



Advanced Topics in the Economics of Technical Change

Master of Science in Innovation Management – MAIN
Academic year 2023/24

1. General information on the course

Name of the course	Advanced Topics in the Economics of Technical Change
Degrees	Master (“Laurea Magistrale”) in Innovation Management – <i>MAIN</i>
Type	Compulsory
Cycle/Year/Semester	2 nd Year; 1 st Semester
Class hours	36h (6 ECTS)
Language of the course	English
Department	Institute of Management (IoM)
Lecturer	Prof. Andrea Mina Institute of Economics, Piazza Martiri della Libertà 33, 56127 Pisa, IT e-mail: andrea.mina@santannapia.it
Time and place of lectures	See MAIN detailed timetable
Office hours	By appointment with the Course Convenor

2. Content of the course, objectives and list of topics

2.1 Contents

The course focuses on the economic treatment of technical change. It broadens and deepens the analysis of science, technology and their economic applications by selecting topical problems of relevance for modern businesses, academia and policy.

2.2 Objectives

The course will equip the students with theoretical frameworks and analytical tools that are necessary to inform strategic decisions on the funding, management and governance of innovation. The students will learn how to apply first principles to key societal challenges (e.g. technology and unemployment; the environment and health) whose origins or possible solutions involve technological change.

2.3 List of topics

- A. Foundations (the Economics of Knowledge Revisited)
- B. Economic growth and the research base
- C. Innovation and firm growth

- D. The economics of standards; General purpose technologies
 - E. Agglomeration economies and high-tech clusters
 - F. Funding gaps and innovation intermediaries
 - G. Networks and innovation
 - H. Skills, employment and technology
 - I. Green innovation
 - J. Medical innovation
 - K. Industry 4.0 and New Digital Technologies
3. Prerequisites
The course builds on the mandatory components of Year I and there are no additional requirements that may constrain access to/absorption of the materials.
 4. Teaching method
The course will be delivered in 12 three-hour long sessions involving formal lectures, discussion, case presentations, and questions. The lectures slides will be made available through the dedicated online platform.
 5. Evaluation method
40% report; 60% written exam.
 6. Bibliographic references

GENERAL READINGS

- Dodgson, M., Gann, D. M., Phillips, N., (Eds.) 2014, *The Oxford Handbook of Innovation Management*, Oxford University Press, Oxford and New York.
- Dosi, G. 1988, Sources, Procedures, and Microeconomic Effects on Innovation, *Journal of Economic Literature* 26(3): 1120-11.
- Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds.), 2005, *The Oxford Handbook of Innovation*, Oxford University Press, Oxford and New York.
- Hall, B.H., Rosenberg, N. (Eds.) *Handbook of the Economics of Innovation*, Volumes 1 and 2, 2010, North-Holland/Elsevier, Amsterdam (NL) and Oxford (UK).
- Malerba, F. Brusoni, S. (Eds.), 2007, *Perspectives on Innovation*, Cambridge University Press, Cambridge (UK).
- Stoneman, P. (Ed.) *Handbook of the Economics of Innovation and Technical Change*, 1995, Blackwell, Oxford (UK) and Cambridge (MA).

INTEGRATIVE READINGS

A – Introduction and Foundations*

- Dasgupta, P. and David, P.A. 1994, Toward a New Economics of Science. *Research Policy* 23(5): 487-521
- Salter, A. and Martin, B. 2001, The economic benefits of publicly funded basic research: a critical review, *Research Policy* 30: 509-532.
- Stephan, P.E. 2010, The Economics of Science, in Hall, B.H., Rosenberg, N. (Eds.) *Handbook of the Economics of Innovation*, Vol. 1, pp. 217-273.
- Stokes, D. 1997, *Pasteur's Quadrant: Basic Science and Technological Innovation*. Brookings Institution Press, Washington DC.

B – Economic growth and the research base

- Etzkowitz, H. (et al.) 2000. The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm. *Research Policy* 29(2): 313-330.
- Fagerberg, J. and Srholec, M. 2008. National Innovation systems, capabilities and economic development, *Research Policy* 37: 1417-1435.
- Freeman, C. 2002, Continental, national and sub-national innovation systems: complementarity and economic growth, *Research Policy* 31 (2): 185-302.
- Furman, J.L., Porter, M.E. and Stern, S. 2002 The Determinants of National Innovative Capacity. *Research Policy*, 31(6): pp. 899-933.
- Perkmann, M. (et al.) 2012, Academic Engagement and Commercialisation: A Review of the Literature on University-Industry Relations. *Research Policy*, 42(2): 423-442.

C – Innovation and firm growth

- Coad, A. (et al.) 2014, Innovative Firms and Growth, Department of Business, Innovation and Skills UK, available at:
<https://ore.exeter.ac.uk/repository/bitstream/handle/10871/15163/bis-14-643-uk-innovation-survey-highly-innovative-firms-and-growth.pdf?sequence=2&isAllowed=y>
- Cohen, W. 2010, Fifty Years of Empirical Studies of Innovative Activity and Performance, in Hall, B.H. and Rosenberg, N. (Eds): *Handbook of the Economics of Innovation*, pp.129-213.
- Teece, D.J. 1986, Profiting from technological innovation, *Research Policy* 15(6): 285–305.
- Hall, B.H. and Harhoff, D. 2012, Recent Research on the Economics of Patents, *NBER Working Paper* No. 17773
- Scherer, F.M. and Harhoff, D. 2000, Technology Policy for a World of Skew-Distributed Outcomes, *Research Policy* 29 (4-5): 599-566.

D – The economics of standards; General purpose technologies

- Bresnahan, T.F., and Trajtenberg, M. 1995, General Purpose Technologies ‘Engines of Growth’? *Journal of Econometrics* 65: 83-108.
- David, P.A. 1985, Clio and the Economics of QWERTY, *American Economic Review*, 75, 332-336.
- David, P.A., and Greenstein, S. 1990, The economics of compatibility standards: an introduction to recent research, *Economics of Innovation and New Technologies* 1: 3-41.
- Helpman, E. (ed.) 1998, *General Purpose Technologies and Economic Growth*, Cambridge, MA: The MIT Press.
- Maine, E., and Garnsey, E., 2006, Commercializing generic technology: The case of advanced materials ventures. *Research Policy*, 35(3): 375-393.
- Shane, S. 2004, *Academic Entrepreneurship: University Spinoffs and Wealth Creation*. New Horizons in Entrepreneurship series. Cheltenham: Edward Elgar.
- Swann, P.G.M. 2010, The economics of standardization, *Report for the UK Department of Business, Innovation and Skills (BIS)*.

E – Agglomeration economies and high-tech clusters

- Beaudry, C., and Breschi, S. 2003, Are firms in clusters really more innovative? *Economics of Innovation and New Technology* 12 (4), 325-342.
- Cooke, P. 2001, Regional innovation systems, clusters, and the knowledge economy. *Industrial and Corporate Change*, 10: 945–974.
- Feldman, M. 1999, The new economics of innovation, spillovers and agglomeration: a review of empirical studies. *Economics of Innovation and New Technology*, 8: 5–25.
- Krugman, P. 1991, *Geography and Trade*, Cambridge, MA: MIT Press.
- Myint, Y., Vyakarnam, S. New, M.J. 2005, The effect of social capital in new venture creation: The Cambridge high-technology cluster, *Strategic Change* 14(3): 165-177.
- Porter, M.E. 1998, Clusters and the new economics of competition, *Harvard Business Review* 76 (6): 77-90.
- Porter, M.E. 2003, The economic performance of regions, *Regional Studies* 37 (6-7): 549-578.
- Probert, J., Connell, D., Mina, A. 2013, R&D service firms: The hidden engine of the high-tech economy? *Research Policy* 42(6): 1274-1285.
- Saxenian, A. 1994, *Regional Advantage*. Cambridge MA: Harvard University Press.

F – Funding gaps and innovation intermediaries

- Berger, A.N. and Udell, G.F. 1998, The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking & Finance* 22 (6): 613-673.
- Cosh, A., Cumming, D. and Hughes, A. 2009, Outside Entrepreneurial Capital, *Economic Journal* 119 (540): 1494-1533.
- Kortum, S., Lerner, J. 2000, Assessing the contribution of venture capital to innovation, *RAND Journal of Economics* 31 (4): 674–692.
- Hall, B.H. 2010, The Financing of Innovative Firms, *Review of Economics and Institutions* 1(1): 1-30.
- Howells, J. 2006. Intermediation and the role of intermediaries in innovation. *Research Policy* 35: 715–728.
- Siegel, D., Veugelers, R., and M. Wright 2007. University commercialization of intellectual, property: policy implications. *Oxford Review of Economic Policy* 23 (4): 640–660
- Beaudry, C., Breschi, S. 2003, Are firms in clusters really more innovative? *Economics of Innovation and New Technology* 12 (4): 325-342.

G – Networks and innovation

- Jackson, M.O. 2005, The Economics of Social Networks, in *Proceedings of the 9th World Congress of the Econometric Society*, Cambridge University Press.
<https://web.stanford.edu/~jacksonm/netect.pdf>
- Barabási, A.L. 2002. *Linked: The New Science of Networks*. Perseus Books Group.
- Powell, W.W., Grodal, S., 2005, Networks of Innovators, in Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds.) *The Oxford Handbook of Innovation*, Oxford University Press, Oxford and New York, pp. 56-85.

- Ahuja, G. 2000, The Duality of Collaboration: Inducements and Opportunities in the Formation of Interfirm Linkages, *Strategic Management Journal* 21(3): 17-343.
- Ahuja, G. 2000, Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study. *Administrative Science Quarterly* 45: 3: 425-455

H – Skills, employment and technology

- Acemoglu, D., and Restrepo, P. 2016, The Race Between Machine and Man: Implications of Technology for Growth, Factor Shares and Employment, *NBER Working Paper* 22252.
- Acemoglu, D. and Autor, D. 2011, Skills, tasks and technologies: Implications for employment and earnings, *Handbook of Labor Economics*, 4: 1043–1171.
- Calvino, F., Virgillito, M.E. 2016, The Innovation-Employment nexus: a critical survey of theory and empirics, *LEM Working Paper* 2016/10 March 2016, ISSN 2284-0400.
- Frey, C.B. Osborne, M.A. 2013, *The Future of Employment: How Susceptible are Jobs to Computerisation?*, Oxford Martin School, http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf.
- Pianta, M. 2005, Innovation and Employment. In J. Fagerberg, D. Mowery and R.R.Nelson (eds), *Oxford Handbook of Innovation*. Oxford: Oxford University Press.
- Tether, B., Mina, A., Consoli, D., Gagliardi, D. 2005, A literature review on skills and innovation: How does successful innovation impact on the demand for skills and how do skills drive innovation?, *Report for the Department of Trade and Industry (UK)*, London.
- Vivarelli, M. 2012, Innovation, Employment and Skills in Advanced and Developing Countries: A Survey of the Literature, *IZA Discussion Paper N. 6291*.

I – Green innovation

- Ghosh, S. and Nanda, R. 2010, Venture Capital Investment in the Clean Energy Sector. *Harvard Business School Working Paper* 11-020.
- Horbach, J. 2008, Determinants of environmental innovation: new evidence from German panel data sources. *Research Policy* 37: 163–173.
- Kesidou, E., Demirel, P. 2012, On the drivers of eco-innovations: Empirical evidence from the UK, *Research Policy* 41: 862– 870
- Klewitz, J., Hansen, E.G. 2014, Sustainability-oriented innovation of SMEs: a systematic review, *Journal of Cleaner Production* 65: 57–75
- OECD (2011) *Fostering Innovation for Green Growth*, OECD Green Growth Studies, OECD Publishing.
- Popp, D. 2006, International innovation and diffusion of air pollution control technologies: the effect if NO_x and SO₂ regulation in the US, Japan and Germany. *Journal of Environmental Economics and Management* 51: 46–71.
- Stern, N. 2006, *Stern Review: The Economics of Climate Change*. Office of Climate Change, UK.

J – Medical Innovation

- Blume, S. 1992, *Insight and Industry: On the Dynamics of Technological Change in Medicine*. MIT Press: Cambridge (MA).

- Consoli, D., Mina, A. 2009, An evolutionary perspective on health innovation systems, *Journal of Evolutionary Economics* 19(2): 297-319.
- Costa-i-Font, J., Courbage, C. and McGuire, A. (eds) 2009, *The economics of new health technologies*, Oxford University Press: Oxford, UK.
- Gelijns, A.C. and N. Rosenberg 1994, The Dynamics of Technological Change in Medicine, *Health Affairs* 13(3): 28-46.
- Mina, A., Ramlogan, R., Tampubolon, G. and Metcalfe, J. S. 2007, Mapping Evolutionary Trajectories: Applications to the Growth and Transformation of Medical Knowledge, *Research Policy* 36(5): 789-806.

K – Industry 4.0 and New Digital Technologies

- Acemoglu, D. and P. Restrepo (2017), ‘Robots and jobs: evidence from US labor markets,’ *NBER Working Paper* No. 23285.
- Brynjolfsson, E., Smith, M.D. 2000, Frictionless Commerce? A Comparison of Internet and Conventional Retailers, *Management Science* 46(4): 563-585.
- Corrado, C., van Ark, B. 2016, The Internet and productivity, in J.M Bauer and M. Latzer (eds.) *Handbook on the economics of the Internet*, Cheltenham (UK), 120-45.
- Frey, C. B. and M. A. Osborne (2017), ‘The future of employment: how susceptible are jobs to computerisation?,’ *Technological Forecasting and Social Change*, 114, 254–280.
- Greenstein, S. 2015, *How the Internet Became Commercial. Innovation, Privatization, and the Birth of a New Network*, Princeton, NJ: Princeton University Press.
- Kagermann, H., W. Wahlster and J. Helbig (2013), ‘Securing the Future of German Manufacturing Industry: Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0,’ Final Report of the Industrie 4.0 Working Group <http://alvarestech.com/temp/tcn/CyberPhysicalSystems-Industrial4-0.pdf>.
- Levin, J.D. 2011, The economics of internet markets, *NBER Working Paper* n. 16852, <http://www.nber.org/papers/w16852>.
- Martinelli, A., Mina, A. Moggi, M. 2021. ‘The enabling technologies of Industry 4.0: Examining the seeds of the Fourth Industrial Revolution’, *Industrial and Corporate Change*, 30(1): 161–188.

* *The order of the sessions is indicative only and can be subject to change.*