The impact of technology transfer on firms' performance

Diego Comin

Dartmouth College

Motivation

Most companies do not have the ability to develop the technologies they use. They acquire most of the generic technologies in the market. But the market typically does not provide solutions for technologies that satisfy a company-specific need.

One way to overcome the absence of markets for specific technological solutions is to seek the help of universities and research institutes. Such connections may allow companies to leverage on the expertise of other institutions to obtain critical specific technologies.

To this date, little is known about the prevalence and impact of these technology transfer practices. This lack of understanding is in part due to the secrecy of the contracts signed by research institutions and companies.

This proposal intends to investigate the interactions between one of the largest research organizations in the world and the companies for which it engages in research contracts. This organization is the German public applied R&D organization Fraunhofer. Fraunhofer was created in 1949, and currently employs over 18,000 scientists and engineers that work in developing new applied technologies that should be ready to be brought to the market in 3-5 years. This research efforts yield approximately 500 patents per year. Beyond their R&D activities, Fraunhofer signs 8000 research contracts with companies every year to help companies develop and maintain new technologies taking advantage of Fraunhofer's knowledge and expertise.

Data

Fraunhofer' research contracts are confidential. For more than two years, I have tried to gain access to this unique data source with the goal of understanding the nature of the interactions and the impact that they have on the performance of German companies. Recently, Fraunhofer's Board of Directors has granted me access to study their research contracts. This is the first time in Fraunhofer's history that such a privilege is granted.

The exploration I intend to conduct has two goals. First, I'd like to understand better the nature of the interactions between Fraunhofer and German companies as well as what companies are

more likely to engage in research contracts with Fraunhofer. Second, I'd like to explore the impact that engaging in a research contract with Fraunhofer has on various dimensions of the companies' performance. To this end, I will merge the research contract dataset with the Mannheim Innovation Panel (MIP) which provides rich information on firms' innovation behavior such as the introduction of product and process innovation, innovation expenditure, R&D engagement, share of sales with new products, as well as on standard measures of firm performance such as sales, employment, and profits.

Empirical design

Two critical problems to explore the effect of Fraunhofer's interaction on the firm performance are selection and omitted variable bias. I will use two distinct empirical strategies to mitigate the potential biases that result from these identification problems.

1. The first approach uses a matching algorithm to randomly pair each treated company with one that before the treatment is similar to the treated one in terms of all observable variables. Then, the impact of interacting with Fraunhofer is estimated by the diff-in-diffs estimate on the performance measures. This approach takes care of constant unobserved heterogeneity at the firm level and of all heterogeneity that is correlated with the observed characteristics. However, it may be affected by omitted variables that are time varying and unobserved.

2. The second approach exploits exogenous variation in the propensity to interact with Fraunhofer that originates in a discontinuity in the compensation scheme faced by Fraunhofer institutes. Specifically, Fraunhofer uses a non-linear scheme to compensate its institutes. When the revenues from research contract passes a threshold of 25% of the institute budget, the bonus the institute receives from research contracts changes from 10% of the value of the contract to 40%. This kink in the scheme induces institutes to supply additional technology services to companies when they are slightly below the 25% mark (relative to when they are above the threshold). This institutional feature of the design of the compensation scheme can be used to build an instrument for the supply of research services that should allow me to identify the causal effect of interacting with Fraunhofer on various performance measures of the companies, including their sales, employment, R&D expenditures, and sales from innovative products and services.

This study shall significantly contribute to our understanding of the nature and impact of technology transfer practices.

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DIEGO COMIN

Dartmouth College
Economics Department
6106 Rockefeller Hall, Room 327
Hanover, NH 03755
(603) 646-2531

EDUCATION

2000	Ph.D., Economics, Harvard University Dissertation: *An Uncertainty-Driven Theory of the Productivity Slowdown* Committee: Robert Barro (chair) Philippe Aghion Elhanan Helpman John Leahy
2000	M.A., Economics, Harvard University
1995	B.A., Economics, Universitat Pompeu Fabra (Barcelona, Spain)

Other Education, Summer School

1997	Santa Fe Institute
1996	European University Institute (EUI) Florence
1994	London School of Economics

ACADEMIC APPOINTMENTS

2014-	Professor of Economics, Dartmouth College
2007 - 2014	Associate Professor of Business Administration, Harvard Business School
2000 – 2007	Assistant Professor of Economics, New York University
2013/14	Visiting Professor, Harvard University, Economics Department
Fall 2012	Visiting Associate Professor, Sloan School of Management

PROFESSIONAL ACTIVITIES

2015-2016 Lead Academic Expert in DG Research and Innovation Study in Deloitte-Rand Consortium for the EU Commission

2014 - 2015 Co-Founder and Advisor of the Public-Private Research Network, PPRN Malaysia

2013 - 2015 Advisor, Prime Minister of Malaysia

2014 Consultant and Visiting Scholar, Bank of Japan

2011 - Research Fellow, Center for Economic Policy Research (CEPR)

2011 - 2014 Fellow, Weatherhead Center for International Affairs, Harvard University

2011- Expert Witness

2007-2008 Consultant, Finance Ministry of the Japanese Government (ESRI)

2004 - Faculty Research Fellow, National Bureau of Economic Research, Economic Fluctuations & Growth Group

2006 -2007 Consultant, The World Bank, Washington, DC

2004 -2005 Consultant, Federal Reserve Bank of New York, NY

2004 Consultant for Smith Barney/Citibank, New York, NY

AWARDS AND HONORS

2013 Speaker, "If Technology has Arrived Everywhere, Why Has Income Diverged?", World Economic Forum, New Champions Meeting, Dalian, China

2013 Keynote Speaker at V ZEW/MaCCI Conference on the Economics of innovation and Patenting

2013 Apgar Award for Innovation in Teaching for the *Malaysia IXP*

2011 Keynote Speaker at Future Challenges of Economic Research Conference on "R&D, Innovation and Growth." Danish Agency for Science, Technology and Innovation

2009 Keynote Speaker at Dynamics of Institutions and Markets/DIME European Network of Excellence on "The Dynamics of Firm Evolution: From Micro-patterns to Aggregate Behavior"

2009 Keynote speaker at Internationale Weiterbildung und Entwicklung gGmbH/InWEnt Conference on "Promoting Innovation"

1995 Premio Especial Extraordinario, Universitat Pompeu Fabra (Barcelona, Spain)

FELLOWSHIPS AND GRANTS

2013-2016 NSF Grant # SBE-1262249 (SciSIP), *Dynamics of Technology and Income*

2013-2015 Institute of New Economic Thinking Grant, *Innovation Systems: Positive and Normative Perspectives*

2012-13 SEEK Fellowship, *Why do Governments Fund Applied Research Institutions? Theory and Empirical Evidence from the German Fraunhofer Institutes*

2010-12 Institute of New Economic Thinking, Inaugural Grantee, *Drivers and Consequences of Technology Diffusion*

2009-2011 Gates Foundation Grant, *The Development of the Tourism Sector in Tanzania*

2007-2010 NSF Grant # SBE-738101 (SciSIP), *Innovation and Technology Implementation: Theory and Policy Implications* (Joint with Bart Hobijn)

2007 Berkley Center's Entrepreneurship and Innovation Kaufman Research Grant

2006 Berkley Center's Entrepreneurship and Innovation Kaufman Research Grant (Joint with Sydney Ludvigson)

2005-2007 NSF Grant # SES-0742957, *An Extensive Dataset on Historical Cross-Country Adoption* (Joint with Bart Hobijn)

2004 Goddard Fellowship

1995-2000 Real Colegio Complutense

1999 Dissertation Completion Fellowship, Harvard University

1995-1999 Bank of Spain Fellowship

RESEARCH

Journal Articles

(1) Aghion, Philippe, Diego Comin, Peter Howitt, and Isabel Tecu. "When Does Domestic Saving Matter for Economic Growth?" *IMF Economic Review*, (January, 2016).

(2) Comin, Diego, Norman Loayza, Farooq Pasha, and Luis Serven. "Medium Term Business Cycles in Developing Countries." *American Economic Journal: Macroeconomics* Vol. 6, no. 5 (October 2014): 209-45.

(3) Comin, Diego, and Bart Hobijn. "How Early Adoption Has Increased Wealth – Until Now." *Harvard Business Review* 90, no. 3 (March 2012): 34-35.

(4) Comin, Diego, and Bart Hobijn. "Technology Diffusion and Postwar Growth." *NBER Macroeconomics Annual* 25, no. 1 (2010), eds. Daron Acemoglu and Michael Woodford, The University of Chicago Press, pp. 209-246.

(5) Comin, Diego, and Bart Hobijn. "An Exploration of Technology Diffusion." The *American Economic Review* 100, no. 5 (December 2010): 2031-2059.

(6) Comin, Diego, William Easterly, and Erick Gong. "Was the Wealth of Nations Determined in

1000 B.C.?" *American Economic Journal: Macroeconomics* 2, no. 3 (2010): 65-97.

(7) Comin, Diego, and Sunil Mulani. "A Theory of Growth and Volatility at the Aggregate and Firm Level." *Journal of Monetary Economics* 56, no. 8 (November 2009): 1023-1042.

(8) Comin, Diego, and Bart Hobijn. "Lobbies and Technology Diffusion." *Review of Economics and Statistics* 91, no. 2 (May 2009): 229-244.

(9) Comin, Diego, Bart Hobijn, and Emilie Rovito. "Technology Usage Lags." *Journal of Economic Growth* 13, no. 4 (December 2008): 237-256.

(10) "On the Integration of Growth and Business Cycles." *Empirica* 36, no. 2 (May 2009): 165-176.

(11) Comin, Diego, Erica Groshen, and Bess Rabin. "Turbulent Firms, Turbulent Wages?" *Journal of Monetary Economics* 56, no.1 (January 2009): 109-133.

(12) Carbonell, Oriol, and Diego Comin. "Testing the Commitment Hypothesis in Contractual Settings: Evidence from Soccer." *Journal of Quantitative Analysis in Sports* 5, no. 4, article 1 (October 2009).

(13) Comin, Diego, Bart Hobijn, and Emilie Rovito, "A New Approach to Measuring Technology with An Application to the Shape of the Diffusion Curves." *Journal of Technology Transfer* 33, no. 2 (April 2008): 187-207.

(14) Comin, Diego, and Mark Gertler. "Medium-Term Business Cycles." The *American Economic Review* 96, no. 3 (June 2006): 523-551.

(15) Comin, Diego, and Sunil Mulani. "Diverging Trends in Aggregate and Firm Volatility." *Review of Economics & Statistics* 88, no. 2 (May 2006): 374-383.

(16) "Using Investment Data to Assess the Importance of Price Mismeasurement." *B.E. Journals of Macroeconomics: Topics in Macroeconomics* 6 no.1, Article 7 (April 2006): 1-44.

(17) Comin, Diego, and Thomas Philippon. "The Rise in Firm-Level Volatility: Causes and Consequences." *NBER Macroeconomics Annual* 20 (2005), eds. M. Gertler and K. Rogoff, The University of Chicago Press, pp. 167-201.

(18) "R&D: A Small Contribution to Productivity Growth." *Journal of Economic Growth* 9, no. 4 (December 2004): 391-421.

(19) Comin, Diego, and Bart Hobijn. "Cross-Country Technology Adoption: Making the Theories Face the Facts." *Journal of Monetary Economics* 51 (January 2004): 39-83.

(20) "Convergence in Health: Dream or Reality?" *Gaceta Sanitaria* 11, no. 1 (January-February 1997): 33-42.

Books

(1) "Malaysia Beyond 2020" UTM Press, 2014.

(2) "Drivers of Competitiveness" World Scientific Publishing, 2016.

Book Chapters

(1) "Technology Diffusion: Measurement, Causes and Consequences" in *Handbook of Economic Growth*, edited by Philippe Aghion and Steven Durlauf. Elsevier (2014), pp. 565-622.

(2) "An Exploration of the Japanese Slowdown during the 1990s" in *Japan's Bubble, Deflation, and Long-term Stagnation*, edited by Koichi Hamada, Anil Kashyap and David Weinstein, The MIT Press (2011).

Comments and Other Publications

(1) "Total Factor Productivity" in *The New Palgrave Dictionary of Economics*, Second Edition, eds. Steven N. Durlauf and Lawrence E. Blume, Palgrave Macmillan, New York (2008).

(2) "Discussion of M. Weitzman's Stochastic Income and Wealth." *Japan and the World Economy*, 16, no. 3 (August 2004): 303-305.

(3) "The Harrod-Domar Model" in *An Eponymous Dictionary of Economics*, eds. C.R. Braún and Julio Segura, Edward Elgar Publishing, Ltd, Cheltenham, UK (2004): 105.

(4) Comment to *Technology Adoption Costs and Productivity Growth: The 70s as a Technological Revolution* by James Bessen, *Review of Economic Dynamics* 5, no. 2 (April 2002): 470-476.

Working Papers

(1) Comin, Diego, Mark Gertler, and Ana Maria Santacreu. "Technology Innovation and Diffusion as Sources of Output and Asset Price Fluctuations." Harvard Business School Working Paper No. 09-134. Revise and resubmit at the *Journal of Political Economy*.

(2) Comin, Diego and Marti Mestieri. "If Technology Has Arrived Everywhere, Why Has Income Diverged?" mimeo. Revise and resubmit at the *American Economic Journal: Macroeocnomics*

(3) Comin, Diego, Danial Lashkari, and Marti Mestieri. "Structural Change with Long-Run Income and Price Effects". Revise and resubmit *Econometrica*

(4) Comin, Diego, and Bart Hobijn. "Implementing Technology." NBER Working Paper No. 12886 (February 2007). Revise and resubmit at the *Journal of Economic Theory*.

(5) Anzoategui, Diego, Diego Comin, Mark Gertler and Joseba Martinez. "Endogenous R&D and Technology Adoption as Sources of Business Cycle Persistence" mimeo (2015).

(6) Comin, Diego, Mikhail Dmitriev, and, Estaban Rossi-Hansberg. "The Spatial Diffusion of Technology." (November 2012).

(7) Comin, Diego and Johannes Rode (2013). "From Green Users to Green Voters" mimeo (May 2013)

Dataset

(1) Comin, Diego, and Bart Hobijn. "The CHAT Dataset." NBER Working Paper No. 15319 (August 2009).

Case Study Materials

(1) Comin, Diego, Diana Dimitrova, and Yukiko Tsukamoto. "CoET: Innovation in Africa." Harvard Business School case 713-021 (2012) 14 pp.

(2) Comin, Diego, Rohan Gopaldas, and Diego Rehder. "Inkaterra." Harvard Business School case 713-022 (2012) 23 pp.

(3) Comin, Diego A., Mohamed Heikal, and Adam Said. "Egypt: Turbulence, and Transition?" Harvard Business School case 713-014 (2012) 26 pp.

(4) Comin, Diego A., Maurice Kuykendoll, and Maurice Williams. "Malaysia: Standing on a Single Leaf." Harvard Business School case 713-007 (2012) 16 pp.

(5) "Malaysia IXP." Harvard Business School teaching note 712-041 (March 2012) 19 pp.

(6) "Drivers of Productivity and Global Competitiveness." Harvard Business School module note 712-037 (February 2012; Rev: 2012) 29 pp.

(7) Comin, Diego, and Richard H.K. Vietor. "South Africa (A) Stuck in the Middle?" Harvard Business School case 711-084 (April 2011: Rev: 2011) 28 pp.

(8) Comin, Diego, and Richard H.K. Vietor. "South Africa (B) Getting Unstuck?" Harvard Business School case 711-085 (April 2011) 4 pp.

(9) Comin, Diego, J. Gunnar Trumbull, and Kerry Yang. "Fraunhofer: Innovation in Germany." Harvard Business School case 711-022 (March 2011; Rev: 2012) 34 pp.

(10) Comin, Diego, and J. Gunnar Trumbull. "Fraunhofer: Five Significant Innovations." Harvard Business School note 711-058 (March 2011; Rev: 2012) 18 pp.

(11) Comin, Diego, and J. Gunnar Trumbull. "Fraunhofer: Innovation in Germany." Harvard Business School teaching note 711-063 (2011; Rev: 2012) 32 pp.

(12) "Business Cycles and the New Challenges of Globalization." Harvard Business School module note 711-064 (2011) 14 pp.

(13) "Peru IXP." Harvard Business School teaching note 711-027 (September 2010) 18 pp.

(14) Comin, Diego, and Richard H.K. Vietor. "China "Unbalanced." Harvard Business School case 711-010 (July 2010; Rev: 2012) 27 pp.

(15) Comin, Diego, and Richard H.K. Vietor. "China Unbalanced." Harvard Business School teaching note 711-028 (September 2010; Rev: 2012) 32 pp.

(16) Abraham, John, and Diego Comin. "Malaysia: People First?" Harvard Business School case 710-033 (April 2010; Rev: 2011) 34 pp.

(17) "Malaysia: People First?" Harvard Business School teaching note 711-035 (2010) 23 pp.

(18) Comin, Diego, Dante Roscini, and Elisa Farri. "Central Europe after the Crash: Between Europe and the Euro." Harvard Business School note 710-047 (April 2010) 19 pp.

(19) Comin, Diego, and Richard H.K. Vietor. "China: Getting Richer Still." Harvard Business School case 710-050 (2010) 12 pp.

(20) "Spain: Can the House Resist the Storm?" Harvard Business School case 709-021 (January 2009; Rev: 2012) 35 pp.

(21) "Spain: Can the House Resist the Storm? (TN)." Harvard Business School teaching note 710-026 (October 2009: Rev: 2012) 28 pp.

(22) "The Great Moderation, Dead or Alive?" Harvard Business School note 709-023 (January 2009; Rev: 2011) 16 pp.

PRESENTATIONS [Numbers indicate number of presentations at each institution]

Harvard University [10], Northwestern, Cornell, Columbia [2], Brown [2], Yale, Penn State, University of Pennsylvania, London Business School, Ohio State, Arizona State University, Duke, Maryland, University of

Rochester [2], University of Houston , Rice University, UCLA, NYU [6], Boston College [3], UC-San Diego, Buffalo, University of Toronto, Rotman school of Management, University of Tokyo, Madison-Wisconsin, Catholic University of Lisbon, Portugal, Universitat Pompeu Fabra/UPF Spain [2], Institute for International Economic Studies/IIES Stockholm, Universitat Autònoma de Barcelona/UAB, Harvard Business School [3], Stanford Business School, Chicago Graduate School of Business, Stern School of Business [7], Wharton, INSEAD [2], Università Bocconi, University of Milano-Bicocca, Centre for European Economic Research/ZEW [2], Economic Fluctuations & Growth/ EFG Meeting [2], National Bureau of Economic Research/NBER [13], Society for Economic Dynamics/SED [3], NY FED [5], Boston FED, San Francisco FED [2], Richmond FED [2], Midwestern Macro Conference at Chicago FED, Instituto Tecnológico Autónomo de México/ITAM-BBVA Conference [2], Paris School of Economics [2], EUI [2], International Monetary Fund/IMF, American Economic Association/AEA Meetings [4], The World Bank [3], World Bank Conference in Innovation Policy at UPF Spain, Bank of Spain, Bank of Portugal, Swiss National Bank/SNB Research Conference, CREI-WB Conference on Macroeconomic Volatility, Minnesota Macro Workshop [2], Iowa Conference on IO, ECB/IMOP Workshop at Hydra, Greece, Chaire en Economie et Management de l'Innovation/CEMFI, Center for Economic and Policy Research/CEPR Business Cycles Group, CEPR Conference on Growth and Institutions at INSEAD France, European Summer Symposium in International Macroeconomics/ESSIM /CEPR [4], Einaudi Institute for Economics and Finance/EIEF [2], World Bank [4], IMF [2], Board of Governors [2], Future Challenges of Economic Research Conference in Copenhagen.

Referee All major economic journals

Thesis Advisor and Examiner:

Marti Mestieri, PhD 2011 (Toulouse School of Economics)
Ana Maria Santacreu, PhD 2009 (INSEAD)
Marc Siscart, PhD 2004 (Queen's University)
Parama Chaudurhi, PhD 2003 (Dartmouth College)
Oriol Carbonell, PhD 2002 (Rutgers University)
Helios Herrera, PhD 2002 (Instituto Tecnológico Autónomo de México/ITAM)
Hyunbae Chun, PhD 2001 (Queens College)