The Redeployability of Patent Assets: Evidence from Failed Startups

Proposal for NBER Entrepreneurship Grant

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Venture capital-backed startups are important sources of patented inventions, generating three times more patents per dollar invested than established corporations (Kortum and Lerner, 2000). Such companies also have a notoriously high risk of failure, whether due to the inherent riskiness of their projects, capital constraints, or managerial problems. As Kerr, Nanda, and Rhodes-Kropf (2014) report, more than half of all startups that received venture capital (VC) between 1985 and 2009 were terminated at a loss.

In this study, we will investigate the frequency and speed with which patent assets originating from failed startups are redeployed to alternative uses and users. Understanding the re-allocation of displaced patents is potentially important for entrepreneurial financing decisions. At one extreme, patent value could be perfectly tied to the underlying human capital or venture: rendered worthless if the company fails or the team disbands. The patent assets of failed startups could also be non-redeployable in the classic sense of Williamson (1988) if frictions in the resale market are severe or the rights cover inventions that are nonviable on the market (e.g., see Galasso et al., 2010). Growing evidence nonetheless suggests that the re-sale market for patents has grown more liquid over the past few decades, particularly in information technology (IT)-related sectors (Hagiu and Yoffie, 2013; Brassell and King, 2013). Consistent with this view, recent studies report that the ability of entrepreneurs to tap into debt sources of financing is affected by first-time patent grants (Farre-Mensa et al., 2017) and the thickness of trade in the secondary market for patents (Hochberg et al., 2017). Direct evidence on the redeployability of patents from failed ventures remains lacking—a gap that this study aims to fill.

Our preliminary descriptive evidence reveals a very active market for the sale of displaced patent assets: most of the failed startups' patents are sold, and are sold quickly—particularly in IT-related sectors. For three-quarters of the re-allocated patents in our sample, we find no evidence that the original inventors subsequently work for the patent buyer (as proxied by future patenting activity). Put differently, the patents appear to retain value beyond the people and are not human capital-specific. The patents sold are typically renewed up to their maximum legal length of protection, particularly when purchased by firms operating in the same industry. Although non-practicing entities are represented among the patent buyers in our sample, the majority of sales are to operating companies in the same sector.

This evidence is based on a sample of 1,766 U.S. patents owned by 282 VC-backed startups that went out of business between 1988 and 2008. Our current sample, which we aim to expand, includes failed startups in three sectors: medical devices, semiconductor devices, and software. To identify disbanded companies and their years of exit, we supplement VentureSource data with exit information from Sandhill Econometrics as in Hall and Woodward (2010). We use a method introduced in Serrano (2010) to identify patent sales in the USPTO Patent Assignment database, and trace the mobility of the original inventive teams based on inventor names in the USPTO grant data.

Our study is the first to trace the redeployability of patent assets from failed startups, an under-studied source of patented inventions in the secondary market and of salvage value for lenders. We expect our analysis to contribute to the entrepreneurial finance and innovation economics literatures, and to an ongoing policy debate over the implications of patent sales on innovative activity (e.g., USFTC, 2011; U.S. White House, 2013).

If awarded, we will use the grant money to cover expenses related to data purchase, research assistance and data matching, and to travel to work together (one coauthor is in Europe and one is on the east coast).

References:

Brassell, M., K. King. 2013. *Banking on IP? The role of intellectual property and intangible assets in facilitating business finance: Final Report*. Newport, UK: UK Intellectual Property Office.

Farre-Mensa, J., D. Hegde, A. Ljungqvist. 2017. What is a patent worth? Evidence from the U.S. patent "lottery." NBER working paper 23268.

Galasso, A., M. Schankerman, C.J. Serrano. 2013. Trading and enforcing patent rights. *Rand J. Econom.* **44**(2): 275-312.

Hall, R.E., S.E. Woodward. 2010. The burden of the nondiversifiable risk of entrepreneurship. *Amer. Econom. Rev.* **100**(3): 1163-1194.

Hochberg, Y., Serrano, C., R.H. Ziedonis. 2014. Patent collateral, investor commitment, and the market for venture lending. NBER working paper 20587.

Kerr, W.R., R. Nanda, M. Rhodes-Kropf. 2014. Entrepreneurship as experimentation. *J. Econom. Perspectives* **28**(3): 25-48.

Kortum, S., J. Lerner. 2000. Assessing the contribution of venture capital to innovation. *RAND J. Econom.* **31**(4): 674-692.

Serrano, C. 2010. The dynamics of the transfer and renewal of patents. *RAND J. Econom.* **41**(4): 686-708.

U.S. Federal Trade Commission (USFTC). 2011. The evolving IP marketplace: aligning patent notice and remedies with competition. Washington D.C. USFTC.

U.S. White House. 2013. *Patent assertion and U.S. innovation.* Executive Office of the President. Washington D.C.: U.S. White House.

Williamson, O.E. 1988. Corporate finance and corporate governance. *J. Finance.* **43**(3): 567-591.

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Curriculum Vita
Spring 2017

CARLOS J. SERRANO

Personal Data

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Citizenship: Canadian; Spanish (born in Vilanova i la Geltrú)

Major Fields of Concentration

Economics of Innovation and Technological Change, Entrepreneurship, Empirical Industrial Organization, Entrepreneurial Finance

Education

Degree	*Field*	*Institution*	*Year*
Ph.D.	Economics	University of Minnesota	2006
M.A.	Economics	University of Minnesota	2002
M.Sc.	Economics	University College London	2000
B.S. (Licenciatura)	Economics	Universitat Autònoma de Barcelona	1999

Dissertation

Title: "The Market for Intellectual Property: Evidence from the Transfer of Patents"
Dissertation Advisors: Professors Thomas Holmes and Samuel Kortum

Current Employment and Affiliations

2012-Present Assistant Professor, Universitat Pompeu Fabra
2012-Present Affiliated Professor, Barcelona GSE
2012-Present Research Associate, Rotman School of Management, University of Toronto

Past Employment

2014-2015 Research Fellow, Banco de España
2005-2012 Assistant Professor, Department of Economics, University of Toronto
2003-2005 Research Analyst, Research Department, Federal Reserve Bank of Minneapolis

Visiting Positions

March 2015 Visiting Fellow, Max Planck Institute for Innovation and Competition
Summer 2012 Visiting Scholar, Stanford Institute for Economic Policy Research (SIEPR), Stanford University

Honors and Awards

2017-2020	ECO2016-76998, Member, Spanish Ministry of Economics and Competitiveness, Government of Spain.
2015-2017	Hoover Institution Fellowship Program Research Grant. Working Group on Intellectual Property, Innovation, and Prosperity, Stanford University.
2014-2015	Research Fellow, Banco de España.
2014-2015	NBER Innovation Policy Grant, NBER.
2014-2017	Grant ECO2013-43011-P, Co-Principal Investigator with Albert Banal-Estañol, Spanish Ministry of Economics and Competitiveness, Government of Spain.
2013-2014	UPfellow, Marie Curie COFUND, European Commission.
2011-2013	SSHRC Standard Grant, Principal Investigator, Government of Canada.
2010-2011	Ranked Top 1 teacher, courses of less than 35 students, Economics, University of Toronto.
2010, 2006-7	SSHRC Conference Travel Grant, University of Toronto.
2006-2014	Faculty Research Fellow, NBER.
2006	Connaught Matching Grant, University of Toronto.
2005	Connaught Start-Up Award, University of Toronto.
1999-2003	Graduate Fellowship, Banco de España.
1998-1999	Erasmus-ENTER Visiting undergraduate student, University College London.

Publications

"Intangible but Bankable," (with Yael V. Hochberg and Rosemarie H. Ziedonis), *Science*. Vol. 348, no. 6240, 12 June 2015, pp. 1202 (Solicited).

"Business Partners: Complementary Assets, Financing, and Invention Commercialization," (with Thomas Astebro), *Journal of Economics & Management Strategy*. Vol. 24 (2), Summer 2015, pp. 228-252.

"Trading and Enforcing Patent Rights," (with Alberto Galasso and Mark Schankerman), *RAND Journal of Economics*. Vol. 44 (2), Summer 2013, pp. 275-312.

"The Dynamics of the Transfer and Renewal of Patents," *RAND Journal of Economics.* Vol. 41, Winter 2010, pp. 686-708.

Working Papers
(Papers can be downloaded from http://www.econ.upf.edu/~cserrano)

"Estimating the Gains from Trade in the Market for Patent Rights," NBER WP 17304, *International Economic Review*. Revised and resubmitted.

"Patent Collateral, Investor Commitment, and the Market for Venture Lending," (with Yael V. Hochberg and Rosemarie H. Ziedonis), NBER WP 20587. *Journal of Financial Economics*. Revised and resubmitted.

"Patent Trading Flows of Small and Large Firms," (with Nicolas Figueroa), NBER WP 18982.

"The Redeployability of Patent Assets: Evidence of Failed Startups," (with Rosemarie Ziedonis).

Teaching Experience

Department of Economics and Business, Universitat Pompeu Fabra; and Barcelona School of Management

2013-present Business Strategy and Management of Innovation (Graduate, MSc in Management, UPF-BSM)
2013-2014 Business Economics (Undergraduate ADE/ECO, UPF)
2016-present Business Economics (Undergraduate ADE/ECO, UPF)
2013 Economic Institutions and Markets (Undergraduate IBE, UPF)

Department of Economics, University of Toronto

2005-2012 Managerial Economics: Competitive Strategy I (Undergraduate*)*
2007-2012 Empirical Applications of Economic Theory (Graduate - Empirical Industrial Organization I)
2010-2012 Empirical Applications of Economic Theory (Undergraduate – Empirical Industrial Organization)
2005-2010 Intermediate Microeconomics (Undergraduate)

Department of Economics, University of Minnesota

2001-2 Principles of Microeconomics (Undergraduate)
2002 Money and Banking (Undergraduate)

Presentations to seminars and conferences

2017
Universitat Pompeu Fabra (March, 2017)

2016
Group for Research in Applied Economics (GRAPE), Warsaw, (March, 2016).

2015
CEPR-IHS, Vienna (Jan. 2015), Max Planck Institute for Innovation and Competition, Munich (Mar. 2015), Searle Center Roundtable on Patents and Technology Standards, Northwestern University, Chicago (Apr. 2015) (Discussant), York University - Toronto (Apr. 2015), Universidad Carlos III de Madrid (May, 2015), Strategy, Entrepreneurship, and Innovation Workshop, Universidade Católica Portuguesa (May, 2015), Firm and Technology Dynamics workshop, University of Nottingham (Jun, 2015), Universidade Católica Portuguesa (Jun, 2015), Barcelona GSE Summer Forum AIO Workshop (Jun, 2015), Society of Economic Dynamics, Warsaw (Jun, 2015), ZEW-MaCCI Conference on the Economics of Innovation, Mannheim (Jul, 2015), Econometric Society World Congress, Montreal (Aug, 2015), EARIE, Munich (Aug, 2015), 7th European Banking Conference, Tilburg (Oct., 2015), Workshop in Innovation Economics, Frankfurt, (Nov., 2015), Ryerson University (Dec., 2015), Israel Strategy Conference, Jerusalem (Dec., 2015).

2014
University of Waterloo (Jan. 2014), Universitat Autònoma de Barcelona (May. 2014), XXIX Jornadas de Economía Industrial (Sept. 2014), Pontificia Universidad Católica de Chile (Sept. 2014), HEC Paris Entrepreneurship Meetings, HEC School of Business, (Sept. 2014) (Discussant), CREI-UPF (Oct. 2014), KU Leuven (Oct. 2014), Bank of Finland – CEPR (Oct. 2014) (Discussant), Copenhagen Business School (Nov. 2014), Universitat de València (Nov. 2014), Banco de España (Nov. 2014), CEMFI (Nov. 2014), NBER (Dec. 2014), University of Toronto (Dec. 2014), Wilfrid-Laurier (Dec. 2014)

2013
Universitat de València (Feb. 2013), Einaudi Institute for Economics and Finance, Rome (May 2013), Sixth Annual Conference on Entrepreneurship and Innovation, Chicago – Discussant (June 2013), Barcelona GSE Summer Forum on Innovation (June 2013), Barcelona GSE Summer Forum on Applied IO - Discussant (June, 2013), Université de Grenoble– 3rd GAEL Conference (Keynote, June 2013), Northwestern – Searle (Oct. 2013).

2012
Federal Reserve Bank of New York (Jan., 2012), Toulouse School of Economics / IAE (Jan. 2012), Universidad Carlos III de Madrid (Jan., 2012), Universitat Pompeu Fabra (Jan. 2012), All-UC Conference on Innovation, Berkeley (March 2012), CEPR-Industrial Organization Conference, Cyprus (May, 2012), Academy of Management (August, 2012), SIEPR (Nov., 2012), University of Waterloo (Dec., 2012)

2011
Fourth Annual Conference on Entrepreneurship and Innovation, Chicago (June 2011), Entrepreneurship, Finance, and Innovation Conference, Boston, (June 2011), European Association for Research in Industrial Economics, Stockholm (Sept. 2011), Roundtable for Engineering Entrepreneurship Research, Georgia Tech, (Nov. 2011), Ryerson University, Toronto (Nov. 2011), OECD-KNOWINNO Workshop on "Knowledge Networks and Markets: Measuring the use and impact of Knowledge Exchange Mechanisms." USPTO Headquarters, (Nov. 2011), SUNY - Stony Brook (Nov. 2011), University of Minnesota (Nov. 2011), Spanish Economics Association Meetings, Malaga (December 2011)

2010
University of Alberta (November 2010), Washington University in St. Louis - School of Business (December 2010), International Industrial Organization Conference, Vancouver (May 2010), Canadian Economics Association Meetings, Quebec City (May 2010), European Association for Research in Industrial Economics, Istanbul (September 2010), Spanish Economics Association Meetings, Madrid (December 2010)

2009
Queens Entrepreneurship and Innovation Meetings, Queens University School of Business (June 2009) (Discussant), Econometric Society Meetings, Barcelona (August, 2009), European Association for Research in Industrial Economics (September 2009), HEC Paris Entrepreneurship Meetings, HEC School of Business, (Sept. 2009) (Discussant), Markets for Patents: Emerging Practices and Directions for Research, Ross School of Business and Law School, University of Michigan (Dec, 2009)

2008
York University, Toronto, (Apr. 2008), IESE – Barcelona (June 2008), Canadian Economics Association Meetings, Vancouver (June 2008), Canadian Economic Association Meetings, Vancouver (May 2008) (Discussant), Society of Economic Dynamics, Boston (July 2008), Roundtable for Engineering Entrepreneurship Research, Georgia Tech (November 2008), Duke University (Dec, 2008), Universidad de Chile (Dec, 2008)

2007
Models of Industry Dynamics in Empirical IO, University of Toronto (May, 2007) (Discussant), NBER Summer Institute (July, 2007), Wilfrid-Laurier University (October 2007), Spanish Economic Association Meetings, Granada (Dec 2007)

2006
UCLA (March 2006), International Conference in Industrial Organization, Boston (April 2006), International Conference in Industrial Organization, Boston (April 2006) (Discussant), Harvard (September 2006), Numerically Intensive Economic Policy Analysis, Kingston, (May 2006), North American Meetings of the Econometric Society, Minneapolis (June 2006), Society of Economic Dynamics Meetings, Vancouver (July 2006), UBC Summer Conference on Industrial Organization, Kelowna (July 2006), Spanish Economic Association Meetings, Oviedo (Dec. 2006),

2005
Concordia University (January. 2005), University of Toronto (January 2005), Universite de Montreal (January 2005), University of Iowa (February 2005), Federal Reserve Bank of Minneapolis (February 2005), University of British Columbia – Sauder Business School (February 2005), University of Texas, Dallas – Management School (February 2005), Federal Reserve Board (February 2005), London School of Economics (February 2005), Universitat Autonoma de Barcelona (February 2005), Midwest Macroeconomics Meeting Iowa (May 2005), University of Toronto (Sept. 2005)

Professional Activities

Editorial advisor, *Canadian Journal of Economics*, 2013-present

Referee for *Applied Economics*, *B.E. Journals in Economic Analysis & Policy*, *Canadian Journal of Economics, Econometrica, Economic Journal, Economic Inquiry, European Economic Review, International Economic Review, International Journal of Industrial Organization, Journal of Economics & Management Strategy, Journal of Economic Behavior and Organization, Journal of Industrial Economics, Journal of Political Economy, Management Science, RAND Journal of Economics, Research Policy, Review of Economics and Statistics, Review of Economic Dynamics, Review of Economic Studies, Research Policy, SERIEs, PLOS-ONE, and Strategic Management Journal.*

University Service

Universitat Pompeu Fabra and Barcelona GSE

Coordinator, Barcelona GSE Summer Forum – Applied Industrial Organization Workshop (2014)
Coorganizer, Barcelona GSE Summer Forum – Applied Industrial Organization Workshop (2014, 2015)
Member, Junior Recruitment Committee (2015 – present)
Coordinator, Junior Recruitment Microeconomics area (2015 – present)

University of Toronto

Coordinator, Conference on "*Empirical Models of Industry Dynamics in Empirical IO*", Toronto.
Member, Recruitment Committee (2007-2008)
Member, Graduate Program Ad-hoc Committee (2007-2010)
Member, Graduate curriculum Committee (2008-2010)

Graduate Supervision

Hugh Macartney, "*Teacher Effort: The Effects of Monitoring, Pressure and Other Incentives,*" Member of Thesis Committee, PhD in Economics, September 2011. First placement: Duke University

Arvind Magesan, "*Estimation of Dynamic Games,*" Member of Thesis Committee, PhD in Economics, September 2010. First placement: University of Calgary.

Muji Rahaman, "*Acquisitions and failure of firms,*" Member of Thesis Committee, PhD in Finance and Economics, September 2009. First placement: Sobey School of Business at Saint Mary's University.

Mingxiao Ye, "*Overprotected to Grow?–pharmaceutical patents and the incentive to innovate,"* Member of Thesis Committee, PhD in Economics, September 2011. First placement: The Bermuda Health Council.

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EDUCATION

University of California, Berkeley, Walter A. Haas School of Business
Ph.D. in Business and Public Policy, 2000
Dissertation Title: Patent Protection and Firm Strategy in the Semiconductor Industry
Committee: David C. Mowery (Haas School), Bronwyn H. Hall (Economics), Robert P. Merges (Boalt Hall School of Law), and David J. Teece (Haas School)

University of North Carolina, Chapel Hill
B.A. Economics and International Studies, 1988
Phi Beta Kappa

ACADEMIC POSITIONS

Boston University, Questrom School of Business
Associate Professor of Strategy & Innovation, July 2015 – present
Academic Director for Entrepreneurship, July 2015 – present

National Bureau of Economic Research
Research Associate, Program on Productivity, Innovation and Entrepreneurship, May 2016-present

Stanford University
Visiting Fellow, the Hoover Institution, Summer 2015
Visiting Scholar, Management Science and Engineering Department, Stanford Engineering, 2014-2015
Visiting Scholar, Stanford Institute for Economic Policy Research, Fall 2012

University of Oregon, Lundquist College of Business
Associate Professor, Management Department, 2010 – June 2015
Research Director, Lundquist Center for Entrepreneurship, 2010-13

University of Michigan
Assistant Professor, Strategy Department, Stephen M. Ross School of Business, 2002-2010
Co-Director, Program in Law, Economics, and Technology, UM Law School 2008-2010

University of Pennsylvania, Wharton School of Business
Assistant Professor, Strategic Management, 1999-2002
Senior Fellow, Management Department, 2002-2008

AWARDS, RESEARCH GRANTS, AND HONORS

- Excellence Award for Core MBA Teaching, Class of 2018 Cohort Award (based on student voting)
- NBER Innovation Policy Working Group Research Grant, 2014 ($20,000)
- Excellence in Undergraduate Teaching Award, 2012, 2014
- Ewing Marion Kauffman Foundation Grant ($45,000), State Innovation Programs and Entrepreneurial Activity, 2010-2014
- Interdisciplinary Research Grant from Microsoft Foundation ($200,000) with Rebecca Eisenberg, U. Michigan Law School Program in Law, Economics & Technology, 2008-2010
- Ewing Marion Kaufman Foundation Sub-award ($45,000), Rajshree Agarwal lead PI, 2009
- "Top 10" Evening MBA Instructor based on student ratings, U. Michigan, 2005-2010
- Research Grant for Studies on Innovation ($20,000), General Electric Fund of Wharton School's Jones Center for Management Policy, Strategy, and Organization, 2002-2005
- Research Awards, Wharton's Mack Center for Technological Innovation ($30,000), 1999-2002, 2003-7.
- School-wide Research Awards, U. Michigan Ross School of Business ($10,000), 2004, 2007
- Best Reviewer Award, Technology & Innovation Management, Academy of Management, 2004
- ISI Web of Science Top-Cited Paper in Economics & Business for "Patent Paradox" study (Hall & Ziedonis, 2001), featured at: http://www.esi-topics.com/nhp/nhp-november2002.html
- Principal Investigator (PI), National Academies Board on Science, Technology, and Economic Policy (STEP), Committee on Intellectual Property Rights in a Knowledge-Based Economy, Study on Patent Litigation in the US Semiconductor Industry ($7,500), 2000-2002
- Co-Principal Investigator with Bronwyn Hall, National Bureau of Economic Research/Alfred P. Sloan Foundation Research Grant for "Patent Paradox" study ($10,000), 1998
- Dissertation Fellow, Orel Crawford Award, UC Berkeley, 1997-98
- Doctoral Student Research Grant, US Air Force Office of Scientific Research ($5,000), 1998
- Outstanding Graduate Student Instructor Award, UC Berkeley Academic Senate, 1997
- Outstanding Graduate Student Instructor Award, Haas School of Business, UC Berkeley, 1997
- *California Management Review,* Research Grant ($5,000), 1995, 1998
- Sasakawa Peace Foundation Fellow, 1994-95
- Orel Crawford Research and Teaching Fellow, 1993-94
- National Doctoral Fellow, American Assembly of Collegiate Schools in Business, 1992-93
- Outstanding Achievement Award, International Trade & Finance, US General Accounting Office, 1991

PUBLICATIONS (under RH Ziedonis and RM Ham)

[23] Galasso A, Ziedonis RH. 2017. Patents and Innovative Activity: Evidence from the Semiconductor Industry. In P. Mennell and D. Schwartz, eds., *Research Handbook on the Economics of Intellectual Property Law Vol 2 – Analytical Methods.*

[22] Hochberg, Y, Serrano C, and Ziedonis RH. 2015. Intangible but Bankable. *Science* 348 (6240): 1202 (solicited).

[21] Ganco M, Ziedonis RH, Agarwal R. 2015. More Stars Stay, but the Brightest Ones Still Leave: Job Hopping in the Shadow of Patent Enforcement. *Strategic Management Journal* 36(5): 659-685.

[20] Hsu D, Ziedonis RH. 2013. Resources as Dual Sources of Advantage: Implications for Valuing Entrepreneurial-Firm Patents. *Strategic Management Journal* 34 (7): 761-781 (Lead article)

[19] Benson D, Ziedonis RH. 2010. Corporate Venture Capital and the Returns to Acquiring Portfolio Companies. *Journal of Financial Economics* 98(3): 478-499

[18] Agarwal R, Ganco M, Ziedonis RH. 2009. Reputations for Toughness in Patent Enforcement: Implications for Knowledge Spillovers via Inventor Mobility. *Strategic Management Journal* 30(13): 1349-1374

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[15] Ziedonis RH. 2008. On the Apparent Failure of Patents: A Response to Bessen and Meurer. *Academy of Management Perspectives* 20(4): 21-29

[14] Ziedonis RH. 2008. Intellectual Property and Innovation. S. Shane, ed., *The Handbook on Technology and Innovation Management*. Hoboken, NJ: John Wiley & Sons Publishing.

[13] Hsu D, Ziedonis RH. 2008. Patents as Quality Signals for Entrepreneurial Ventures. *Academy of Management Best Papers Proceedings* [a much-revised version was published in SMJ in 2013 under the title, Resources as Dual Sources of Advantage: Implications for Valuing Entrepreneurial-Firm Patents.]

[12] Ziedonis RH. 2004. Don't Fence Me In: Fragmented Markets for Technology and the Patent Acquisition Strategies of Firms. *Management Science* 50(6): 804-820
Reprinted in: Heller M. 2009. *Commons and Anticommons.* UK: Edward Elgar Publishing

[11] Ziedonis RH. 2003. Patent Litigation in the U.S. Semiconductor Industry. W.A. Cohen and S.A. Merrill, eds., *Patents in the Knowledge-Based Economy*. Washington DC: National Academies Press

[10] Hall BH, Ziedonis RH. 2001. The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-95. *Rand Journal of Economics* 32(1): 101-128

- An ISI Web of Science top-cited paper in economics & business journals: http://www.esi-topics.com/nhp/nhp-november2002.html
- Reprinted in:
  Miller JS. 2009. *Critical Concepts in Intellectual Property Law: Patents.* UK: Elgar Publishing, 2009
  Nickerson J, Silverman B. 2009. *Economic Institutions of Strategy*, *Advances in Strategic Management,* v 26. UK: Emerald Group Publishing
  Margolis SE, Newmark CM. 2009. *Intellectual Property and Business*, UK: Elgar Publishing Ltd
  Cantwell J. 2006. *The International Library of Critical Writings in Economics: The Economics of Patents.* UK: Elgar Publishing Ltd

[9] Ziedonis RH, Hall BH. 2001. The Effects of Strengthening Patent Rights on Firms Engaged in Cumulative Innovation: Insights from the Semiconductor Industry. In G.D. Libecap, ed., *Advances in the Study of Entrepreneurship, Innovation, and Economic Growth,* vol. 13. UK: Elsevier Science Ltd

[8] Linden G, Mowery DC, Ziedonis RH. 2000. National Technology Policy in Global Markets: Developing Next-Generation Lithography in the Semiconductor Industry. *Business and Politics* 2(2): 93-113
Selected for reprinting in: Feldman M, Link AN. 2001. *Science and Technology in the 21st Century: Toward a Global Policy Agenda*. Norwell, Massachusetts: Kluwer Academic Publishers

[7] Ham RM, Linden G, Appleyard MM. 1998. The Evolving Role of Semiconductor Consortia in the United States and Japan. *California Management Review* 41(1): 137-163

[6] Ham RM, Mowery DC. 1998. Improving the Effectiveness of Public-Private R&D Collaboration: Case Studies at a U.S. Weapons Laboratory. *Research Policy* 26: 661-675

[5] Ham RM, Mowery DC. 1997a. Country Case Study: The United States of America. J. Dunning, ed., *Governments, Globalization, and International Business*. UK: Oxford University Press

[4] Ham RM, Mowery DC. 1997b. Technology Collaboration Between Industry and National Laboratories: The Importance of Project Structure and Management. *International Journal of Industrial Engineering Special Issue: Technology Transfer* 4(4): 244-253

[3] Ham RM, Mowery DC. 1995a. Enduring Dilemmas in U.S. Technology Policy. *California Management Review* 37(4): 89-107. Reprinted in Koopman G, Scharrer H. 1996. *The Economics of High Technology Competition and Cooperation in Global Markets.* Hamburg, Germany: Institut für Wirtschaftsforschung*;* and in French as La politique technologique de Clinton. *Politique etrangere* 4: 991 - 1004, 1995.

[2] Ham RM, Mowery DC. 1995b. Improving Industry-Government Cooperative R&D. *Issues in Science and Technology* (Summer): 67-73.

[1] John KE, Sirois E, Park M, Winston T, Ham RM. 1993. Benefits of Teamwork in a Mail Survey of U.S. Firms on Patent Protection: A Coordinated Methodological Approach. *Proceedings of the International Conference on Establishment Surveys*, American Statistical Association.

WORKING PAPERS

- Patent Collateral, Investor Commitment, and the Market for Venture Lending, with Yael Hochberg and Carlos Serrano, NBER working paper # 20587.
    - Featured in *Science* as "Intangible but bankable", 12 June 2015 vol 348 issue 6240, available at: https://www.sciencemag.org/content/348/6240/1202.1.full.pdf
- The Redeployability of Patent Assets: Evidence from Failed Startups, with Carlos Serrano.
- Bridging the Funding Gap for Technology Startups: Evidence from Michigan's R&D Loan Program, with Bo Zhao. (Previously entitled "State Governments as Financiers of Technology Startups: Implications for Firm Performance")
- State Innovation Programs and the Retention of Science and Technology Startups: Evidence from the Great Lakes Region, with Bo Zhao and Arvids Ziedonis
- Two Decades of Research on Intellectual Property: Top-Cited Papers, Salient Themes, and Emerging Issues, with Sina Khoshsokhan
- R&D Investments and Tax Avoidance: The Role of Intra-Firm Cross-Border Collaboration, with Jingjing Huang and Linda Krull
- Research Consortia as Performers and Brokers of R&D: Trade-offs for Member Firms, with Arvids Ziedonis

PRESENTATIONS

- "Patent Collateral, Investor Commitment, and the Market for Venture Lending"
  - Interdisciplinary Research Seminar, Ivey Business School, Western University, 2017
  - Munich Summer Institute, Munich Germany, 2016 (Keynote)
  - Dynamics of Entrepreneurship Conference, ZEW Center for European Economic Research, Mannheim Germany 2016 (Keynote)
  - Stanford Hoover Institution IP^2 Conference, 2015
  - Boston University Strategy & Innovation Seminar, 2015
  - Berkeley Innovation Seminar, Haas/Engineering, 2014
  - Distinguished Speaker Series, University of Colorado Boulder, 2014
  - Third Annual Empirical Patent Law Conference, Northwestern Law School, 2014
  - Management Department Seminars, Drexel, Univ. South Carolina, UC Riverside, 2014
  - Northwestern/Searle Center Innovation and Entrepreneurship Conference, 2014
  - Wharton Technology Conference, University of Pennsylvania, 2014
  - Institutions and Innovation Conference, Harvard Business School, 2013
  - Academy of Management Meetings, Orlando FL, 2013

- "Bridging the Funding Gap for Technology Startups: Evidence from Michigan's R&D Loan Program" (previously circulated as "State Governments as Financiers of Technology Startups: Implications for Firm Performance")
  - Kauffman Incentives to Innovate Conference: State Policies to Jumpstart Entrepreneurship, 2014
  - Carnegie Mellon University Study of Innovation, Entrepreneurship & Technology Seminar, 2014
  - Strategy and Economics Seminar, U. British Columbia, 2013
  - Wharton Technology Conference, U. Pennsylvania, 2013
  - Stanford Institute of Economic Policy Research (SIEPR) Seminar, Stanford, 2012
  - Innovation Seminar, UC Berkeley Haas School of Business, 2012
  - National Bureau of Economic Research (NBER) Entrepreneurship Workshop, 2012
  - Academy of Management Meetings, Boston MA, 2012 (presented by co-author)
  - Northwestern Law Searle Center, Innovation and Entrepreneurship Conference, 2012
  - UCLA Entrepreneurship Seminar, 2012
  - Management Seminar, U. Oregon, 2012

- "Patent Thickets: Evidence from Academic Research"
  - EPO Economic and Scientific Advisory Board meeting, Leuven Belgium, 2012

- "The Private Value of Patents for Entrepreneurial Firms: Evidence from Medical Devices, Semiconductors and Software"
  - Northwestern/Searle Conference on Software/Business Methods Patents, April 2014
  - Ecole Polytechnique Federal de Lausanne, Switzerland, 2013
  - European Intellectual Property and Policy (EPIP) Conference, Leeuven Belgium, 2012
  - West Coast Entrepreneurship Research Forum, USC, 2012
  - Academy of Management Meetings, Boston MA, 2012

- "Job Hopping in the Shadow of Patent Enforcement"
  - Stanford Institute of Economic Policy Research (SIEPR) Seminar, Stanford, 2011
  - Academy of Management Meetings, San Antonio TX, 2011
  - DRUID Conference on Innovation, Strategy, and Structure, Denmark, 2011 (plenary session)
  - Max Planck Institute for Economics, Jena Germany, 2011
  - U. Munich & Technical U. of Munich Innovation Seminar, 2011
  - Darden Entrepreneurship and Innovation Research Conference, UVA, 2011

- Wharton Technology Conference, U. Pennsylvania, 2011
- Innovation Seminar, UC Berkeley Haas School of Business, 2011
- Management Sciences Research Seminar, Ohio State U., 2010
- Management Seminar, U. Oregon, 2010
- Strategy Brownbag, Ross School of Business, U. Michigan, 2009

- "Reputations for Toughness in Patent Enforcement: Implications for Knowledge Spillover through Inventor Mobility"
  - Kellogg/Northwestern Entrepreneurship and Innovation Seminar, 2009
  - U. Arizona Entrepreneurship Seminar, 2009
  - UCLA Business Environment Conference, 2009
  - Emory Strategy Seminar, 2008
  - Georgia Tech Roundtable on Engineering Entrepreneurship Research (REER), 2008
  - Entrepreneurship Research Workshop, U. Michigan, 2008
  - Duke Strategy Conference (presented by discussant), 2008
  - Wharton Technology Mini-Conference (presented by coauthor), 2008
  - Berkeley Innovation Seminar, Haas School and Economics Department, 2008
  - West Coast Entrepreneurship Research Forum, U. Washington, 2007
  - Academy of Management Meetings, Showcase Symposium, 2007

- "Patents as Quality Signals for Entrepreneurial Ventures"
  - Faculty Research Seminar, U. Oregon, May 2011
  - Academy of Management Meetings, 2008
  - NBER Entrepreneurship Workshop (presented by coauthor), 2007
  - Conference on Technology Entrepreneurship and Institutions, U. Wisconsin, 2007
  - Berkeley Innovation Seminar, Haas School and Economics Dept., 2007
  - First Annual Ross School Workshop on Entrepreneurship Research, 2007

- "Are Weak Patent Regimes Stronger Than We Think?: Evidence from Venture-backed Firms"
  - Workshop on Innovation and Entrepreneurship Research, LCB/University of Oregon, June 2011
  - Symposium on Intellectual Property and Entrepreneurship, UC Berkeley Center for Law and Technology and Kauffman Foundation, Boalt School of Law, March 2008

- "An Empirical Analysis of Non-Rival Patent Litigation"
  - Northwestern Law School/Searle Center Workshop of Patent Litigation, Nov 2010
  - American Economic Association Meetings, January 2007

- "Markets for Patents: Toward a Research Agenda"
  - U. Michigan "Markets for Patents" Conference, Ross School, UM Law School, 2009

- "Patent Cross Licensing and Litigation: Evidence from Semiconductors and Electronics"
  - Symposium on Patent Cross Licenses: Academic and Business Perspectives, UC Berkeley Center for Law and Technology, Boalt School of Law, 2009

- "Startups as Sources of New Technology…and Patents"
  - US Federal Trade Commission hearings on the Evolving IP Marketplace, 2009

- "Corporate Venture Capital and the Returns to Acquiring Entrepreneurial Firms"
  - U. North Carolina at Chapel Hill, Strategy Seminar, 2007
  - U. Illinois at Urbana-Champaign Strategy Seminar, 2006
  - Stern School Interdisciplinary Economics, Strategy and Marketing Seminar, New York U., 2006
  - Tuck School Innovation and Learning Seminar, Dartmouth, 2006

- Rotman School Strategy Seminar, U. Toronto, 2006
- Harvard Corporate Entrepreneurship Conference, 2005
- Stanford Technology Ventures Seminar, Stanford, 2005
- Berkeley Innovation Seminar, Haas School and Economics Department, 2005
- Finance Seminar, U. Michigan, 2005
- Roundtable for Engineering Entrepreneurship Research, Georgia Tech, 2004
- Academy of Management Meetings, New Orleans, LA, 2004

• "Empirical Research on Patent Litigation"
  - Patent Reform Hearings, National Academies of Science, Federal Trade Commission, and the American Intellectual Property Law Association, Washington DC, 2005.

• "Research Consortia as Performers and Brokers of R&D: Trade-offs for Member Firms"
  - Roundtable Engineering Entrepreneurship Research, Georgia Tech, 2005
  - Academy of Management Meetings, Hawaii, 2005

• "Don't Fence Me In: Fragmented Markets for Technology and Patent Acquisition Strategies of Firms"
  - Academy of Management, Uses and Abuses of Patent Data, 2003-2005
  - Empirical Research on Patents Workshop, Stanford & Berkeley Schools of Law, 2005
  - Workshop on the Economics of Intellectual Property, NBER Summer Institute, 2004
  - New York U. Law School Colloquium on Intellectual Property and Antitrust, New York, 2003
  - U. Michigan Intellectual Property Law Seminar, 2003
  - Purdue Microeconomics Seminar, Krannart School, 2002
  - International Society for New Institutional Economics (ISNIE) Conference, 2002
  - U. Pennsylvania Law and Economics Seminar, Penn Law School, 2002
  - Wharton Management of Technology Seminar, 2002
  - Strategy and the Business Environment Conference, Stanford, 2002
  - Department of Justice/FTC Hearings on Intellectual Property, Washington DC, 2002
  - BYU and U. Utah Winter Strategy Conference, 2002

• "Obtaining and Enforcing Patents in Semiconductors: Insights from Two Recent Studies"
  - Technological Innovation and Entrepreneurship Workshop, Krannart School, Purdue, 2002
  - Interdisciplinary Committee on Organizational Studies Seminar, U. Michigan, 2002
  - Department of Justice/FTC Hearings on Intellectual Property, Washington DC, 2002
  - Wharton Impact Conference on Managing Knowledge Assets, 2001

• "Patent Enforcement in the U.S. Semiconductor Industry, 1973-2001"
  - Academy of Management Conference, Seattle WA, 2003
  - Department of Justice/FTC Hearings on Intellectual Property, Washington DC, 2002
  - National Academies Conference on "The Operation of the Patent System," Washington DC, 2001

• "Research Consortia and the Diffusion of Technological Knowledge: Insights from SEMATECH"
  - International Society for New Institutional Economics (ISNIE) Conference, 2004
  - Corporate Strategy and International Business Seminar, U. Michigan, 2002
  - Academy of Management Conference, Washington DC, 2001

• "The Patent Paradox Revisited: An Empirical Study of Patenting in the Semiconductor Industry"
  - Advanced Patent Law Institute Annual Meeting, San Jose, CA, 2000
  - Federal Research Bank of Philadelphia, innovation research workshop, 2000
  - Jones Center for Management Policy, Strategy, and Organization, Wharton School, 2000
  - American Law and Economic Association Annual Meeting, New York, NY, 2000

- National Academies, Board on Science, Technology, and Economic Policy conference on "Intellectual Property Rights: How Far Should They Be Extended?" http://www4.nas.edu/pd/step.nsf/, Washington DC, 2000
- National Bureau of Economic Research, Patent System conference, Santa Barbara, CA, 1999
- Berkeley Institutional Analysis Seminar, 1999
- Other seminar presentations in 1999: Arizona State, Georgetown, George Mason Univ, Harvard, NYU, Ohio State, Michigan, and Wharton.

- "Improving Industry-Government Cooperative R&D: Evidence from Case Studies at a National Weapons Laboratory"
  - International Trade & Finance Seminar, U.S. GAO, San Francisco, CA, 1995
  - Los Alamos National Laboratory, 1995

TEACHING

Dissertation Committees

- Jax Kirtley, Strategy and Innovation, Boston University Questrom School of Business; initial placement: Wharton, Entrepreneurship.
- Sina Khoshsokhan, Strategy and Innovation, Boston University Questrom School of Business, ongoing
- Lauren Lanahan, Public Policy, UNC-Chapel Hill; 2012 Kauffman Doctoral Fellow; initial placement: U Oregon, Management
- Bo Zhao, Business Economics, U. Michigan Ross School of Business, (committee co-chair); 2012 Kauffman Doctoral Fellow; placement: U. Hong Kong, Strategy and Business Economics.
- David Benson, Strategy, U. Michigan Ross School of Business (committee chair); 2008 Kauffman Doctoral Fellow, SRC Fellow; Emeritus Faculty Award for Best Ross School Dissertation in 2009-2010 cohort; placement: Brigham Young University Strategy and Entrepreneurship.
- Martin Ganco, Strategy, U. Illinois; 2009 Kauffman Doctoral Fellow; 2011 Best Dissertation Award, AOM Business Policy Strategy Division; placement: U. Minnesota Strategy.
- Angus Cho, Economics, U Michigan (2008); placement: Shanghai U. Finance and Economics.
- Amit Seru, Finance, U Michigan Ross School (2007); placement: U. Chicago, Finance.
- Miriam Bitton, Law, U Michigan (2006); placement Bar-llan U. School of Law.

Courses

2016-	**Competition, Innovation, and Strategy** (SI750, MBA core), Boston University
2011-15	**Business Strategy and Planning** (BA453, undergraduate capstone), Univ. of Oregon • Received Business Council Award for Excellence in Undergraduate Teaching, 2012 and 2014
2011-15	**Strategic Management** (MGMT614, MBA core), Univ. of Oregon
2011-15	**Economic Perspectives on Causal Inference** (MGMT607), Univ. of Oregon • Introduced and developed new methods course for PhD students • Taught to PhD students from management, accounting, and finance departments
2003-10	**Corporate Strategy** (STRAT601, required for evening MBA students), Univ. of Michigan • Consistently listed among "Top 10" Evening MBA Instructors based on student ratings
2001-07	**Intellectual Property and Competitive Strategy,** Wharton and Univ. of Michigan

- Developed as new MBA elective at Wharton, Spring 2001 (MGMT654)
  - Top-rated MBA elective in the Management Dept in two semesters taught (Spring 2001, 2002).
- Introduced to U Michigan's Ross MBA Curriculum in 2003 (CSIB673; CSIB553)
  - Consistently among top 5% MBA electives based on student ratings.

1999-2001 **Competitive Strategy** (MBA core), the Wharton School

1996 **Social, Political and International Environment of Business** (undergraduate)
Graduate Student Instructor, UC Berkeley, Haas School of Business

OTHER WORK EXPERIENCE

1989-1996 **Policy Analyst**
U.S. General Accounting Office, Washington DC; San Francisco, CA
Evaluated intellectual property systems and R&D programs
Initiated and led a monthly video-seminar on international trade and technology
Managed staff in Europe, San Francisco, and Washington DC

1988-1989 **Research Assistant**
Institute for International Economics, Washington DC
Principal researcher for E.M. Graham and Paul Krugman, *Foreign Direct Investment in the United States*. Washington, DC: Institute for International Economics, 1989.

1987-1988 **Research Assistant, Graduate School of Business/Department of Economics**
University of North Carolina, Chapel Hill
Examined the effects of trade policies on textile industry

1987 **Intern, Venture Management Exchange**
Berlin Center of Innovation, West Berlin, Germany
Coordinated seminars on venture financing
Recruited MBA students for positions with German startups

EDITORIAL AND REVIEW ACTIVITY

Management Science
- Associate Editor, Business Strategy Department, 2015-
- Guest Associate Editor, Business Strategy & Entrepreneurship Departments, 2012-2014

Strategic Management Journal, Editorial Board, 2005-
Strategy Science, Editorial Board, 2014 -
Academy of Management Journal, Editorial Board, 2004-2010

Referee on an ad hoc basis: *American Economic Review, California Management Review*, *Jl of Financial Economics, Jl of Industrial Economics, Jl of Law and Economics*, *Organization Science*, *Management Science*, *Rand Jl of Economics*, *Research Policy, Strategic Management Journal, Strategic Entrepreneurship Jl.*

Referee for grant proposals to the *National Institutes of Health* (on patent-related projects) and the *Kauffman Foundation*

OTHER PROFESSIONAL SERVICE

Elected positions:

- Strategic Research Initiative, 2012-
- Business Policy and Strategy Executive Committee, 2011-2013
- Business Policy and Strategy Research Committee, 2007-2009

Scientific Committee, IP Statistics for Decision Makers Conference, Organisation for Economic Cooperation and Development (OECD), Sydney Australia, Nov 2016

Panelist and Discussant, The Federal Trade Commission's Patent Assertion Entity Study, Technology Policy Institute, Washington DC, Oct 20, 2016

Keynote Lecture, Munich Summer Institute, Munich Germany, June 2016

Keynote Lecture, Conference on the Dynamics of Entrepreneurship, ZEW Center for European Economic Research, Mannheim Germany, June 2016

Speaker, National Academies of Sciences, NCSES/CNSTAT Workshop on Advancing Concepts and Models of Innovative Activity and STI Indicator Systems, Washington DC May 19-20, 2016

Co-Chair (with Giovanni Gavetti), Business Policy and Strategy New Faculty Consortium, 2014-15

Co-Chair (with Jeff Furman), Business Policy and Strategy New Faculty Consortium, 2013-14

Faculty Mentor, Kauffman Dissertation Fellowship Awardees, Entrepreneurship Workshops, 2013-2016

Co-Organizer (with Tim Simcoe and Anne Bower), 'Do I have an endogeneity problem and what should I do about it?' AOM Professional Development Workshop, 2012, 2014

Chair and Panel Organizer, "More than Words? The Effects of Policy Reforms on Entrepreneurial Firms," AOM meetings, 2014; selected as Academy Showcase Symposium

Featured Speaker, Kauffman Incentives to Innovate Conference: State Policies to Jumpstart Entrepreneurship, 2014; http://new.livestream.com/kauffmanfoundation/incentivestoinnovate

Provost Faculty Research Mentor, Drexel Career Award for Assistant Professors, Dennis Park, 2014-15

Undergraduate Honors Thesis Advisor, Jeanna Lobdell on entrepreneurial "restarts," 2014

Invited Speaker, European Patent Office Workshop on Patent Thickets, Belgium, 2012

Co-Organizer (with Julian Atanassov and Nagesh Murtha), Second Annual LCB Research Workshop: Innovation, Sustainability, and Entrepreneurship, UO Lundquist College of Business, 2012

Co-Organizer (with Julian Atanassov), Innovation & Entrepreneurship Internal Research Workshop, UO Lundquist College of Business, 2011

Keynote Speaker, DRUID Conference on Innovation, Strategy, and Structure, Denmark 2011

Invited Speaker on "Innovation Communities and the Law," MIT Sloan Technological Innovation, Entrepreneurship, and Strategic (TIES) Group 50th Anniversary Conference, April 2011.

Discussant and Speaker, Professional Development Workshops on Patent Data, Academy of Management Annual Meetings, 1999, 2003, 2004, 2010-2013

Discussant and Speaker, West Coast Research Symposium Doctoral Symposium, 2010-12

Co-Organizer (with Steven Klepper, Hart Posen, Brian Wu, Minyuan Zhao, and Arvids Ziedonis), CCC Doctoral Colloquium and Faculty Research Conference, Ross School of Business, April 2010.

Co-Organizer (with Rebecca Eisenberg), "Markets for Patents" Research Conference, Ross School of Business and University of Michigan Law School, Dec 2009

Co-Organizer (with Francine Lafontaine), Annual Workshops on Entrepreneurship Research, Ross School of Business, 2007-2008

Co-Chair and Panel Organizer of Showcase Symposium on Scientists, Engineers, and the Process of Innovation, Academy of Management Annual Meetings, 2007

Invited Speaker, National Academies Conference on "Investor Exits: Implication for Innovation and Entrepreneurship in the U.S. Economy," Science, Technology, and Economic Policy Board, Aug 2007

Discussant, Economics of Intellectual Property, NBER Summer Institute, July 2007

Discussant, Roundtable for Engineering Entrepreneurship Research, Georgia Tech, 2006, 2010, 2012

Peer Reviewer, Genomics Research Institute of the National Institutes of Health, Intellectual Property and Its Effects on Genomics-Related R&D, March 2005

Chair and Panel Organizer, "Institutions and the Creation and Use of New Technologies," International Society of New Institutional Economics (ISNIE), Tucson, Arizona, Sept. 2004

Co-Chair and Panel Organizer, "Managing Intellectual Property in Knowledge Economies: Theory, Empirical Evidence, and Business Strategies" (with Markus Reitzig), Academy of Management Annual Meetings, TIM Division, Seattle, WA, Aug 2003

Co-Organizer, Wharton Technology Mini-Conference, a junior faculty research symposium (with Lori Rosenkopf and Christian Terweisch), Spring 2001, Spring 2002

Invited Speaker, U.S. Department of Justice/Federal Trade Commission Hearings on the Patent System and Innovation, Spring 2002

Editorial Board, Technological Innovation and Intellectual Property (TIIP), 2002-2007.

Invited Faculty Participant, Business Policy and Strategy Doctoral Consortium, Academy of Management, Denver, Colorado, August 2002

Invited Panelist, "Workshop on Intellectual Property Rights in Research Partnerships," George Washington University, Washington DC, October 2001

Faculty Participant, Doctoral Consortium on Competition, Cooperation, and Competitiveness (CCC), Duke University, April 2001; UC Berkeley, April 2005; U Michigan 2010; MIT 2011.

Discussant, Wharton Research Conference on Strategy and the Business Environment, Sept. 2000.

Co-Chair, "Strategic Management of Intellectual Property" Panel (with J.P. Liebeskind), Academy of Management Conference, Toronto, Canada, August 2000

- Selected as Showcase Symposium for Technology and Innovation Management and Business Policy and Strategy Divisions, 2000

Invited Panelist, Workshops on Intellectual Property Rights, Yale University, New Haven, CT, September 1999; the National Academy of Science, Washington DC, February 2000

MEDIA COVERAGE

Research findings have been featured in policy reports by the *U.S. Federal Trade Commission*, the *European and U.S. Patent Offices*, and the *National Academies*, and in media outlets such as *Science*, the *Economist*, the *New York Times*, *PatentlyO*, and the *Wall Street Journal*.