UNIVERSITAT DE BARCELONA SCHOOL OF ECONOMICS Summer School

Economics of Science and Innovation Summer School

July 10-14, 2023

Science and innovation play an increasingly important role in the growth of economies throughout the world. Innovation is an essential driver of economic progress and a strategic priority for governments, leading companies, and start-up businesses and represents a major source of competitive advantage, wealth creation, and improvements in the quality of life.

Overview of the course: This course is intended to introduce participants to selected topics in the economics of innovation, such as science, intellectual property, and knowledge spillovers. Overall emphasis will be on empirical analysis and policy implications, while formal mathematical modelling will remain in the background.

The programme will introduce participants to the most relevant theoretical and empirical questions in the economics of science and innovation. Applied economic studies of innovation are multidisciplinary, as they draw theories, data, and methods from as diverse fields as economics, management, sociology, law, and history, among others. In addition to it, participants will also learn and discuss the various methodologies for tackling open questions in the field.

The course is mainly conceived for master and PhD students as well as for policy-makers interested in gaining an understanding of the fundamentals of the policy tools they administer. Firm managers will also be interested in the lectures on intellectual property.

Introduction to the field: Once limited to the study of the micro and macroeconomic determinants and outcomes of technical change, the economists' interest in innovation processes now covers everything from the generation of new knowledge to its diffusion, whether embodied in new hardware or biological samples, codified in software programmes, patents or scientific publications, or transmitted personally by its producers, when moving across organizations and/or in the physical space and socializing within and outside the workplace. More and more sources of relevant knowledge are considered, well beyond the once exclusive interest in R&D, ranging from pure science to learning by doing and by using, whether referred to technologies or organizational practices. Each one of these sources corresponds to a different bundle of institutions, organizations, and locations, following a distinctive economic logic, which requires a specific understanding. The translation of the knowledge inputs so generated into new goods, services, industrial processes, and organizational practices is mediated by the strategic interaction of multiple actors, including international institutions, national and local governments, incumbent and entrant firms and their associations, universities, and individuals therein. Economists of innovation have come to cover such a wide array of topics by following a tradition of multidisciplinarity, diversity, appliedness, and policy orientation. Within economics, they have kept open dialogue between different approaches, most notably between marginalist and evolutionary ones. Besides, they have drawn theory, data, and methods from management, sociology, law, geography, and history, among others. This has been helped by the prominence given to applied research. When it comes to

innovation, this goes well beyond the boundaries of econometrics, due to the disproportionate role played by original data collection and processing, and the importance of other analytical methods, such as bibliometrics and social network analysis.

Readings: Required readings are reported in bold. They are more for the appropriateness relative to theoretical or methodological discussions we will have than for their importance relative to other readings. Most of them are freely accessible on the web (missing links will be provided shortly before the school's start, sometimes to wp versions). Were this not the case, a file will be circulated in class.

Instructors: Francesco Lissoni, Bordeaux School of Economics (FL); Valerio Sterzi, Bordeaux School of Economics (VS), and Massimiliano Coda-Zabetta, Dept of Econometrics, Statistics, and Applied Economics of the University of Barcelona (MCZ)

Monday 10

8:45–9:00 Welcoming remarks

9:00 – 9:30 Introduction to the Economics of Innovation (FL)

- Overview of the field, past and present
- What the course covers and why
- What the course does not cover
- Data for innovation studies

10: 00 – 13:00 The economics of science /1 (FL)

- The "simple economics" of basic research
- Is science a public good? Priority as intellectual property
- Social networks in science
- Matthew effect

Readings

14:00-15:30 Lab: Bibliometrics (MCZ)

- Scientific publications as data
- Data sourcing and handling

Tuesday 11

9:00-11:00 The economics of intellectual property (IP) /1 (VS)

- IP rights: Overview
- Introduction to the economics of IPRs
- The choice between formal and informal IP
- The economics of patent examination, filing and processing

11:30-13:00 The economics of intellectual property (IP) /2 (VS)

- The economics of patent licensing
- The problems with patents /A: (1) sleeping patents; (2) patent race
- Market for patents

14:00-15:30 Lab: Patent data (MCZ)
- Patents as data
- Data sourcing and handling

Wednesday 12

9:00-10:30 The economics of intellectual property (IP) /3 (VS)
- The economics of patent litigation
- The problems with patents /B: (3) patent notice failure; (4) patent trolls; (5) IP fragmentation and cumulativeness

11: 00-13:00 The economics of science /2 (FL)
- Academic patents and inventors
    - Who owns academic inventions
    - Academic inventors and social networks
- IP in science: a double-edged sword?
    - Anticommons and research bias
    - Gender and junior bias
- Corporate science

14:00-15:30 Lab: Networks in innovation (MCZ)
- Network detection & formation
- Structural measures

Thursday 13

9:00-11:00 Economics of science /3 (FL)
- Corporate science
- Teamwork
- Peer effects

11:30-13:00 Geography of knowledge (FL)
- Geographic spillovers
- Migration and innovation
- STEM careers

14:00-15:30 Lab: Geography with innovation data (MCZ)

- Geolocalisation
- Measuring spillovers and peer effects
- Migration and innovation

Friday 14

9-11 Student Presentations (FL, MCZ)

- Students will have the chance to present their research and receive feedback

11-12 Delivery of certificates and farewell cocktail

Readings

The economics of science /1 (FL)

- Arrow, K.J. (1962) "Economic welfare and the allocation of resources for invention" in: Nelson, R.R. (ed.) *The Rate and Direction of Inventive Activity: Economic and Social Factors*. Princeton University Press link
- Azoulay, P., Stuart, T., & Wang, Y. (2014). Matthew: Effect or fable?. *Management Science, 60*(1), 92-109 link
- Bush, V. (1945) "Science - The Endless Frontier: A Report to the President on a Program for Postwar Scientific Research" *Transactions of the Kansas Academy of Science 48*(3), 231-264 link
- Crane, D. (1977). Social structure in a group of scientists: a test of the "invisible college" hypothesis. In *Social networks: A developing paradigm* (pp. 161-178). Academic Press link
- Jin, G. Z., Jones, B., Lu, S. F., & Uzzi, B. (2019). The reverse Matthew effect: Consequences of retraction in scientific teams. *Review of Economics and Statistics, 101*(3), 492-506 link
- Kline, S.J., Rosenberg N. (1986) "An Overview of Innovation", in: Landau R., Rosenberg N. (eds.) *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, National Academy Press link
- Merton, R. K. (1957). Priorities in scientific discovery: a chapter in the sociology of science. *American Sociological Review, 22*(6), 635-659 link
- Merton, R. K. (1979) "Foreword", in: Garfield, E. *Citation indexing: Its theory and application in science, technology, and humanities*. New York: Wiley. link
- Merton, R. K. (1988) "The Matthew effect in science, II: Cumulative advantage and the symbolism of intellectual property" *Isis 79*(4), 606-623
- Moody, J. (2004). The structure of a social science collaboration network: Disciplinary cohesion from 1963 to 1999. *American sociological review, 69*(2), 213-238 link
- Nelson, R.R. (1959) "The simple economics of basic scientific research" *Journal of Political Economy, 67*(3), 297-306 link

- Stephan, P. E. (1996). The economics of science. *Journal of Economic literature*, *34*(3), 1199-1235 link
- Stokes, D.E. (1997), *Pasteur's quadrant: Basic science and technological innovation*. Brookings Institution Press [chapter 3, sections: Official Reporting Categories; Expanding the Dimensional Image; Rethinking the Dynamic Paradigm] pdf in class link

The economics of intellectual property (IP) /1 (VS)

- Eckert, A., & Langinier, C. (2014). A survey of the economics of patent systems and procedures. *Journal of Economic Surveys*, 28(5), 996-1015. link.
- Economides, N. S. (1988). The economics of trademarks. *Trademark Rep.*, 78, 523. link
- Hall, B., Helmers, C., Rogers, M., & Sena, V. (2014). The choice between formal and informal intellectual property: a review. *Journal of Economic Literature*, 52(2), 375-423. link
- Orsenigo, L., & Sterzi, V. (2010). Comparative study of the use of patents in different industries. Knowledge, Internationalization and Technology Studies (KITeS), 33, 1-31. link
- Scotchmer, S. (2004). Innovation and incentives. MIT press (chapters 2.1, 2.2). link
- Trimble, M. (2016). Patent working requirements: Historical and comparative perspectives. *UC Irvine* l. Rev., 6, 483. link

The economics of intellectual property (IP) /2 (VS)

- De Marco, A., Scellato, G., Ughetto, E., & Caviggioli, F. (2017). Global markets for technology: Evidence from patent transactions. *Research Policy*, 46(9), 1644-1654. link.
- Galasso, A., Schankerman, M., & Serrano, C. J. (2013). Trading and enforcing patent rights. *The RAND Journal of Economics*, 44(2), 275-312. link.
- Hagiu, A., & Yoffie, D. B. (2013). The new patent intermediaries: platforms, defensive aggregators, and super-aggregators. *Journal of Economic Perspectives*, 27(1), 45-66. link
- Mann, W. (2018). Creditor rights and innovation: Evidence from patent collateral. *Journal of Financial Economics*, 130(1), 25-47. link.
- Morton, F. M. S., & Shapiro, C. (2013). Strategic patent acquisitions. *Antitrust LJ*, 79, 463. link
- Torrisi, S., Gambardella, A., Giuri, P., Harhoff, D., Hoisl, K., & Mariani, M. (2016). Used, blocking and sleeping patents: Empirical evidence from a large-scale inventor survey. *Research policy*, 45(7), 1374-1385. link

The economics of intellectual property (IP) /3 (VS)

- Chien, C. V. (2008). Of trolls, Davids, Goliaths, and kings: Narratives and evidence in the litigation of high-tech patents. *NCL Rev.*, 87, 1571. link
- Cotter, T. F. (2019). On the Economics of Injunctions in Patent Cases. link
- Chen, F., Hou, Y., Qiu, J., & Richardson, G. (2023). Chilling effects of patent trolls. *Research Policy*, 52(3), 104702. link.
- Galasso, A., & Schankerman, M. (2015). Patents and cumulative innovation: Causal evidence from the courts. *The Quarterly Journal of Economics*, 130(1), 317-369.150. link
- Menell, P. S., & Meurer, M. J. (2013). Notice failure and notice externalities. *Journal of Legal Analysis*, 5(1), 1-59. link

- Osborn, L. S., Pearce, J. M., & Haselhuhn, A. (2015). A case for weakening patent rights. . *John's L. Rev.*, 89, 1185. link.
- Sterzi, V. (2021). Patent assertion entities and patent ownership transparency: strategic recording of patent transactions at the USPTO. *Journal of Competition Law & Economics*, 17(4), 978-1006. link
- Sterzi, V., Rameshkoumar, J. P., & Van Der Pol, J. (2021). Non-practicing entities and transparency of patent ownership in Europe: the case of UK dormant companies. *Technological Forecasting and Social Change*, 172, 121069. link

The economics of science /2 (FL)

- Breschi, S., & Catalini, C. (2010). Tracing the links between science and technology: An exploratory analysis of scientists' and inventors' networks. *Research Policy, 39*(1), 14-26 link
- Breschi, S., Lissoni, F., & Montobbio, F. (2007). The scientific productivity of academic inventors: new evidence from Italian data. *Econ. Innov. New Techn., 16*(2), 101-118 link
- Dasgupta P., & David, P.A. (1994). Toward a new economics of science. *Research policy, 23*(5), 487-521
- Heller, M. A., & Eisenberg, R. S. (1998). Can patents deter innovation? The anticommons in biomedical research. *Science, 280*(5364), 698-701 link
- Hvide, H. K., & Jones, B. F. (2018). University innovation and the professor's privilege. *American Economic Review, 108*(7), 1860-1898. link
- Lissoni, F., Llerena, P., McKelvey, M., & Sanditov, B. (2008). Academic patenting in Europe: new evidence from the KEINS database. *Research Evaluation, 17*(2), 87-102. link
- Mowery, D. C., & Sampat, B. N. (2001). Patenting and licensing university inventions: lessons from the history of the Research Corporation. *Industrial and Corporate Change, 10*(2), 317-355.
- Mowery, D. C., Nelson, R. R., Sampat, B. N., & Ziedonis, A. A. (2001). The growth of patenting and licensing by US universities: an assessment of the effects of the Bayh–Dole act of 1980. *Research policy, 30*(1), 99-119
- Murray, F., & Stern, S. (2006). When ideas are not free: The impact of patents on scientific research. *Innovation policy and the economy, 7*, 33-69. link
- Murray, F., & Stern, S. (2007). Do formal intellectual property rights hinder the free flow of scientific knowledge?: An empirical test of the anti-commons hypothesis. *Journal of Economic Behavior & Organization, 63*(4), 648-687 link
- Williams, H. L. (2013). Intellectual property rights and innovation: Evidence from the human genome. *Journal of Political Economy, 121*(1), 1-27 link

Economics of science /3 (FL)

- Ahmadpoor, M., & Jones, B. F. (2017). The dual frontier: Patented inventions and prior scientific advance. *Science, 357*(6351), 583-587
- Arora, A., Belenzon, S., & Patacconi, A. (2018). The decline of science in corporate R&D. *Strategic Management Journal, 39*(1), 3-32

- Arora, A., Belenzon, S., & Sheer, L. (2021). Knowledge spillovers and corporate investment in scientific research. *American Economic Review, 111*(3), 871-98 link
- Azoulay, P., Graff Zivin, J. S., & Wang, J. (2010). Superstar extinction. *The Quarterly Journal of Economics, 125*(2), 549-589
- Della Malva, A., & Hussinger, K. (2012). Corporate science in the patent system: An analysis of the semiconductor technology. *Journal of Economic Behavior & Organization, 84*(1), 118-135 link
- Boudreau, K. J., Brady, T., Ganguli, I., Gaule, P., Guinan, E., Hollenberg, A., & Lakhani, K. R. (2017). A field experiment on search costs and the formation of scientific collaborations. *Review of Economics and Statistics, 99*(4), 565-576 link
- Hicks, D. (1995). Published papers, tacit competencies and corporate management of the public/private character of knowledge. *Industrial and corporate change, 4*(2), 401-424 link
- Jones, B. F. (2009). The burden of knowledge and the "death of the renaissance man": Is innovation getting harder?. *The Review of Economic Studies, 76*(1), 283-317 link
- Jones, B. F., Wuchty, S., & Uzzi, B. (2008). Multi-university research teams: Shifting impact, geography, and stratification in science. *science, 322*(5905), 1259-1262 link
- Lissoni, F., Montobbio, F., & Zirulia, L. (2013). Inventorship and authorship as attribution rights: An enquiry into the economics of scientific credit. *Journal of Economic Behavior & Organization, 95*, 49-69 link
- Ma, Y., Mukherjee, S., & Uzzi, B. (2020). Mentorship and protégé success in STEM fields. *Proceedings of the National Academy of Sciences, 117*(25), 14077-14083 link
- Oettl, A. (2012). Reconceptualizing stars: Scientist helpfulness and peer performance *Management Science, 58*(6), 1122-1140 link
- Simeth, M., & Cincera, M. (2016). Corporate science, innovation, and firm value. *Management Science, 62*(7), 1970-1981 link
- Waldinger, F. (2012). Peer effects in science: Evidence from the dismissal of scientists in Nazi Germany. *The review of economic studies, 79*(2), 838-861.
- Wuchty, S., Jones, B. F., & Uzzi, B. (2007). The increasing dominance of teams in production of knowledge. *Science, 316*(5827), 1036-1039 link

Geography of knowledge (FL)

- Agrawal, A., Cockburn, I., & McHale, J. (2006). Gone but not forgotten: knowledge flows, labor mobility, and enduring social relationships. *Journal of Economic Geography, 6*(5), 571-591 link
- Agrawal, A., Kapur, D., McHale, J., & Oettl, A. (2011). Brain drain or brain bank? The impact of skilled emigration on poor-country innovation. *Journal of Urban Economics, 69*(1), 43-55 link
- Almeida, P., & Kogut, B. (1999). Localization of knowledge and the mobility of engineers in regional networks. *Management science, 45*(7), 905-917 link
- Berkes, E., & Gaetani, R. (2021). The geography of unconventional innovation. *The Economic Journal, 131*(636), 1466-1514 link
- Borjas, G. J., & Doran, K. B. (2012). The collapse of the Soviet Union and the productivity of American mathematicians. *The Quarterly Journal of Economics, 127*(3), 1143-1203 link
- Borjas, G. J., & Doran, K. B. (2015). Which peers matter? The relative impacts of collaborators, colleagues, and competitors. *Review of economics and statistics, 97*(5), 1104-1117 link

- Breschi, S., & Lissoni, F. (2009). Mobility of skilled workers and co-invention networks: an anatomy of localized knowledge flows. *Journal of economic geography, 9*(4), 439-468 link
- Henderson, R., Jaffe, A., & Trajtenberg, M. (2005). Patent citations and the geography of knowledge spillovers: A reassessment: Comment. *American Economic Review, 95*(1), 461-464 link
- Jaffe, A. B., & De Rassenfosse, G. (2019). Patent citation data in social science research: Overview and best practices. *Research handbook on the economics of intellectual property law*, 20-46 link
- Jaffe, A. B., Trajtenberg, M., & Henderson, R. (1993). Geographic localization of knowledge spillovers as evidenced by patent citations. *the Quarterly journal of Economics, 108*(3), 577-598 link
- Kerr, W. R. (2008). Ethnic scientific communities and international technology diffusion. *The Review of Economics and Statistics, 90*(3), 518-537 link
- Marx, M., Strumsky, D., & Fleming, L. (2009). Mobility, skills, and the Michigan non-compete experiment. *Management science, 55*(6), 875-889 link
- Miguelez, E. (2018). Inventor diasporas and the internationalization of technology. *The World Bank Economic Review, 32*(1), 41-63 link
- Miguelez, E., & Fink, C. (2013). *Measuring the international mobility of inventors: A new database* (Vol. 8). WIPO link
- Moretti, E. (2021). The effect of high-tech clusters on the productivity of top inventors. *American Economic Review, 111*(10), 3328-3375 link
- Moser, P., Voena, A., & Waldinger, F. (2014). German Jewish émigrés and US invention. *American Economic Review, 104*(10), 3222-3255 link
- Thompson, P., & Fox-Kean, M. (2005). Patent citations and the geography of knowledge spillovers: A reassessment. *American Economic Review, 95*(1), 450-460 link