Technological Forecasting & Social Change xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

Did the global financial crisis impact firms' innovation performance? The role of internal and external knowledge capabilities in high and low tech industries

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ARTICLE INFO

Keywords:
Financial crisis
Innovation performance
Internal capabilities
R&D human capital
External knowledge resources

ABSTRACT

This paper examines the role exerted by internal innovation efforts and external knowledge assets as dynamic capabilities to overcome adverse economic conditions. Additionally, we examine the differential impacts of the financial crisis in high and low-tech industries. Using panel data of manufacturing firms in Spain for the period 2006–2013, our results show that maintaining strong internal and external knowledge capabilities enables firms to mitigate the effects of the financial crisis. Findings emphasize the value of human capital, by enabling internal capabilities, as a coping mechanisms in low-tech sectors during the financial downturn. Similarly, open innovation allows firms to minimise the resources limitations and risk surrounding innovation, particularly during the financial crisis. This study provides valuable insights to managers aiming to develop strong internal knowledge bases to remain competitive under uncertain financial conditions.

1. Introduction

The global financial crisis has made business opportunities less certain forcing companies to postpone long-term innovation investments (Archibugi et al., 2013; Cincera et al., 2012; Colombo et al., 2016; Filippetti and Archibugi, 2011; Paunov, 2012). Public and private R&D investment in most OECD countries has declined since the start of the economic downturn in 2008 (OECD, 2012). Despite an overall fall in firms' innovation efforts, empirical research has demonstrated that firms have continued to deploy innovation strategies to remain competitive during the financial crisis (Colombo et al., 2016; Zouaghi and Sánchez, 2016). According to Hausman and Johnston (2014), the development of new innovations and technologies during the recession period has become crucial to gain competitive advantage.

The innovation literature notes that firms' innovative capacity depends greatly on external competitive pressures (Hansen et al., 2014; Kafouros, 2008). Competing in markets characterised by high levels of instability requires different resources and innovation strategies to those needed to succeed in stable markets (Lee and Makhija, 2009). Colombo et al. (2016) note that high-tech entrepreneurial ventures have responded to the economic crisis through investments in product innovation and expansion into international markets. In contrast, low-tech industries might face additional difficulties in managing R&D projects during a crisis (Berchicci et al., 2013) as they require greater internal organisational capabilities to adapt to rapidly changing external environments. While the return on research efforts might be limited in low-tech manufacturing firms due to lower competitive pressures (Hansen and Winther, 2014), such investments, however, are important in order to benefit from innovation activities in the long term (Kafouros, 2008). Reflecting the cumulative nature of knowledge (Lane et al., 2006; Zahra and George, 2002), firms need to develop strong internal capabilities to support their strategic objectives and survive during economic downturn conditions.

Despite extensive research on the impact of the global financial crisis on firms' innovation performance (e.g. Archibugi and Filippetti, 2013; Berchicci et al., 2013; Cincera et al., 2012; Filippetti and Archibugi, 2011; Laperche et al., 2011; Paunov, 2012), findings remain inconclusive. Further, the role exerted by firms' internal and external knowledge resources during the economic downturn are still largely under-researched (Colombo et al., 2016). In this paper, we argue that internal innovation efforts and external knowledge assets as dynamic capabilities provide firms with sources of competitive advantage (Zahra and George, 2002) that might enable them to overcome adverse economic conditions.

Additionally, we examine the differential impact of the financial crisis in high and low-tech industries. Our hypothesising suggests that

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https://doi.org/10.1016/j.techfore.2018.01.011
Received 28 April 2016; Received in revised form 9 November 2017; Accepted 7 January 2018

the heterogeneity of technological intensity in manufacturing sectors creates distinct contexts for knowledge creation and sharing that influence firms' ability to adjust to external economic pressures and new market situations (Berchicci et al., 2013). High-tech industries are characterised by high levels of technological sophistication and extensive R&D activities (Covin et al., 1990), and are thereby more likely to survive the economic recession and position themselves well for the recovery period (Adcock et al., 2014). Internal resources accumulated during the pre-crisis period act as a stimulus to enhance growth performance during the crisis (Colombo et al., 2016). Low-tech industries, in contrast, acquire externally developed mature and well-established technologies, modify these or apply them in a new context (Bender, 2008); hence they show a strong dependence on the external provision of equipment and knowledge (Heidenreich, 2009). Zouaghi and Sánchez (2016) find that supplier-dominated industries (i.e., agri-food sector) use cooperation agreements to cope with the economic crisis. Therefore, we argue that maintaining strong internal and external knowledge capabilities would enable firms to mitigate the effects of the financial crisis.

This study makes two important contributions to the innovation management literature. First, we investigate the indirect impact of the recent financial crisis on innovation novelty – incremental and radical innovation performance. Downs and Mohr (1976) challenged the idea of a single theory of innovation and argued that each form of innovation could be explained by different predictive variables. Second, the paper examines how internal capabilities and external knowledge assets influenced innovation performance during the financial crisis. Past research has shown the direct effect of innovation investments on firms' innovation performance (Shefer and Frenkel, 2005; Zahra and George, 2002); however, there is limited understanding of their relative influence over the business cycle during pre-crisis and crisis periods (Cerrato et al., 2016). This study draws on the concept of dynamic capabilities, defined as "*the ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments*" (Teece et al., 1997; p 519). These capabilities encompass activities by which managers continuously configure assets into viable resource combinations (Fainshmidt et al., 2017), which makes them suitable to study performance differentials across manufacturing sectors during the financial crisis.

The paper proceeds as follows. Next, we provide an overview of the relevant literature and present the research hypothesis. We then outline our sample, measures and analytical techniques. The research results are reported, followed by a discussion of the theoretical and managerial implications of our findings. We conclude with a discussion of the study's limitations and suggested directions for future research.

2. Theoretical framework and hypotheses

2.1. Internal capabilities and firm innovation performance

2.1.1. R&D intensity

The tacit nature of technological knowledge and the risks associated with the loss of technological competitiveness require internal investments in knowledge generation activities (Spithoven and Teirlinck, 2015). Extant research suggests that internal investments in R&D improve firms' learning capabilities, often referred to as absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002), and constitute an important input to the development of intangible capital (Garcia Martinez et al., 2017; Gu et al., 2016). Prior studies suggest R&D expenditure as a key factor determining a firm's capacity to innovate (Shefer and Frenkel, 2005; Van Beers and Zand, 2014). Segarra-Blasco and Arauzo-Carod (2008) argue that firms operating in markets characterised by strong competition, fast technological change with short product life cycles, and strong market turbulence are forced to continuously introduce new technological developments and innovations to remain competitive.

R&D investments are also important in low-tech industries (Hansen and Winther, 2014; Hervas-Oliver et al., 2011; Hirsch-Kreinsen, 2008). Kafouros (2008) argues that the payoffs from investments in R&D are indeed higher in low-tech firms due to lower competitive pressures, which enable firms to benefit over the long "useful-life" of low-tech products. Hervas-Oliver et al. (2011) find that low-tech firms that conduct internal R&D activities enhance their absorptive capacity and product innovativeness. Van Beers and Zand (2014) point out that new product development is significantly influenced by internal R&D investment in manufacturing firms and its continuity essential for higher innovation performance in low-tech industries. We therefore hypothesise that R&D intensity increases the firm's knowledge base and is positively associated to firm innovation performance.

H1. R&D intensity is positively associated to innovation performance.

2.1.2. R&D human capital

Human capital theory affirms that individual skills, knowledge and capabilities are valuable resources and an important source of economic productivity, and that these skills can be built through education and experience (Becker, 1964). R&D human capital is responsible for transforming the idiosyncratic tacit and explicit knowledge, including learning abilities, experience, and abilities necessary to perform firms' activities (Delgado-Verde et al., 2016; D'Este et al., 2012). A highly skilled workforce can assimilate and integrate external knowledge into internal innovation processes (Huang et al., 2015; Teirlinck and Spithoven, 2013). In particular, highly task specific (skills) human capital is required to integrate external knowledge with a high degree of tacitness associated with highly sophisticated, complex technological processes (Gibbons and Waldman, 2004).

Human capital is central for manufacturing competiveness and product innovativeness. Garcia Martinez et al. (2017) argue that highly skilled R&D staff is a valuable strategy for high and low-tech manufacturing industries to enhance innovation performance as it increases the stock of knowledge of an organization. Hansen and Winther (2014) show that highly skilled employees are crucial in low-tech manufacturing firms to increase sales and innovativeness. Similarly, Hervas-Oliver et al. (2011) highlight that qualified human resources drive innovation in low-tech manufacturing industries. Thus, we argue that R&D human capital matters for the determination of a firm's absorptive capacity and leads to superior innovation performance.

H2. R&D human capital is positively associated to innovation performance.

2.2. External knowledge sources and firm innovation performance

Today's fast paced business environment and shortened product life cycles require firms to develop external links and external collaboration relationships to boost their innovative performance and meet new business challenges (Garcia Martinez et al., 2017). Inter-organisational alliances are increasingly recognised in the innovation management literature as 'access relationships' that enable partners to acquire non-redundant knowledge and capabilities residing outside their organisational and technological boundaries (Chesbrough, 2012; Cui and O'Connor, 2012; De Man and Duysters, 2005; Vasudeva and Anand, 2011). Resource-based scholars argue that strategic alliances facilitate access to diverse markets and technological knowledge (Lin, 2014; Zhou and Li, 2012) and boost innovation by enhancing combinatory search (Jiang et al., 2010; Lahiri and Narayanan, 2013). These advantages are hypothesised to be particularly relevant for breakthrough innovation and novel technologies (Datta and Jessup, 2013; Garcia Martinez, 2013) or following technological shocks that create demand for new resources (Asgari et al., 2017).

Such open strategies depends on contributions from across a network of partners ranging from suppliers of raw materials, equipment,