for Excellence in Joint Mathematics and Economics, UCSD
2005–2007	William H. Stout Scholarship, UCSD
2007	Friends of the International Center Scholarship, UCSD

RESEARCH INTERESTS

Corporate finance, entrepreneurship, governance, social networks, law and finance

WORKING PAPERS

Investments in Innovation and Profit Windfalls from Patent Term Extensions

An unanticipated transitional provision included in the Uruguay Round Agreements Act extended the life of some unexpired patents by up to 3 years, giving the corresponding owners a longer period of exclusionary rights over their inventions. By exploiting the random timing of patent expiration around a policy threshold date, I find that a 1 percentage point increase in the share of term-extended patents owned that would have expired if not for the transitional provision leads to an increase in cash flow by 12 percent of book assets. Given these windfall profits, I find evidence of capital investment, debt issuance reduction, and acquisitions of external technology. Combining the instrumental variable and difference-in-differences methods, I show that capital investment and debt issuance are sensitive to cash flow for patent-practicing firms. Executive bonuses and option grants also increases in response to windfall profits.

Director Networks and Mobility: Estimating the Value of Interpersonal Ties from Corporate Bankruptcies

I hypothesize that corporate bankruptcies weaken interpersonal ties among directors and design an experiment to investigate the degree in which director mobility and compensation is dependent on professional connections forged from current and past board memberships. To isolate the network effect, I construct a treatment and a control group using only directors who never served on boards of bankrupt firms. The treatment is defined as having ties with directors who have had appointments at bankrupt firms at the time of filing. Using difference-in-differences, I find that being connected to directors who had been board members at bankrupt firms at the time of bankruptcy limits one's access to his or her business network. On average, a director's chances of finding additional directorships within a 1-year period is lowered by almost 10 percent if given the treatment.

Invited and Conference Presentations

2016	*Planned*: Ninth Annual Searle Conference on Innovation Economics (Northwestern Pritzker School of Law) , UCLA Anderson Finance Brown Bag

Work Experience

2008–2011	Research Assistant, Board of Governors of the Federal Reserve System, Washington D.C.

Teaching

2016	Foundations of Finance (MBA) for Prof. Amit Goyal
2015	Fundamentals in Finance (MFE) for Prof. Eduardo Schwartz
2014–2015	Venture Capital and Private Equity (MBA) for Prof. Mark Garmaise
2015	Takeovers, Restructuring, and Corporate Governance (MBA) for Prof. Stephen Greene
2013	Empirical Methods in Finance (MFE) for Prof. Richard Roll
2013	International Financial Markets (MBA) for Prof. Andrea Eisfeldt

Miscellaneous

Programming	MATLAB, R, SAS, Stata, CSS, HTML, PHP, Perl, Python, PostgreSQL, JavaScript
Languages	English (native), Mandarin Chinese (conversational)
Personal	Eagle Scout

- Microeconomic Theory
- Game Theory
- Game theory with Asymmetric Information and Applications
- Probability Theory
- Econometrics
- Time Series Analysis
- Macroeconomics: Dynamics and Growth Theory
- Market Micro-Structure
- Asset Pricing Theory
- Empirical Corporate Finance
- Corporate Finance Theory
- Applied Econometrics: Panel Data, Monte Carlo Simulations, Bootstrapping
- Multivariate Analysis
- Contract Theory
- Empirical Methods in Strategy (causal inference)
- Bayesian Statistics in Marketing

I would like to attend the 3rd Entrepreneurship Research Boot Camp (ERBC) in order to learn about the latest research in entrepreneurial finance from top active scholars. My current research explores the relationship between patent policy and corporate R&D investment. By strengthening my comprehension of the entrepreneurship literature through this summer program, I hope to extend my research to early-stage firms. My goal is to understand corporate investment strategy in innovation throughout all stages of a firm's development.

Current Research

In my latest research paper, which will presented at the Ninth Annual Searle Conference on Innovation Economics, I study how patent term extensions affect investment strategy for innovating firms. I exploit an unexpected provision in the Uruguay Round Agreements Act (URAA), a major update in U.S. patent law that extended the term on some patents that would have expired otherwise. URAA's unanticipated transitional provision gave all utility and plant patents still in force by June 8, 1995 a maximum term of 17 years from the grant date—the old policy—or 20 years from the filing date—the new policy. This implies that certain patents may enjoy up to three more years of life after its old expiration date. Since the effective policy date could not have been known 17 years prior, these automatic term extensions for patents expiring around this threshold date is exogenous. This therefore provides an exogenous source of profits for patent-practicing firms that own them. By comparing firms that received term extensions on expiring patents to those that did not within a small time-frame, I show that the average firm benefiting from patent term extensions reaped a profit windfall and subsequently increased capital investments, reduced debt issuance, and increased incentive-based compensation for their executives. This reveals financial constraints—in the same sense as in Fazzari, Hubbard, and Petersen (1988)—and agency issues (i.e., compensation independent of effort) within patent-practicing firms. However, internal R&D investment levels did not respond to this profit windfall. That is, the lengthening of the term for expiring patents did not yield additional investments in innovation. These firms instead acquire existing patents from other firms on average.

This paper contributes to the finance literature in two distinct dimensions. First, I address endogeneity issues when testing various theories on capital structure and investment decisions. Using patenting decisions made in the *past* as an exogenous source of cash flow, I am able to test whether adverse selection or agency costs exists within innovating firms. Second, I study firm investment strategies in innovation. In this paper, I observe that internal R&D investment is rather insensitive to cash flow—at

least cash flow generated from patent term extensions. However, I find evidence that firms prefer to acquire innovation via patents externally, which is a potentially less risky investment—at least in the short run. This finding may have implications on optimal patent policy design as it suggests that the elasticity of *internal* R&D investment with respect to the patent term is centered around zero (Budish, Roin, and Williams 2016).

Future Research

I intend to study how various key stakeholders of start-ups can influence the direction of internal R&D and also how patent policy determines financing and R&D strategy. First, the interaction of stakeholders, which can include venture capital funds, founders, inventors, and universities, makes studying corporate innovation more dynamic and interesting. Moreover, start-up firms themselves can influence each other through "incubators" and "accerlators" (standalone and corporate) in which they share the same network of consultants and lawyers and possibly even ideas for future joint work. I believe understanding the function of each stakeholder is important to understanding the growth and development of start-ups.

Second, patent policy can play major a role in how start-ups innovate and acquire external financing. For example, as shown in Mann (2015), the strengthening of creditor rights with regards to using patents as collateral gave firms more access to capital. I am currently working on another paper that estimates the effects of the adoption of "local patent rules" on corporate R&D investments and patent litigation decisions. I hypothesize that local patent rules reduce uncertainty in court decisions on patent infringement cases, which translates to a less risky environment for firms to innovate. To test the effectiveness of these court procedural changes, I will use the staggered court district-level adoption of local patent rules from 2001 to 2009 as an exogenous increase in predictability of court rulings. Specifically, firms are treated if they have been defendants repeatedly in the past (i.e., sued for infringement) in a particular court district. The control group consists of firms that are repeated defendants in all other districts that did not adopt local patent rules within the same time period. I expect that treated firms, especially small companies and start-ups as they may have more difficulty enforcing patent infringements, increase R&D investment and patenting activity.

In summary, I hope to dedicate my future research to understanding corporate investment strategies in innovation. I believe that ERBC will provide me a valuable opportunity to gain additional insights into the economics of start-ups and early-stage firms.

UCLAAnderson
SCHOOL of MANAGEMENT

Mark J. Garmaise
Professor of Finance
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March 17, 2016

Dear Professor,

I am writing in support of Shenje Hshieh's application to attend the NBER Entrepreneurship Research Boot Camp. In my judgment, Shenje will contribute meaningfully to the workshop and will benefit greatly from it. Shenje's research makes clear, I believe, that he would be a good fit for the workshop.

Shenje has already written a nice paper that will form the core of his dissertation. In this paper, Shenje studies the impact of a profit windfall on technology firms. He exploits a patent term extension for U.S. firms that arose from the Uruguay Round Trade Agreement. Under this patent reform, patents expiring on or after June 8, 1995 could receive up to a three year extension, depending on the particular circumstances of a given patent. Patents that expired before the June 8, 1995 cut-off date were not eligible for an extension. Thus, a patent granted slightly more than seventeen years before the cut-off date (and hence now expired) was treated very differently from a patent granted slightly less than seventeen years before the cut-off date (and hence still in force).

Shenje makes use of this feature of the patent term extension to set up a clever empirical design. He contrasts firms with patents that expired right before the cut-off date ("control firms") with

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firms that had patents scheduled to expire just after the cut-off date ("treatment firms"). While these firms should generally be expected to be quite similar, the patent extension granted a cash flow boon to only the latter set of treatment firms. Shenje first shows that, indeed, the treatment firms did enjoy higher cash flows. He also finds that the treatment firms borrow less and invest more in capital expenditures. These are all the sorts of effects one might expect from a cash flow windfall.

What is most interesting, in my view, is that Shenje finds that the treated technology firms are no more to invest in research and development (R&D). By contrast, they are more likely to acquire existing patents from other firms. In other words, a profit windfall for technology firms leads them to buy innovation rather than to create it. I think this finding has implications for how to analyze the welfare benefits of the patent system as a whole. While patents may well incentivize firms to engage in R&D, Shenje's results suggest that the profits from patents are not more likely to be deployed in generating new innovation. This is an important fact that I do not believe has been emphasized in the previous literature, and it should make us think differently about patents.

Shenje's interest in innovation and the empirical skills he has demonstrated in his work suggest to me that he will be a very good participant in the workshop. I hope you will offer him a slot.

Sincerely,