

ROUTLEDGE STUDIES IN GLOBAL
COMPETITION

The Economics of Knowledge, Innovation and Systemic Technology Policy

Edited by
Francesco Crespi and
Francesco Quatraro



The Economics of Knowledge, Innovation and Systemic Technology Policy

**Edited by
Francesco Crespi and
Francesco Quatraro**



First published 2015
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

© 2015 selection and editorial matter, Francesco Crespi and Francesco Quatraro; individual chapters, the contributors

The right of the editors to be identified as the authors of the editorial matter, and of the authors for their individual chapters, has been asserted in accordance with sections 77 and 78 of the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this book may be reprinted or reproduced or utilized in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying and recording, or in any information storage or retrieval system, without permission in writing from the publishers.

Trademark notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data

The economics of knowledge, innovation and systemic technology policy / edited by Francesco Crespi and Francesco Quatraro.

pages cm

Includes bibliographical references and index.

1. Knowledge management—Economic aspects—Europe.
 2. Technological innovations—Economic aspects—Europe.
1. Crespi, Francesco. II. Quatraro, Francesco.

HD30.2.E264 2015

338.94'06—dc23

2014046462

ISBN: 978-0-415-70301-7 (hbk)

ISBN: 978-0-203-79507-1 (ebk)

Typeset in Times New Roman
by Wearset Ltd, Boldon, Tyne and Wear



Printed and bound in Great Britain by
TJ International Ltd, Padstow, Cornwall

The Economics of Knowledge, Innovation and Systemic Technology Policy

There is wide consensus on the importance of knowledge for economic growth and local development patterns. This book proposes a view of knowledge as a collective, systemic and evolutionary process that enables agents and social systems to overcome the challenges of the limits to growth. It brings together new conceptual and empirical contributions, analysing the relationship between demand and supply factors and the rate and direction of technological change. It also examines the different elements that compose innovation systems.

The Economics of Knowledge, Innovation and Systemic Technology Policy provides the background for the development of an integrated framework for the analysis of systemic policy instruments and their mutual interaction with the socio-political and economic conditions of the surrounding environment.

These aspects have long been neglected in innovation policy, as policy-makers, academics and the business community have mostly emphasized the benefits of supply-side strategies. However, a better understanding of innovation policies grafted on a complexity-based approach calls for the appreciation of the mutual interactions between both supply and demand aspects, and it is likely to improve the actual design of policy measures.

This book will help readers to understand the foundations and workings of demand-driven innovation policies by stressing the importance of competent and smart demand.

Francesco Crespi is Associate Professor at the Department of Economics of Roma Tre University, and Research Associate at the Bureau of Research on Innovation, Complexity and Knowledge (BRICK), Collegio Carlo Alberto, Italy.

Francesco Quatraro is Associate Professor at the Department of Economics and Statistics of University of Torino, and Research Associate at the Bureau of Research on Innovation, Complexity and Knowledge (BRICK), Collegio Carlo Alberto, Italy and at the GREDEG, University of Nice Sophia Antipolis, France.

Routledge studies in global competition

Edited by

John Cantwell

Rutgers, the State University of New Jersey, USA

and

David Mowery

University of California, Berkeley, USA

•

1 Japanese Firms in Europe

Edited by Frédérique Sachwald

**2 Technological Innovation,
Multinational Corporations and
New International
Competitiveness**

The case of intermediate countries

Edited by José Molero

**3 Global Competition and the
Labour Market**

Nigel Driffield

**4 The Source of Capital Goods
Innovation**

*The role of user firms in Japan and
Korea*

Kong-Rae Lee

5 Climates of Global Competition

Maria Bengtsson

**6 Multinational Enterprises and
Technological Spillovers**

Tommaso Perez

**7 Governance of International
Strategic Alliances**

Technology and transaction costs

Joanne E. Oxley

8 Strategy in Emerging Markets

*Telecommunications
establishments in Europe*

Anders Pehrsson

9 Going Multinational

*The Korean experience of direct
investment*

Edited by Frédérique Sachwald

**10 Multinational Firms and
Impacts on Employment, Trade
and Technology**

*New perspectives for a new
century*

Edited by Robert E. Lipsey and

Jean-Louis Mucchielli

11 Multinational Firms

The global-local dilemma

Edited by John H. Dunning and

Jean-Louis Mucchielli

**12 MIT and the Rise of
Entrepreneurial Science**

Henry Etzkowitz

**13 Technological Resources and the
Logic of Corporate
Diversification**

Brian Silverman

- 14 The Economics of Innovation, New Technologies and Structural Change**
Cristiano Antonelli
- 15 European Union Direct Investment in China**
Characteristics, challenges and perspectives
*Daniel Van Den Bulcke,
Haiyan Zhang and
Maria do Céu Esteves*
- 16 Biotechnology in Comparative Perspective**
Edited by Gerhard Fuchs
- 17 Technological Change and Economic Performance**
*Albert L. Link and
Donald S. Siegel*
- 18 Multinational Corporations and European Regional Systems of Innovation**
*John Cantwell and
Simona Iammarino*
- 19 Knowledge and Innovation in Regional Industry**
An entrepreneurial coalition
Roel Rutten
- 20 Local Industrial Clusters**
Existence, emergence and evolution
Thomas Brenner
- 21 The Emerging Industrial Structure of the Wider Europe**
*Edited by Francis McGowen,
Slavo Radosevic and
Nick Von Tunzelmann*
- 22 Entrepreneurship**
A new perspective
Thomas Grebel
- 23 Evaluating Public Research Institutions**
The U.S. Advanced Technology Program's Intramural Research Initiative
Albert N. Link and John T. Scott
- 24 Location and Competition**
*Edited by Steven Brakman and
Harry Garretsen*
- 25 Entrepreneurship and Dynamics in the Knowledge Economy**
*Edited by Charlie Karlsson,
Börje Johansson and
Roger R. Stough*
- 26 Evolution and Design of Institutions**
*Edited by Christian Schubert and
Georg von Wangenheim*
- 27 The Changing Economic Geography of Globalization**
Reinventing space
Edited by Giovanna Vertova
- 28 Economics of the Firm**
Analysis, evolution and history
Edited by Michael Dietrich
- 29 Innovation, Technology and Hypercompetition**
Hans Gottinger
- 30 Mergers and Acquisitions in Asia**
A global perspective
*Roger Y.W. Tang and
Ali M. Metwalli*

- 31 Competitiveness of New Industries**
Institutional framework and learning in information technology in Japan, the U.S and Germany
Edited by Cornelia Storz and Andreas Moerke
- 32 Entry and Post-Entry Performance of Newborn Firms**
Marco Vivarelli
- 33 Changes in Regional Firm Founding Activities**
A theoretical explanation and empirical evidence
Dirk Fornahl
- 34 Risk Appraisal and Venture Capital in High Technology New Ventures**
Gavin C. Reid and Julia A. Smith
- 35 Competing for Knowledge**
Creating, connecting and growing
Robert Huggins and Hiro Izushi
- 36 Corporate Governance, Finance and the Technological Advantage of Nations**
Andrew Tylecote and Francesca Visintin
- 37 Dynamic Capabilities Between Firm Organisation and Local Systems of Production**
Edited by Riccardo Leoncini and Sandro Montresor
- 38 Localised Technological Change**
Towards the economics of complexity
Cristiano Antonelli
- 39 Knowledge Economies**
Innovation, organization and location
Wilfred Dolfsma
- 40 Governance and Innovation**
Maria Brouwer
- 41 Public Policy for Regional Development**
Edited by Jorge Martinez-Vazquez and François Vaillancourt
- 42 Evolutionary Economic Geography**
Location of production and the European Union
Miroslav Jovanovic
- 43 Broadband Economics**
Lessons from Japan
Takanori Ida
- 44 Targeting Regional Economic Development**
Edited by Stephan J. Goetz, Steven C. Deller and Thomas R. Harris
- 45 Innovation, Knowledge and Power in Organizations**
Theodora Asimakou
- 46 Creativity, Innovation and the Cultural Economy**
Edited by Andy C. Pratt and Paul Jeffcutt
- 47 Co-opetition Strategy**
Giovanni Battista Dagnino and Elena Rocco
- 48 Knowledge Intensive Entrepreneurship and Innovation Systems**
Evidence from Europe
Edited by Franco Malerba
- 49 Innovation in Complex Social Systems**
Edited by Petra Ahrweiler

- 50 Internationalization, Technological Change and the Theory of the Firm**
Edited by Nicola De Liso and Riccardo Leoncini
- 51 Territory, Specialization and Globalization in European Manufacturing**
Helena Marques and Francisco Puig
- 52 Institutional Diversity and Innovation**
Continuing and emerging patterns in Japan and China
Cornelia Storz and Sebastian Schäfer
- 53 Innovation and Economic Crisis**
Daniele Archibugi and Andrea Filippetti
- 54 The Communications Industries in the Era of Convergence**
Catherine Mulligan
- 55 Innovation, Technology and Knowledge**
Charlie Karlsson, Börje Johansson and Roger R. Stough
- 56 Evolution of Competition Laws and their Enforcement**
Pradeep S. Mehta
- 57 The Economics of Structural Change in Knowledge**
Francesco Quatraro
- 58 Economic Geography and the Unequal Development of Regions**
Jean-Claude Prager and Jacques-François Thisse
- 59 Social Networks, Innovation and the Knowledge Economy**
Edited by Isabel Salavisa and Margarida Fontes
- 60 The Economics of Creativity**
Ideas, firms and markets
Edited by Thierry Burger-Helmchen
- 61 Epistemic Economics and Organization**
Forms of rationality and governance for a discovery oriented economy
Anna Grandori
- 62 Universities, Cities and Regions**
Loci for knowledge and innovation creation
Edited by Roberta Capello, Agnieszka Olechnicka and Grzegorz Gorzelak
- 63 Strategies for Shaping Territorial Competitiveness**
Edited by Jesús M. Valdaliso and James R. Wilson
- 64 The Economics of Knowledge, Innovation and Systemic Technology Policy**
Edited by Francesco Crespi and Francesco Quatraro

Contributors

Cristiano Antonelli, Department of Economics, University of Turin and BRICK Collegio Carlo Alberto.

Pierre-Alexandre Balland, Urban and Regional Research Centre Utrecht (URU).

Federico Biagi, JRC-IPTS European Commission, University of Padua and SDA Bocconi.

Susana Borrás, Copenhagen Business School.

Ron Boschma, Lund University – CIRCLE.

Davide Consoli, INGENIO (CSIC-UPV), Valencia (Spain).

Riccardo Crescenzi, Department of Geography and Environment & SERC, London School of Economics, Rossi Doria Centre for Economic and Social Research, Roma Tre University, Italy.

Francesco Crespi, Associate Professor at the Department of Economics of Roma Tre University, and Research Associate at the Bureau of Research on Innovation, Complexity and Knowledge (BRICK), Collegio Carlo Alberto, Italy.

Charles Edquist, Lund University – CIRCLE.

Amnon Frenkel, Samuel Neaman Institute for Advanced Studies in Science and Technology Technion – Israel Institute of Technology.

Luisa Gagliardi, Department of Geography and Environment, London School of Economics, Centre for Regional Economics, Transports and Tourism (CERTeT), Bocconi University, Italy.

Agnieszka Gehringer, Department of Economics, University of Göttingen.

Jens Horbach, University of Applied Sciences Augsburg.

Dieter Kogler, University College Dublin.

Jackie Krafft, University of Nice Sophia Antipolis, CNRS-GREDEG.

Sorin M.S. Krammer, University of Groningen, Faculty of Economics and Business, Department of Global Economics and Management.

Shlomo Maital, Samuel Neaman Institute for Advanced Studies in Science and Technology Technion – Israel Institute of Technology.

Alberto Marzucchi, Department of International Economics, Institutions and Development (DISEIS), Catholic University of Milan, Italy.

Cristian Matti, INGENIO (CSIC-UPV), Valencia, Spain.

Sandro Montresor, Faculty of Economics and Law, Kore University of Enna, Italy.

Marco Percoco, Department of Policy Analysis and Public Management, Università Bocconi.

Andreas Pyka, University of Hohenheim, Economics Institute, Wollgrasweg 23, D-70599 Stuttgart, Germany.

Francesco Quatraro, Associate Professor at the Department of Economics and Statistics of University of Torino. Research Associate at the Bureau of Research on Innovation, Complexity and Knowledge (BRICK), Collegio Carlo Alberto, Italy and at the GREDEG CNRS, University of Nice Sophia Antipolis, France.

Jacques-Laurent Ravix, University of Nice Sophia Antipolis, CNRS-GREDEG.

Verónica Robert, Universidad Nacional de General Sarmiento.

Pier Paolo Saviotti, INRA-GAEL, Université Pierre Mendès-France, BP 47, 38040 Grenoble, France. GREDEG CNRS, Sophia Antipolis, Valbonne, France; Eindhoven Centre for Innovation Studies (ECIS), School of Innovation Sciences, Eindhoven University of Technology, P.O. Box 513, NL-5600MB Eindhoven, The Netherlands; Temporary Research Fellow, Institute of Advanced Studies (IAS), Durham University, Durham, UK.

Jurai Stančík, JRC-IPTS European Commission.

Gabriel Yoguel, Universidad Nacional de General Sarmiento.

Contents

<i>List of figures</i>	xi
<i>List of tables</i>	xiv
<i>List of contributors</i>	xvi
1 Knowledge, innovation and the different dimensions of systemic technology policy	1
FRANCESCO CRESPI AND FRANCESCO QUATRARO	
PART I	
Knowledge, innovation and the demand side	13
2 On the co-evolution of innovation and demand: some policy implications	15
PIER PAOLO SAVIOTTI AND ANDREAS PYKA	
3 The competent demand-pull hypothesis	48
CRISTIANO ANTONELLI AND AGNIESZKA GEHRINGER	
4 Market-based demand-driven innovation: seven key principles and illustrative case studies	70
AMNON FRENKEL AND SHLOMO MAITAL	
PART II	
The supply-side dimensions	107
5 Characterizing the evolution of the EU R&D intensity gap using data from top R&D performers	109
JURAI STANČÍK AND FEDERICO BIAGI	
6 Good governance, firm performance and policy recommendations: is the shareholder value counter-revolution obsolete?	127
JACKIE KRAFFT AND JACQUES-LAURENT RAVIX	

7	The geography of inter-firm knowledge spillovers in bio-tech	147
	RON BOSCHMA, PIERRE-ALEXANDRE BALLAND AND DIETER KOGLER	
8	Social capital and the innovative performance of Italian provinces	170
	RICCARDO CRESCENZI, LUISA GAGLIARDI AND MARCO PERCOCO	
PART III		
	Innovation and systemic technology policy	201
9	The ontology of complexity and the implications for innovation policy	203
	VERÓNICA ROBERT AND GABRIEL YOGUEL	
10	The multi-dimensional additionality of innovation policies: a multi-level application to Italy and Spain	239
	ALBERTO MARZUCCHI AND SANDRO MONTRESOR	
11	Innovation policies as engines of economic growth: standard lessons and systemic insights for Bulgaria	271
	SORIN M.S. KRAMMER	
12	The emergence of wind energy in Spain: a review of the policy mix	311
	CRISTIAN MATTI AND DAVIDE CONSOLI	
13	The role of environmental policy for eco-innovation: theoretical background and empirical results for different countries	348
	JENS HORBACH	
14	Innovation policy for knowledge production and R&D: the investment portfolio approach	361
	SUSANA BORRÁS AND CHARLES EDQUIST	
15	Conclusions and policy implications	383
	FRANCESCO CRESPI AND FRANCESCO QUATRARO	
	<i>Index</i>	385

Figures

2.1	Effect of product quality on the disposable income created in the economic system	29
2.2	Influence of the different preference systems on the rate of growth of income	30
2.3	Influence of the different preference systems on the rate of growth of employment	31
2.4a	Product quality, as measured by the services supplied by a product (Y_i) in the low-quality (thin curve) or high-quality (bold curve) case	33
2.4b	Effect of product quality on sectoral demand	33
2.4c	Effect of product quality on sectoral output	33
2.4d	Effect of product quality on sectoral wages	33
2.4e	Effect of product quality on the quantity of human capital used in a sector	33
2.4f	Effect of product quality on the quality of human capital used in a sector	33
2.5	Effect of product quality on the disposable income created in the economic system for the low-quality case (a) and for the high-quality case (b)	34
2.6	Effect of product quality on the aggregate rate of income growth	35
2.7	Effect of product quality on the aggregate rate of employment growth	35
2.8	Effect of changing the weight k_{Hi} of H_i in the production function for different values of barrier in human capital B_{Hi}	38
2.9	Effect of changing the wage parameter k_w for different values of barrier in human capital	38
2.10	Employment for the LQ (light line) and HQ (heavy line) scenarios for $B_{Hi}=0.5$ and $k_{Hi}=2.0$	39
2.11	Income curves for the LQ (grey curves) and HQ (black curves) cases showing the impact of different preferences on income generation. The parameter settings correspond to the standard scenario	40

2.12	Income curves for the LQ (grey curves) and HQ (black curves) cases showing the impact of different preferences on income generation. The parameter settings correspond to higher values of the B_H barrier in human capital and in the weight of human capital in the production function	41
3.1	Smithian view on demand-pulling mechanism	49
3.2	Kaldorian demand-pulling mechanism	53
3.3	Schmookler's demand-pulling mechanism	55
3.4	Market for external knowledge and equilibrium in the presence of knowledge externalities	59
3.5	General equilibrium consequences of knowledge externalities	60
3.6	Demand pull and adaptive vs. creative reaction	61
4.1	The three value disciplines	70
4.2	Markets of 1,000	80
4.3	Nokia's 2×2 market map	81
4.4	Lead users as a source of quality	83
5.1	Decomposition of the R&D intensity gap into structural and intrinsic components	116
5.2	The share of structural component in the total R&D intensity gap	117
5.3	R&D intensity gap across regions and sectors	119
5.4	Sector weights across regions	120
7.1	Degree distribution (2007–2010)	155
7.2	Knowledge exchanges between the top 20 actors (2007–2010)	157
8.1	Growth rate of patents (per million inhabitants), 2001–2007	179
8.2	Social capital, composite indicator, 2001	180
A.8.1	Moran's I test on the dependent variable (patents' growth rate)	192
A.8.2	Moran's I test for the regression residuals	192
9.1	The relationship between the two traditions of complexity in the economic history and the five evolutionary groups	226
10.1	The multi-dimensional additionality of innovation policies	255
10.2	Multi-level additionality of innovation policies	259
10.3	The multi-level additionality of innovation policies, cross-dimensional averages	261
10.4	The multi-dimensional additionality of innovation policies, total cross-level effects	261
11.1	Dynamic export profile of Bulgaria	280
11.2	Export sophistication and GDP per capita	281
11.3	The percentage of Bulgarian patents with international co-inventors	285
11.4	Distribution of Bulgarian scientific publications	286
11.5	Relative impact index in selected disciplines for Bulgaria and comparators	287

A.11.1	Composition of net exports for Bulgaria, 2010	301
12.1	Wind energy cumulated capacity (selected countries)	312
12.2	Total wind farms and wind turbines in Spain, 2003–2010	312
12.3	Wind farm technologies and forms of know-how	314
12.4	Wind power installed capacity (MW), Spanish regions, 2011	318
12.5	Wind power industrial sites, 2013	320
12.6	Market concentrations in the Spanish wind energy market: main actors	321
12.7	Concentration of wind power capacity at regional level	322
12.8	Distribution of energy research infrastructure, 2012	323
12.9	Evolution of energy balance in Spain: ordinary and special regime, 1997–2012	332
12.10	Evolution of power capacity in Spanish electricity system: wind power, ordinary and special regime, 1997–2012	332
12.11	Evolution of total subsidies granted by FIT scheme and RES-E produced with wind resources, 1998–2012	333
12.12	Evolution of average price compensation, 1998–2012	333
12.13	Grants and energy produced as part of the total, 2004 and 2012	334
12.14	Evolution of regional normative related to renewable energy in CCAA, 1990–2010 (four-year moving average)	335
12.15	Main technological components of a wind turbine	344
12.16	Wind farm technologies and forms of know-how	345
14.1	Mapping R&D organizations in innovation systems – a generic illustration	365

Tables

A.2.1	Parameter sets on the rate of growth of income and on the rate of growth of employment	44
4.1	List of case studies	72
5.1	Number of companies by year	113
5.2	Summary statistics	113
5.3	Sector division by ICB1 categories and R&D intensity	114
5.4	Regional division	115
6.1	Evidence on the impact of good governance on company performance	138
6.2	Evidence on the impact of good governance on innovation	140
7.1	Changes in citation ties between observations	153
7.2	Key players in biotech: top 20 centrality scores (2007–2010)	156
7.3	Structural characteristics of knowledge spillovers	157
7.4	Structural variables	158
7.5	Descriptive statistics of the control variables	160
7.6	The determinants of inter-organizational knowledge spillovers, 2008–2010	162
8.1	Estimation of the empirical model: regional knowledge production function with social capital – annual growth rate of regional patenting (2001–2007)	181
8.2a	First stage regression	183
8.2b	First stage statistics	185
8.3	Robustness checks (1): estimation of the empirical model – regional knowledge production function with blood donations and voluntary associations; annual growth rate of regional patenting (2001–2007)	185
8.4	Robustness checks (2): correlation between the instrument and alternative social capital proxies	186
A.8.1	Variables list	188
A.8.2	Further robustness checks (1): estimation of the empirical model – regional knowledge production function with social capital; level of patents (2002, 2005, 2007)	190

A.8.3	Further robustness checks (2): estimation of the empirical model – regional knowledge production function with social capital; annual growth rate of regional patenting (2001–2007)	191
9.1	Four dimensions of the ontology of complexity	207
9.2	Two alternative paths of complexity in economic thinking	214
9.3	Assumptions regarding the ontology of complexity by thematic group/author	220
10.1	Additionality of Italian policies	252
10.2	Additionality of Spanish policies	256
A.10.1	Italy and Spain in the CIS4: descriptive statistics	264
A.10.2	Probit estimation of propensity scores	265
11.1	Main export destinations for Bulgaria	279
11.2	The structural shift and rebirth of Bulgarian international patenting	284
11.3	Scientific specialization index for Bulgaria	286
11.4	Firm internal capabilities development across innovators and exporters	290
11.5	External drivers and obstacles for firm innovation and exports	291
A.11.1	Top 15 products contributing to Bulgarian export sophistication (EXPY)	300
A.11.2	Scientific publications and citation totals	301
A.11.3	Top five Bulgarian ‘hot’ scientific papers in terms of citations	302
A.11.4	Top Bulgarian institutions in terms of scientific publications	303
A.11.5	Top scientific partners in Bulgarian publications	304
12.1	Global market shares – main wind turbine manufacturers	316
12.2	National market share of wind power capacity – developers and wind turbine manufacturers	317
12.3	Industrial sites specialized in wind energy technologies: Spain, 2006–2013	319
12.4	Distribution of policy instruments among regions by category	324
12.5	Main archetypes of regions and their relative comparative advantage	325
12.6	Performance of EU/OECD countries in the introduction of renewables	327
12.7	Taxonomy of demand-side policy and instruments	338
12.8	Typologies of policy instruments for renewable energy	342
13.1	Determinants of eco-innovation	350
13.2	Main determinants of eco-innovations from an empirical perspective	352