

Economics of Science, Technology and Innovation

The Economics of Persistent Innovation

Edited by
Christian Le Bas
William Latham

THE ECONOMICS OF PERSISTENT INNOVATION: AN EVOLUTIONARY VIEW

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**THE ECONOMICS OF PERSISTENT
INNOVATION: AN EVOLUTIONARY VIEW**

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Economics of Science, Technology and Innovation

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PREFACE AND ACKNOWLEDGEMENTS

Christian Le Bas

The idea of studying the persistence of firm innovative behavior emerged gradually over the period during which I directed the Economy and Applied Statistics Laboratory¹ at the University Lumière Lyon 2 in the middle 1990s. Definitive studies were carried out from the very beginning by enthusiastic and productive young researchers. First Alexandre Cabagnols dealt with persistence as a substantial part of his PhD thesis. Then Claudine Gay identified the crucial roles of consistent and persistent inventors in the collective process of knowledge growth. Subsequently, with the assistance of Karim Touach, Claudine and I have undertaken new empirical research on persistent inventors as relatively unknown figures in inventive structures. This nascent enterprise received an intellectual and logistical boost several years ago with the collaborations of William Latham and James Mulligan, my colleagues from University of Delaware (USA). The completion of this book owes much to their efforts and especially to the productive links I have forged with William Latham, the co-editor, my co-author and my friend. We are indebted to the highly successful cooperative exchange program between the University of Delaware and the University Lumière Lyon 2 which encouraged the development of the professional contacts that led to our collaboration. While it is hopeless to try to acknowledge all of those whose comments, remarks and criticisms have enriched our work, I must make special mention of Paolo Saviotti whose salient comments contributed so vitally to Chapter 7.

This project was accomplished with precious, and mostly persistent, support from a variety of sources including the funding for two different research groups by the University Lumière Lyon 2 (first the Economy and Applied Statistics Laboratory and then the Economics of the Firm and Institutions Laboratory² and grants from the French National Center for Scientific Research³ program, "Economic Issues in Innovation."⁴ I cannot forget the Catholic University of Lyon's program (GEMO-ESEDES) which provided me with the time for writing a significant part of this book. Finally I

wish to thank the editors and publishers of the collection at Springer for accepting the risk of publishing the manuscript.

I dedicate this book first, to the memory of Ehud Zuscovitch, with whom I shared both a passion for evolutionary economics and a friendship and, second, to Keith Pavitt, a true intellectual leader in the field of the economics of innovation.

¹ Laboratoire d'Économie et de Statistiques Appliquées (LESA)

² Laboratoire d'Economie de la Firme et des Institutions

³ Centre National de la Recherche Scientifique

⁴ Les enjeux économiques de l'innovation.”

INTRODUCTION

William Latham
Christian Le Bas

Persistence of firm innovative behavior became an important topic in applied industrial organization with the publication of the seminal empirical work of P. Geroski and his colleagues (1997). Evidence that firms innovate persistently has led previous studies to focus on the determinants of innovation persistence and on its heterogeneity across industries, technologies and countries. The aims of this book are: (1) to illumine the scale and scope of the phenomenon of persistence in innovation, and (2) to account for the principal factors that explain why some firms innovates persistently and others do not.

Because this book deals intensively and extensively with the subject of firm innovation persistence, which is not, as yet, a well-known term, we need to provide a nontrivial definition of it that encompasses the full range topics we want to address and aids our understanding of how they are related to each other. We begin with a careful identification of “innovation.” Our first definition is drawn from K. Pavitt (2003), “innovation processes involve the exploration and exploitation of opportunities for a new or improved product, process or service, based either on an advance in technical practice or a change in market demand, or a combination of the two.” While this definition is clear, and conforms well to both our empirical and theoretical perspectives, some elaboration may help to clarify the concept. For example, in empirical quantitative studies, including those of this book, the choice of a measurable indicator of innovation brings additional nuances to the definition. Pavitt (2003) argues that a simple improvement of an existing product ought to be included as an innovation. This means that innovation is not necessarily “radical” or “architectural” but, often, very often indeed, merely “incremental.”¹ However, while innovation occurs at the level of the individual firm it is not a “firm-in-isolation” phenomenon: what is new for only a single firm within an industry, cannot be considered to be an innovation for the industry or the economy as a whole.

Our view of the appropriate definition of innovation has implications for the economic analysis of innovation. Nelson and Winter (1982) distinguished

three strategies for firm technological development: innovation, imitation and “no change.” It is clear to us that a large number of previous studies addressing innovation persistence have combined innovation and imitation as a single strategy as the alternative to “no change” (see, for instance, Saviotti, 2003). Our own definition of innovation is obviously similar to the one implicitly accepted by the community of researchers in economic studies of innovation persistence.

The second part of the term that identifies our subject of interest in this book, “innovative persistence” is persistence. We need also to define what we mean by persistence. Fortunately common usage accords well with our usage of the term in this case. By persistence we mean, in part, “continuing to occur over time.” We also mean, as will be further explained by Das and Mulligan in Chapter 6, “continuing to occur over space.” Generalizing the concept we will recognize as persistent any behavior initiated at one point and subsequently observed at related points. The nature of the relationship may be purely temporal, temporal and spatial, or across other spaces in which firms operate including industrial and technological space.

Until relatively recently little empirical evidence on the innovative persistence phenomenon had been assembled and, in addition, no systematic theoretical framework has yet been suggested for understanding persistence in innovation. This book aims to fulfill this dual gap. We present new empirical evidence that the contributing authors have assembled and suggest a coherent theoretical framework. We will present arguments in favor of an evolutionary competence/capability approach to the phenomenon of persistence in innovation. The authors who support such an evolutionary theory of innovation, either explicitly or tacitly, utilize a vision of the firm rooted in behavioral theory (Metcalf, 1995). In behavioral theory firms have the capacity for learning and exhibit adaptive behaviors. In general, firms do not maximize any objective function in particular, because economic information is difficult to gather and to analyze. In the technological arena, there is an additional reason for optimizing conduct not to be the dominant mode: creativity, and especially technological creativity, is fundamentally an uncertain process. Creativity and innovation are connected to diversity across firms as well. Each firm uses its own particular visions and routines to explore the technological and economic opportunities it meets, and exploits them in its own particular ways. Economists have attempted for some time to find regularities within the innovation process in order to understand this diversity among firms. Pavitt's (1984) well-known taxonomy of sectoral technological trajectories is among the best attempts, though it is still tentative, for explaining this diversity. It is based on the simple idea that firms from different sectors develop innovation differently. The rates and the directions of technical change experienced by a firm depend on three firm characteristics:

the sources and the nature of the firm's technological opportunities, the nature of the firm's technological requirements, and the possibilities for innovating firms to appropriate the benefits of their innovating activities.

The last feature is required if firms are to have incentives to invest resources in research and other innovative activities such as design (Dosi et al. (1990, pp 90ff)). Pavitt identifies four general sectoral technological trajectories:

- (a) science-based sectors (electronics, chemicals),
- (b) scale-intensive sectors (automobiles, consumer durables),
- (c) specialized-supplier sectors (machinery, instruments), and
- (d) supplier-dominated sectors (private services, traditional manufacturing), in which firms buy innovation through their capital goods.

Table 1 illustrates some salient sectoral characteristics of the technological trajectories in terms of

- (i) firms' sources of new knowledge,
- (ii) firms' price and/or performance sensitivity,
- (iii) firms' means of protecting innovations,
- (iv) firms' sources of process technology, and
- (v) types of innovation (product versus process).

Regarding the last of these, Von Tunzelman (1995) asserts that the measure of an organization's technological effectiveness is its success in transforming knowledge about technologies (processes) into knowledge about products.

A continuing theme of this book is that the study of innovative persistence must explicitly consider the specific features of the relevant innovative trajectories. Thus in Chapter 3 Alexandre Cabagnols shows how the idea of sectoral innovative trajectories can be applied and provides insightful commentary. Nilotpal Das and James G. Mulligan in Chapter 6 explicitly focus their analysis on the adoption of process innovation of a sort that is typical in a "supplier-dominated" trajectory.

Table 1: Innovation characteristics of four sectoral technological trajectories

	Innovative Trajectory Sectors			
Sectoral Characteristics	Science-based	Scale-intensive	Specialized-supplier	Supplier-dominated
Source of New Knowledge	R&D and Public Science	Product Engineering	Design and Development	Suppliers and Large Users
Price or Performance Sensitive	Mixed	Price Sensitive	Performance Sensitive	Price Sensitive
Means of Appropriation	Patents	Trade secrets	Design know-how	Non-technical
Sources of Technology	In-house + Suppliers	In-house	In-house + Customers	Suppliers
Innovation Type: Product Versus Process	Mixed	Process	Product	Process

Adapted from Dosi et al. (1990)

The book is structured as follows. Chapter 1 elaborates important basic themes and definitions and presents a brief survey of the previous literature. In Chapter 2 we provide a first empirical analysis of the principal determinants of innovation persistence following the lines opened by of Geroski et al. (1997). The data are for French industrial firms patenting in the US. The results emphasize the importance of firm size and the existence of a minimum threshold of innovative activity. In Chapter 3 Alexandre Cabagnols uses several French innovation surveys to evaluate firm competences that promote innovation (entry) and those that maintain the firm in a dynamic of persistence in innovation. He shows it may be that the two sets of competences are not identical.

In Chapter 4 a fascinating new perspective on innovative persistence is presented: the role of persistent individual inventors. Persistent inventors are individual inventors for whom we find large numbers of French, German, British and Japanese patents in the National Bureau of Economic Research's U.S. patent database. The presence of such inventors, who are consistently inventing, is used to explain and predict some mechanisms underlying general

patent activity. In Chapter 5 Alexandre Cabagnols explores the impact of the level of technological accumulation of French and UK firms on their ability to persist in innovation over longer periods of time (1969-84). Cabagnols estimates a Cox model in which the stock of technological knowledge enters as a time varying covariate. In particular he observes that the impact of past patenting activity on the development of subsequent innovations decreases very quickly in both countries (he finds a depreciation rate of 60%). Both the French and the UK samples lead to qualitatively similar results. In Chapter 6 Nilotpal Das and James G. Mulligan analyze evidence concerning persistence in the adoption of innovations by firms that do not create innovations themselves. Until recently the economic literature has ignored persistence in the adoption of subsequent vintages of technologies by adopting firms. The Chapter contains original empirical work extending recent results to account for the persistence of adoption across vintages of ski-lift technology. They find for example, that firms that adopted the earliest vintages were most likely to adopt newer versions of the technology. This is counter to the possibility that firms might delay adoption in anticipation of a newer version appearing in the future. The authors argue that persistence in this case is due to the firm's incentive to differentiate the quality of its service from that of its competitors. Chapter 7 sets out an evolutionary approach to persistence in innovation. We first identify the foundation of evolutionary principles upon which a non-formal analysis of innovation persistence can be built. Then we propose a more formal model incorporating important features of the evolutionary tradition. The model is shown to be capable of accounting for a number of real-world observations and of facilitating some interesting insights regarding the nature of innovative persistence. In the Chapter 8 we discuss the main findings set out in this book, suggest new future research agenda and draw some implications in terms of public policy.

ENDNOTES

¹ For additional definitions of innovation see Tushman and Anderson, 2004

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