Journal of Business Research 67 (2014) 2777–2785

Contents lists available at ScienceDirect

Journal of Business Research

Knowledge-flows and firm performance☆

Zeynep Erden [1], David Klang *, Renato Sydler [2], Georg von Krogh [3]

ETH Zurich, Department of Management, Technology, and Economics, Weinbergstrasse 56/58, 8092 Zurich, Switzerland

ARTICLE INFO

Article history:
Received 1 May 2011
Received in revised form 1 February 2012
Accepted 1 August 2012
Available online 23 September 2012

Keywords:
Knowledge-flows
Biopharmaceutical industry
Firm performance
Knowledge-based view

ABSTRACT

This study advances the understanding of how knowledge-flows impact on firm performance. Incorporating recent research on the knowledge-based view of the firm, this paper tests and extends the knowledge flow model by using more fine-grained measures and by proposing a nonlinear effect. This study tests the predicted effects in a longitudinal research design with data on a global sample of public biopharmaceutical firms. The results largely support the expectation that knowledge-flows largely have a nonlinear impact on firm performance. However, one traditional measure of knowledge-flows, geographical location, turns out to have no significant influence in the extended model. The paper explains the implications of these findings for practice and research.

1. Introduction

According to the resource-based view (RBV), the firm is a unique bundle of idiosyncratic resources and capabilities which may sustain the competitive advantage of the firm (Barney, 1991; Mahoney & Pandian, 1992; Rumelt, 1984; Wernerfelt, 1984). The type, magnitude, and nature of a firm's resources and capabilities are therefore important determinants of its profitability (Amit & Schoemaker, 1993), with the role of management to optimally deploy existing resources and capabilities and to develop the firm's future resource base. When firm resources are valuable, rare, inimitable, and non-substitutable they can generate sustained competitive advantage (Barney, 1991). The influential work of Dierickx and Cool (1989) proposes characteristics of asset and resource accumulation that contribute to inimitability and, thus, to sustainability of competitive advantage. Dierickx and Cool (1989) focus on processes and mechanisms that operate over time: "The strategic asset is the cumulative result of adhering to a consistent set of policies over a period of time" (p.1506). A firm's asset stock results from the strategies and choices made over time by the management. Therefore, specific strategic expenditures should be viewed as investments in strategic assets (Hall, Griliches, & Hausman, 1986; Telser, 1961).

The focus on strategic assets and resources has led to an extension of RBV towards the knowledge-based view of the firm (KBV). According to this perspective, knowledge is the most strategically important intangible resource of the firm (Spender & Grant, 1996). How the firm creates, transfers, and uses knowledge impacts on its performance and its ability to compete within an industry (Grant, 1996; Nonaka, 1994; Spender, 1996). Heterogeneous knowledge bases and capabilities among firms are the main determinants of performance differences. Knowledge is a firm-specific asset which is not easily imitated, not tradable (see Barney, 1986) in factor markets. Instead, the firm must accumulate knowledge over time (see Dierickx & Cool, 1989).

The stocks and flows model of organizational knowledge is an important contribution to KBV (DeCarolis & Deeds, 1999). The model has significant value for the management of a firm, since it provides concrete insights regarding a profile of strategic investments in knowledge-flows to succeed in a particular industry. The knowledge stocks and flows model predicts that competitive advantage depends on the continual accumulation of relevant knowledge stocks from knowledge-flows (DeCarolis & Deeds, 1999). The absorptive capacity for new knowledge (Cohen & Levinthal, 1990) is critical to a successful firm, which continually receive (both internal and external) flows of knowledge (DeCarolis & Deeds, 1999). Thus, firms should depend on both their access to flows of knowledge (Andersson, Hohn, & Johanson, 2007) and the respective stock of knowledge as the basis for their absorptive capacity (DeCarolis & Deeds, 1999). In their study of the biotechnology industry, DeCarolis and Deeds (1999) demonstrate in a cross-sectional setting that their proposed knowledge stock variables predict firm performance. Among all knowledge flow variables, which include geographical location, R&D intensity, and alliances, only geographic location shows a significant impact on firm performance (DeCarolis & Deeds, 1999). Yet, it is questionable if

☆ The authors are listed alphabetically and have contributed equally to this paper. Constructive comments and suggestions from Markus Reitzig, London Business School (United Kingdom), Stefan Häfliger, ETH Zurich (Switzerland), and from the anonymous reviewers were helpful in revising previous versions of this paper. The authors especially thank Diego Ardila Alvarez, Uyum Evcin, David Ervenich, Daniel Furrer, and Gerald Weber for their help with the data collection. David Klang gratefully acknowledges the financial support from the Hilti Corproration (research grant no. 160709).

* Corresponding author. Tel.: +41 44 632 0568; fax: +41 44 632 1045.
E-mail addresses: zerden@ethz.ch (Z. Erden), dklang@ethz.ch (D. Klang), rsydler@ethz.ch (R. Sydler), gvkrogh@ethz.ch (G. von Krogh).
[1] Tel.: +41 44 632 8991; fax: +41 44 632 1045.
[2] Tel.: +41 44 632 8171; fax: +41 44 632 1045.
[3] Tel.: +41 44 632 8850; fax: +41 44 632 1045.

0148-2963/$ – see front matter © 2012 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jbusres.2012.09.001

the geographic location of a biotechnology firm should be the only knowledge flow measure that over time significantly impacts on firm performance.

As Dierickx and Cool (1989, p. 1506) emphasize, “Asset stocks are accumulated over time by choosing appropriate time paths of flows over a period of time.” Thus, a lagged effect likely exists between the time of the management taking specific decisions for strategic investments in knowledge-flows and the accumulation of knowledge stocks. A cross-sectional setting such as that in the study of DeCarolis and Deeds (1999) cannot resolve this issue, calling for time-resolved data of knowledge-flows and firm performance. Additionally, the characteristic of asset mass efficiencies explains the economies of scale in the production of intangible asset stocks such that the productivity of investments in the current period increases with larger asset stocks (Dierickx & Cool, 1989; Knott, Bryce, & Posen, 2003). Given a constant level of knowledge stock, higher investments in knowledge-flows may lead to diminishing returns and, thus, to decreased firm performance beyond a certain point. While DeCarolis and Deeds (1999) proposed a linear relationship between knowledge-flows and firm performance, this reasoning accentuates the need to extend the model towards nonlinear effects. Finally, recent advancements of the KBV have given rise to additional, more accurate knowledge flow variables (Herrera, Munoz-Doyague, & Nieto, 2010; Madsen, Mosakowski, & Zaheer, 2003). These advancements call for an extension of the current operationalization of knowledge-flows towards additional components and variables to shed more light on the relationship between flows of knowledge and firm performance.

The current study addresses these shortcomings in the existing literature and makes the following three contributions. First, the study analyzes the relationship between knowledge-flows and firm performance by using longitudinal data. This research design tests the validity of the original relationship proposed by DeCarolis and Deeds (1999). Since knowledge-flows are dynamic and change across firms and time the cross-sectional research design found in prior work is limited in terms of making statistically valid inference (Bierly & Chakrabarti, 1996; Bowen & Wiersema, 1999; Hill & Hansen, 1991). This study is the first approach to use panel data regression techniques to analyze the time-resolved impact of knowledge-flow variables on market capitalization as a measure for firm performance in the biopharmaceutical industry.

Second, in terms of the interaction mechanism, previous research assumes a positive, linear relationship between knowledge-flows and firm performance (DeCarolis & Deeds, 1999). Nevertheless, current research specifically questions the assumed linear relationship (Folta, Cooper, & Baik, 2006; Rothaermel & Deeds, 2006). For example, although decisions for larger investments in knowledge-flows may lead to larger knowledge stocks, asset mass efficiencies constrain the accumulation process (Dierickx & Cool, 1989). After a certain point, additional investments may lead to diminishing returns and, therefore, lower firm performance, since the firm cannot absorb additional knowledge (Cohen & Levinthal, 1990; DeCarolis & Deeds, 1999). This study attempts to resolve this issue by extending the model of knowledge-flows and firm performance by proposing an inverted U-shaped relationship between the two.

Third, this study extends the knowledge-flow variables suggested by previous research (DeCarolis & Deeds, 1999) by adding more accurate as well as new knowledge flow variables. Prior research uses a single score composed of different measures, such as the number of biotechnology firms, NIH grants, and medical schools per Metropolitan Statistical Area (MSA), to measure the knowledge-flows stemming from the knowledge spillovers in the geographical cluster where a firm is located (DeCarolis & Deeds, 1999). Nevertheless, this approach neglects the individual impact of each measure, leading to a coarse-grained view of the mechanisms between knowledge-flows and firm performance. The current study develops a new and more precise measure that captures the density of different kinds of participants in clusters of biopharmaceutical and biotechnological firms in order to capture the geographical component of knowledge-flows.

Additionally, the paper introduces personnel growth as a new variable to measure the human capital component of knowledge-flows. Recent insights from KBV show that the inflow of personnel into the firm can augment the firm's knowledge (Herrera et al., 2010; Madsen et al., 2003). Therefore, strategic investments by the management in hiring additional employees may significantly impact on firm performance.

The next section introduces the theoretical foundations of the model of knowledge-flows and develops specific extensions. The following section presents the research design and data collection method. Afterwards, the results are explained and discussed. The last section concludes the findings and explains their implications for practice and further research.

2. Theory and hypotheses

Dierickx and Cool (1989) wrote their seminal work about the process of resource and asset accumulation and its attributes. While the RBV states that resources might be attained on strategic factor markets (Barney, 1986), Dierickx and Cool (1989) question this view by stating that no such markets exist for some of the assets needed for sustained competitive advantage. They point out that successful strategy implementations require very firm-specific resources, which by their idiosyncratic nature cannot be traded in open markets.

In their discussion about asset and resource accumulation, Dierickx and Cool (1989) use a bathtub metaphor to describe the building and maintenance of asset and resource stocks, “[…] by choosing appropriate time paths of flows over a period of time” (p.1506). Specifically, they explain that “[…] at any moment in time, the stock of water is indicated by the level of water in the tub; it is the cumulative result of flows of water into the tub (through the tap) and out of it (through a leak). In the example of R&D, the amount of water in the tub represents the stock of know-how at a particular point in time, whereas current R&D spending is represented by the water flowing in through the tap; the fact that know-how depreciates over time is represented by the flow of water leaking through the hole in the tub” (Dierickx & Cool, 1989, p.1506). According to this metaphor, managers make strategic choices about expenditures (flows) aimed at accumulating non-tradable assets and resources (stock). In that sense, flows-in minus flows-out defines the change in the stock level, where inflows are investments in an asset stock and the outflows are the erosion of existing asset stocks (Knott et al., 2003). Dierickx and Cool (1989, p. 1506) emphasize, “While flows can be adjusted instantaneously, stocks cannot. It takes a consistent pattern of resource flows to accumulate a desired change in strategic asset stocks.”

Dierickx and Cool (1989) define five attributes of the process of intangible asset and resource accumulation that may lead to the inimitability of these assets and resource and thus to sustainable competitive advantage: time compression diseconomies, asset mass efficiencies, interconnectedness of asset stocks, asset erosion, and causal ambiguity. The characteristic of time compression diseconomies for the accumulation process of the intangible assets implies that maintaining a given rate of investments in flows over a particular time interval produces a larger increment to the asset stock than maintaining twice these investments in flows over half the time interval (Dierickx & Cool, 1989; Mansfield, 1968). The attribute of asset mass efficiencies explains that starting with a low initial asset stock; it might be difficult for the firm to build more asset stock quickly. Especially, at the point of discontinuities, asset mass efficiencies might be even more critical, since a critical mass of asset stock may be required in order to catch up with the industry leaders. Furthermore, an addition to an existing stock might well be dependent on the level of other existing asset stocks, which makes them highly interconnected. Moreover, asset stocks may erode over time (Dierickx & Cool, 1989). For example, R&D know-how can lose its value due to technological obsolescence. Management therefore has to ensure