Internal R&D, external R&D, and firm innovation: evidence from the pharmaceutical industry

Citation for published version (APA):

Document status and date:
Published: 01/01/2015

DOI:
10.26481/dis.20150211nw

Document Version:
Publisher's PDF, also known as Version of record

Please check the document version of this publication:
• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
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Download date: 02 Nov. 2023
Internal R&D, External R&D, and Firm Innovation
Evidence from the Pharmaceutical Industry

by Ning Wang

Abstract

The principal purpose of this dissertation is to develop a better understanding of the impact of internal and external research and development (R&D) strategies of firms on their innovative output. More specifically, three research questions have been empirically examined in the dissertation. First, what is the lag structure of the relationship between firm patenting and internal R&D? Second, under what conditions is there complementarity or substitutability between internal and external R&D strategies in shaping a firm’s innovative output? Third, what is the impact of the structure of interfirm R&D alliance network on a focal firm’s innovative output?

The first study aims to revisit the classic research question regarding the lag structure of the patents–R&D relationship through an examination of the impact of internal R&D on firm patenting in the context of the global pharmaceutical industry. The empirical analysis in the study, using both a multiplicative distributed lag model and a dynamic linear feedback model, differs from previous work that examines the patents–R&D relationship in three aspects. First, the estimation results exhibit direct evidence on lagged R&D effects, with the first lag (t – 1) of R&D being significant in all distributed lag specifications. Second, a U-shaped lag structure of the patents–R&D relationship is found in most estimations of the multiplicative distributed lag model, which suggests a potential long-run effect of internal R&D investments on firm patenting. Finally, the results from the dynamic linear feedback model coincide with those from the multiplicative distributed lag model, indicating not only lag effects from more recent R&D but, in support of the main hypothesis, also an overall long-run effect of internal R&D investments in the distant past on the knowledge production or innovation process of incumbent pharmaceutical firms.

In contrast with the various strands of extant empirical research that are inconclusive about the complementarity or substitutability between different innovation mechanisms, such as internal and external R&D, the second study of this dissertation suggests that, instead of a clear-cut answer to the question whether internal and external R&D are complementary or substitutive innovation activities, there appears to be a contingent relationship between internal and external R&D strategies in shaping a firm’s innovative output. The results from this study indicate
that the level of in-house R&D investments, characterized by decreasing marginal returns, is a contingency variable that critically influences the association between internal and external R&D strategies. More specifically, internal R&D and external R&D, through either R&D alliances or R&D acquisitions, are complementary innovation activities at higher levels of in-house R&D investments, whereas at lower levels of in-house R&D efforts, internal and external R&D turn out to be substitutive strategic options.

The third study examines the impact of two aspects of interfirm alliance network structure—structural holes and indirect ties—on a focal firm’s innovative output. A contingency approach is used by considering the various dimensions of a focal firm’s innovative output—new technology and new products—so as to identify their divergent requirements on the focal firm’s network structure of interfirm R&D alliances. The research setting for this study is the global pharmaceutical industry and the analytic focus is on incumbent pharmaceutical firms as the focal actors in the industry network. The results from the empirical analyses indicate that: (1) with regard to the relative efficacy of network closure vs. structural holes, an R&D alliance network rich in structural holes is more advantageous for incumbent pharmaceutical firms’ creation of new technology, whereas a dense, interconnected network turns out to be more beneficial for their development of new products; (2) concerning the dual role of indirect ties, incumbent pharmaceutical firms with more indirect ties in an R&D alliance network are actually associated with reduced innovative output in terms of new products, while no significant effect is found in the case of new technology.