University-Industry Interaction and Scientific Productivity: Evidence from China

Yanzhao Lai[1] and Nicholas Vonortas[2]

Research Objective

Over the last decades, university–industry relations have attracted a lot of attention for promoting the "Third Mission" of universities by fostering links with knowledge users and facilitating technology transfer (Bercovitz, and Feldman, 2008; Jenson et al., 2010; Aguiar-Diaz et al., 2015). There is, however, widespread concern that heavy involvement with firms or entrepreneurial activities may "corrupt" the academic research agenda, distracting attention from the fundamental research, and concentrating it on the application-oriented needs of the industry. *This project* addresses the long-standing question of the effect of university-industry proximity on academic output and performance *by utilizing a unique dataset which covers four types of university-industry (UI) interactions (contract research, licensing, trade secrets and university spin-off) of 61 Chinese research-intensive universities from 2009 to 2015, focusing how different types UI interactions impact on academic research output.*

This project contributes to the extant literature in two ways. First, we will deploy a qualitative and quantitative research approach to understand the effects of industry involvement in different circumstances (e.g. contract research, licensing and spin-off), considering the effects of industry engagement on academic publishing. Second, previous studies have mostly focused on OECD countries, whereas emerging economies like China – the focus of this paper – India or Brazil have been less studied. To the best of our knowledge, only Zhang and Wang (2017) have used individual data and Cheng et al. (2018) have used province data to study relationship between UI interaction and research output in China. This project aims to fill this gap by offering empirical evidence about Chinese university-industry interaction and research output at institutional level.

Theoretical Background and Hypothesis

The relationship between university–industry linkage and the academic research output and performance has been controversial. On the one hand, studies have shown that the number of university–industry relations has a positive effect on researchers' productivity (Perkmann et al., 2013; Banal-Estanol et al., 2015; Muscio et al., 2017; Tseng et al., 2018), since it can enable researchers to actively seek ideas and resources from industry and shape their research agendas accordingly. On the other, closer relationship with the industry can generate time pressure, thereby reducing the ability to concentrate on academically relevant outputs (Calderini et al., 2007). As several authors have pointed out, university–industry interactions embrace a much broader spectrum of activities than commercialization of intellectual property.

Production of scientific research involves multiple inputs, including **knowledge, time** and **resources** (Griliches, 1979). Other **constraints** in university-industry interactions such as information confidentiality proposed by companies will also affect the dissemination of research results and have impact on university scientific productivity (Stephan, 2012). This project is premised on the idea that university-industry interactions affect the four main determinants of university scientific output (Stephan, 1996; Lee, 2000; Banal-Estanol et al., 2015).

Accordingly, we hypothesize:

[1] Department of Economics, The George Washington University, USA; yzlai@gwmail.gwu.edu
[2] Institute of International Science and Technology Policy & Department of Economics, The George Washington University, USA; São Paulo Excellence Chair, University of Campinas, Brazil; Leading Research Fellow, National Research University Higher School of Economics, Russian Federation; vonortas@gwu.edu

1) Contract research commissioned by industry have an inverted U-shaped effect on research output;
2) Licensing has a positive effect on research output;
3) Trade secrets have a negative effect on research output;
4) university spin-offs have a negative effect on research output.

Empirical Context and Data

Before the reform of the higher education system in 1984, there was very little technology transfer in Chinese universities (Chen and Kenney, 2007). As part of the transition to market economy, the Chinese government implemented a series of policies aimed at encouraging research collaboration between university and industry and technology transfer (Chen at al., 2016). The developing closer relationship between university and industry and the growth of university commercialization give us a great opportunity to investigate how university-industry interactions affect academic research output. Three major datasets will be utilized to construct the dataset:

- Higher Education Statistical Survey (HESS): The surveys conducted by Ministry of Education contains the R&D information about public universities in China. The information includes university publications, number of technology transfer contracts, funding resources, revenue from patent licensing and other 23 indicators relevant to university R&D
- Web of Science (WoS): WoS database for university annually publications and citations
- University-run Enterprise Statistical Survey: The surveys conducted by Ministry of Education contains operating and finance information about Chinese university-run enterprise.

Expected Results and Policy Implication

Preliminary empirical results seem to go in the direction of the four hypotheses listed above. In particular, contract research and technology transfer (e.g. licensing, trade secrets) have different impact on university scientific productivity. Contract research commissioned by industry have an inverted U-shaped effect on research output; and licensing has positive effect on research but trade secrets has negative effect on research output. Support from NBER will allow us to acquire additional data of university-run enterprise in China which leads to deeper investigation about the impact of university spin-off on university scientific productivity.

The theoretical framework and the empirical results of this research shed light on policy making at the institutional level to build an entrepreneurial university with less “corruption” of the academic research agenda. To create an institutional environment that attracts industry resources, interaction with industry not only promotes university absorptive capacity and facilitates scientific production, but also allows easier access to more resource which enhance the research production. Maintaining a balanced relationship with industry is, however, also necessary for a sustainable entrepreneurial university. Excessive proximity with industry might generate extra pressures such as time limitation or research constraint, thereby reducing the ability to concentrate on academically relevant outputs.

We believe our results will have broader appeal than for a single country. Support from NBER will allow us to expand our theoretical and empirical research with additional case studies of different regions in China and other emerging countries. We will conduct interviews with university faculty members and build case studies from five different regions of China. The case studies will allow us to understand whether what we examine is a particular Chinese phenomenon unfurling under a certain cultural and policy background or one could learn lessons for other countries and future studies could be replicated in other emerging economies.

Reference

- Aguiar-Díaz, Inmaculada, et al. "University–industry relations and research group production: is there a bidirectional relationship?" *Industrial and Corporate Change* 25.4 (2015): 611-632.
- Banal-Estañol, Albert, Mireia Jofre-Bonet, and Cornelia Lawson. "The double-edged sword of industry collaboration: Evidence from engineering academics in the UK." *Research Policy* 44.6 (2015): 1160-1175.
- Bercovitz, Janet, and Maryann Feldman. "Academic entrepreneurs: Organizational change at the individual level." *Organization Science* 19, no. 1 (2008): 69-89.
- Calderini, Mario, Chiara Franzoni, and Andrea Vezzulli. "If star scientists do not patent: The effect of productivity, basicness and impact on the decision to patent in the academic world." *Research Policy* 36, no. 3 (2007): 303-319.
- Chen, Aihua, Donald Patton, and Martin Kenney. "University technology transfer in China: a literature review and taxonomy." *The Journal of Technology Transfer* 41, no. 5 (2016): 891-929.
- Chen, Kun, and Martin Kenney. "Universities/research institutes and regional innovation systems: the cases of Beijing and Shenzhen." *World development* 35, no. 6 (2007): 1056-1074.
- Cheng, Hua, Zhiying Zhang, Qing Huang, and Zhongju Liao. "The effect of university–industry collaboration policy on universities' knowledge innovation and achievements transformation: based on innovation chain." *The Journal of Technology Transfer* (2018): 1-22.
- Griliches, Zvi. "Issues in assessing the contribution of research and development to productivity growth." *The Bell Journal of Economics* (1979): 92-116.
- Hayhoe, Ruth. *China's universities, 1895-1995: A century of cultural conflict*. Routledge, 2004.
- Jensen, Richard, Jerry Thursby, and Marie C. Thursby. *University-industry spillovers, government funding, and industrial consulting*. No. w15732. National Bureau of Economic Research, 2010.
- Lee, Yong S. "The sustainability of university-industry research collaboration: An empirical assessment." *The Journal of Technology Transfer* 25, no. 2 (2000): 111-133.
- Muscio, Alessandro, Laura Ramaciotti, and Ugo Rizzo. "The complex relationship between academic engagement and research output: Evidence from Italy." *Science and Public Policy* 44, no. 2 (2017): 235-245.
- Perkmann, Markus, Valentina Tartari, Maureen McKelvey, Erkko Autio, Anders Broström, Pablo D'Este, Riccardo Fini et al. "Academic engagement and commercialisation: A review of the literature on university–industry relations." *Research policy* 42, no. 2 (2013): 423-442.
- Stephan, Paula E. "The economics of science." *Journal of Economic literature* 34, no. 3 (1996): 1199-1235.
- Stephan, Paula E. *How Economics Shapes Science*. Vol. 1. Cambridge, MA: Harvard University Press, 2012.
- Tseng, Fan-Chuan, Mu-Hsuan Huang, and Dar-Zen Chen. "Factors of university–industry collaboration affecting university innovation performance." *The Journal of Technology Transfer* (2018): 1-18.
- Zhang, Ben, and Xiaohong Wang. "Empirical study on influence of university-industry collaboration on research performance and moderating effect of social capital: evidence from engineering academics in China." *Scientometrics* 113, no. 1 (2017): 257-277.

Budget Estimate

	Description	Cost ($)	Cost in total ($)
Data	University-run Enterprise Statistical Survey	1000	1000
	Transfer the data into electronic data (RA)		
	University-run enterprise statistical Survey	1250	1250
	Higher Education Statistical Survey	1250	1250
	Web of Science	500	500
Field Work	Interviews in China		4000
Conference	Two conferences in United States		
	Innovation Policy and the Economy NBER	1800 per person	3600
	Atlanta Conference on Science and Innovation Policy	1800 per person	3600
	International Conference	2500 per person	5000
Sum Cost			19200

Yanzhao Lai

The George Washington University
Department of Economics
2115 G Street NW, Monroe Hall 340
Washington, DC 20052

Phone: + 1 910 508 8111
E-mail: yzlai@gwmail.gwu.edu
laiyanzhao@gmail.com

Education

- Ph.D., Economics, The George Washington University, Washington, DC, 2019 (expected)
- M.A., Economics, Boston University, Boston, MA, 2011
- M.Sc., Mathematics, University of North Carolina, Wilmington, NC, 2009
- B.A., Information and Computing Science, Huazhong University of Science and Technology, Wuhan, China, 2007

Dissertation

"Essays on the Entrepreneurial University"

Committee: Professor Nicholas Vonortas (chair), Professor Roberto Samaniego, Professor Anupama Phene

Working Papers

- Regional Entrepreneurial Ecosystems in China, with Nicholas Vonortas, under review (R&S) at *Industrial and Corporate Change*

Working in Progress

- The relationship between university-industry interactions and university scientific productivity: evidence from China
- Social Influence on Academic Entrepreneurship: The Effect of Geographical and Cognitive Proximity
- What drives students to become entrepreneurs? Classmates or Advisers
- Returnee Academic Entrepreneurship
- Do Peer Schools Affect University Patenting and Licensing?

Seminars/Invited Presentations

- The 12th Asia-Pacific Productivity Conference, Seoul, Korea, July, 2018
- International Schumpeter Society, Seoul, Korea, July, 2018
- Technology Transfer Society Annual Conference, Arlington, VA, November 4th, 2017

Referee

- Science and Public Policy

Professional Experience

- Chance Focus (Shanghai) Asset Management, Senior Consultant, 2015-2018

- China Resource Asset Management, Project Manager Intern, Distressed Investment Division, 2014
- China Minsheng Bank, Project Manager Intern, Small Loan Department, 2011
- GuangFa Securities, Project Manager Intern, Investment Banks Division, 2010
- UNCW, Mathematic and Statistic Department, Teaching Assistant, fall 2007- fall 2009
  - Teaching assistant for Prof. Russell L. Herman in Multivariable Calculus from 2007 to 2008
  - Teaching assistant for Prof. Xin Lu in Calculus with Analytic Geometry from 2008 to 2009
- American Institute of Mathematical Sciences Proceeding, Editorial assistant, 2009
- Discrete and Continuous Dynamical Systems Series B (SCI), Editorial assistant, Sept.2008-Aug.2009
- Citic Stock Trading Contest, Ranked 1st out of 7040 participants, 2007

Others

- Computer: Stata, R, LaTeX, ArcMap,
- Languages: Chinese (native), English (fluent)

Working Papers

- **Regional Entrepreneurial Ecosystems in China, with Nicholas Vonortas, under review (R&S) at *Industrial and Corporate Change***

  This study focuses on regional entrepreneurial ecosystems and offers a two-stage structural model which distinguishes two sets of factors, those that have direct impact on entrepreneurial activities and those that have indirect impact. Based on the empirical analysis of 263 Chinese cities from 2007 to 2015, we find that human capital, knowledge creation, access to finance and market are four main factors that drive local entrepreneurial activity. Moreover, the presence of high growth firms in the region, startup companies, university graduates, as well as city openness are significant predicators of both the regional stock of human capital and knowledge creation. Risk finance is found to be strongly associated with the presence of high growth firms and startups. The presence of research-intensive universities has a strong positive impact on regional entrepreneurial ecosystems.

NICHOLAS S. VONORTAS

A. Professional Preparation

University of Athens (Greece)	B.A. Economics	1981
Leicester University (United Kingdom)	M.A. Economic Development	1983
New York University (United States)	M. Phil. Economics	1987
New York University (United States)	Ph.D. Economics	1989

B. Appointments

Professor, Institute for International Science and Technology Policy (IISTP) & Department of Economics, George Washington University, 2004-present; Associate Professor 1996 – 2003; Assistant Professor 1990-1996. Director, PhD Candidacy, Department of Economics, 2014-present; Director IISTP, 2001 – 2012; Director, Graduate Program in International Science and Technology Policy, 1998 – 2012.

São Paulo Excellence Chair "Innovation Systems, Strategy and Policy", Department of Science and Technology Policy, University of Campinas (UNICAMP), State of São Paulo, Brazil, 2014-2019.

Innovation Policy Forum (Panel Member), STEP Board, National Research Council, US National Academies of Science, 2015-present.

Leading Research Fellow, Institute for Statistical Studies and Economics of Knowledge, Nat'l Research University Higher School of Economics (HSE), Moscow, Russian Federation, 2015-present.

Visiting Professor, Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), University of Lund, Sweden, Spring 2013.

Visiting Professor, Fundacão Getulio Vargas (FGV), Rio de Janeiro, Brazil, Fall 2012.

Research Associate, CESPRI-KITeS, Luigi Bocconi University, Milano, Italy, 2001 – 2012.

Visiting Scholar, National Technical University of Athens, Greece, Spring 1998.

Visiting Scholar, Maastricht Economic Research Institute on Innovation and Technology (MERIT), University of Maastricht, Netherlands, Fall 1997.

Instructor of Economics, Department of Economics, New York University, 1986 – 1988.

C. Recent Publications

(i) Most closely related to the proposed project

- Fischer, B. B., P. R. Schaeffer, and N. S. Vonortas (forthcoming) "Innovation and "Evolution of University-Industry Collaboration in Brazil from a Technology Upgrading Perspective", *Technological Forecasting and Social Change*.
- Kergroach, S., D. Meissner, and N. S. Vonortas (forthcoming) "Technology Transfer and Commercialization by Universities and PRIs: Benchmarking OECD Country Policy Approaches", *Economics of Innovation and New Technology*.

- Fischer, B. B., S. Queiroz, and N. S. Vonortas (2018) "On the Location of Knowledge-Intensive Entrepreneurship in Developing Countries: Lessons from São Paulo, Brazil", *Entrepreneurship & Regional Development*, 30(5-6): 612-638.
- Fischer, B. B., P. R. Schaeffer, S. Queiroz, and N. S. Vonortas (2018) "Quality Comes First: University-Industry Collaboration as a Source of Academic Entrepreneurship in a Developing Country", *Journal of Technology Transfer*, 43(2): 263-284.
- Kim Y.-J. and N. S. Vonortas (2014) "Cooperation in the Formative Years: Evidence from Young Enterprises in Europe", *European Management Journal*, 32(5): 795-805.

(ii) Other related products

- Protogerou, A., Y. Caloghirou and N. S. Vonortas (2017) "Determinants of Young Firms' Innovative Performance: Empirical Evidence from Europe", *Research Policy*, 46: 1312-1326.
- Meissner, D., W. Polt, and N. S. Vonortas (2017) "Towards A Broad Understanding of Innovation - Implications for Innovation Policy", *Journal of Technology Transfer*, 42(5): 1184-1211.
- Feige, D. and N. S. Vonortas (2017) "Context Appropriate Technologies for Development: Choosing for the Future", *Technological Forecasting and Social Change*, 2017, 119: 219-226.
- Spanos, Y. E., N. S. Vonortas, and I. Voudouri (2015) "Antecedents of Innovation Impacts in Publicly Funded Collaborative R&D Projects", *Technovation*, 36-37: 53-64.
- Vonortas, N. S. (2013) "Social Networks in R&D Program Evaluation", *Journal of Technology Transfer*, 38(5): 577-606.

D. Synergistic Activities

- Editor, *Science and Public Policy* (since 2010).
- Panel member Innovation Policy Forum, National Academies of Science, 2015-.
- Advisory Committee for International Science & Engineering, NSF, 2006-2011; Acting Chair, Strategic Planning Panel, 2011; Chair COV, International Science & Engineering Programs, 2011.
- Has served as PI in a variety of international research projects funded by international organizations such as the United Nations and the World Bank, public agencies such as the European Commission and the Research Foundation of the State of São Paulo, and research programs funded by national agencies such as the National Science Foundation and the Department of Energy in the United States.
- Active member of several extensive networks of scientists in the United States, the European Union, East Asia and Latin America interested in the issues of technology creation and diffusion in the private sector, decision-making processes, and impact appraisal R&D programs.