Challenging the knowledge resources complementarity hypothesis

Vendrell-Herrero, Ferran; Molina-Fernandez, Luis M; Bustinza, Oscar

DOI:
10.1080/14778238.2021.1967215

This is the author's copy of a Manuscript published by **Taylor & Francis** in *Knowledge Management: Research & Practice*, accepted 5th August 2021.

Challenging the knowledge resources complementarity hypothesis: A counterexample

Ferran Vendrell-Herrero[a], Luis M Molina[b], Oscar F. Bustinza[b]

[a]*Department of Management, University of Birmingham, UK;* [b]*Department of Management, University of Granada, Spain*

Abstract: Drawing on the resource-based view of the firm, and counter to the mainstream literature, we propose and empirically show that two knowledge resources can be substitutive (rather than complementary) for each other. Our test focuses on the interplay between managers' and workers' knowledge stock, considered as knowledge resources that firms can apply to improve innovation. We hypothesise a mutually exclusive effect of managerial experience (managers' knowledge stock) and labour skills (workers' knowledge stock) on product innovation. Drawing on the most recent waves of the World Bank Enterprise Survey (WBES), we construct a cross-sectional sample of 2,725 manufacturing firms. We used binary choice model to test the proposed effects. The results show negative interaction between labour skills and managers' experience in determining the probability to achieve product innovation, putting the knowledge resource complementarity hypothesis into question, and opening an academic debate that will have implications for knowledge management practice.

Keywords: knowledge resources; capabilities; innovation; interaction effects; Latin America

Introduction

Within manufacturing companies knowledge management focuses on the pursuit of product innovation (Corso et al. 2001). Product innovation is an element central to firm differentiation and the achievement of supra-normal returns (Utterback and Abernathy 1975). With new processes, methods, and methods of delivery, product innovation is an enabler of successful innovation that results in significant efficiency enhancements (Albury 2005). To succeed, innovation that materializes in development, implementation and use of new or

improved products requires significant improvement in organizational value-added outcomes (Crossan and Apaydin 2010). Since the most frequent approach to measuring firm innovations is to examine the new products introduced by a firm, product innovation is the most salient aspect of innovation management (Mairesse and Mohnen 2010). The most common reasons for adopting product innovation are to achieve higher market share, greater customer loyalty and better competitive positioning (Damanpour and Gopalakrishnan 2001). Nevertheless, for successful implementation, product innovation requires establishment of a dynamic and reciprocal relation with the firm's competencies that underlie technologies and customers relationships (Danneels 2002).

Since the dynamics of product innovation are linked to different business resources (Ritter and Gemünden 2003), product firms seek to develop organizational resources that facilitate positive innovative outcomes (Lages et al. 2009). One theory that has enabled extensive understanding of strategic organizational resources and capabilities is the Resource-Based View (RBV) of the firm (Wernerfelt 1984). This theory explains that organizational resources and capabilities are responsible for enhancing and extracting greater business benefits from product innovation (Lai et al. 2010). The general framework of the RBV identifies four fundamental attributes of strategic resources: (1) value, (2) rarity, (3) imperfect imitability and (4) non-substitutability (Barney 1991). Although extensive documentation shows that these attributes are explained to a great extent by the firm’s internal knowledge and the leadership team’s resources and capabilities (Damanpour et al. 2018), fuller understanding is needed to determine which resources are valuable, rare, inimitable and non-substitutable (VRIN), and how these resources should be combined to achieve greater competitive advantage (Ainuddin et al. 2007).

A growing number of studies based on the RBV disagree with approaches that study the relationship between a specific individual resource and performance (Sirmon et al. 2007).

This line of research questions whether the direct relationship among better resources always brings better results and argues the need to analyse the relationships among these resources. The relationship among resources can be either synergistic—among complementary resources (Paradkar et al. 2015)—substitutive (Clarysse et al. 2011), or neutral (Lavie 2006). Resource complementarity is the dominant paradigm. To date, quite a few studies have analysed substitutability. Although Peteraf and Bergen (2003) asserted the importance of considering substitution of resources, very few studies have analysed this relationship, and those performed focus primarily on the different internal and external resources available to entrepreneurs and the possibility of these resources' substitutability (Xiao and Ramsden 2016).

The lack of studies on resource substitution is a significant problem. In fact, Priem and Butler (2001) question the capability of the RBV as a scientific theory. In this debate, the possibility that the resources are substitutable plays a central role in determining the real value of a specific resource to generate a competitive advantage for its company. In their view, one weakness of the RBV is that the value of a specific resource for a company is determined externally to the RBV. Nevertheless, part of the resource's value in generating a competitive advantage depends on the RBV rationale in itself, since the RBV predicts that resources only generate a competitive advantage if they are non-substitutable. It thus follows that analysis of resource substitution is key to the RBV schema. Despite the centrality of substitution, no significant empirical evidence has been gathered to date on this effect. Our study focuses on this major research gap in an area that reinforces and supports the RBV, that is, whether we can test and validate the substitution effect, as the theory proposes.

Among the resources and capabilities available to drive innovation, previous studies stress the great importance of resources and capabilities that focus on knowledge (Curado et al. 2018; Khaksar et al. 2020). Knowledge, or knowledge stock, is a specific type of resource

that has received considerable attention within the RBV, as knowledge stock should fulfil the rarity attribute and thus sustain a competitive advantage. The study of available knowledge sources and their relationship to innovation is a topic of great interest, with predominant focus on the relationship between the relative importance of internal and external knowledge (Segarra-Cipres et al. 2014). The alternative of investigating possible substitutability among the different knowledge sources on innovation has received insufficient analysis, despite the theoretical and practical importance of determining whether more knowledge is always better or whether it is possible to substitute one form of knowledge for another to drive innovation. Following Conner and Prahalad (1996) on substitution of forms of knowledge and their application by workers and managers, we argue that there is a mutually exclusive effect of workforce skills and managerial experience in determining innovation outcomes. Skilled workers have more freedom to develop their own projects and apply their expertise when working with less-experienced managers. Furthermore, more-experienced managers work more effectively when they work with less-qualified workers, who focus on the assigned tasks. We test these effects on a sample of 2,725 Latin American manufacturing firms taken from the World Bank Enterprise Survey (WBES).

This study makes three important contributions to knowledge management scholarship. First, it sheds new light on the relationship between firm knowledge stocks and firm's capacity to innovate, emphasizing the existence of harmful synergies between managers' and workers' knowledge stock (Conner and Prahalad, 1996). Second, in doing so, it offers a counterexample that falsifies the largely extended conviction that resources are non-substitutable, i.e. adding more of a resource cannot diminish firm's capacity to innovate (Barney, 1991; Lavie 2006; Paradkar et al. 2015). Therefore, the study shows that investing on a knowledge resource might diminish the value of other knowledge resources that the company already possesses. Third, it responds to recent calls for studies to contextualize

theory applicable to the full range of economic development (e.g., Teagarden et al. 2018). Most extant work has focused on more developed economies to the neglect of less developed counterparts. The use of the WBES data enables us to explore knowledge stock dynamics in a number of developing countries.

This article is organized as follows. First, we perform the literature review from which to propose the hypotheses. Next, we present the methodology and explain the sample chosen. Analysis and discussion of the results follow. The article ends with a section on conclusions, as well as the study's limitations and future lines of research.

Literature review and hypothesis development

Knowledge and innovation

Knowledge is a key resource in the strategic management literature (Grant 1996). The theory of resources and capabilities emerged to provide an economic explanation of the differences in organizations' performance (Barney 1991). The knowledge-based view (KBV) of the firm has been crucial in explaining differences in performance between organizations. According to this view, firms differ in both the knowledge resources they have available (knowledge stock) and their capability to manage these resources. In this context, knowledge management has emerged as a central research field that studies the best strategies and practices for improving knowledge as a key resource. Although many studies support the KBV of the firm using transaction cost theory (Baskerville and Dulipovici 2006), the main research line on the KBV of the firm takes RBV as its theoretical foundation. This paper therefore grounds development of its propositions in the RBV, considering knowledge stocks as resources and knowledge capabilities (i.e., absorptive capacity, knowledge transfer capability, etc.) as a specific type of RBV capability.

A rich literature has emerged on the relationship between innovation and the KBV of the firm (Arias-Aranda and Molina 2002). For Andreeva and Kianto (2011, pp. 1017), "a key premise in the literature on new product innovation is that the rate of new product introduction is a function of a firm's ability to manage, maintain, and create knowledge". The relationship of different knowledge stocks to innovation has thus been analysed (Sun and Hou 2017), as have the importance of internal (Tortoriello et al. 2012) and external (Bustinza et al. 2019) flows, the interaction between internal and external flows (Caner and Tyler 2015) and the interaction between flows and stocks of knowledge (Roper and Hewitt-Dundas 2015). Research has also studied how the organization's knowledge management capabilities (Ruiz-Jiménez et al. 2016) affect its innovation performance.

These studies always assume, however, that more knowledge resources and capabilities are better, leading to a widely accepted knowledge resource complementarity hypothesis. Although (as indicated in the introduction) the theoretical framework for the firm's resources and capabilities stresses that one of the four main attributes a resource must have is non-substitutability (Barney 1991), these studies do not investigate the possibility of substitution effects among them. Research has recently begun to study both the importance of the relationship of substitutability among resources (Clarysse et al. 2011; Peteraf and Bergen 2003) and the importance of configuring resources for optimal performance (Youndt et al. 2004). By way of a counterexample, the following sections present a series of theoretical arguments that suggest a substitution effect between employees' training and the manager's experience.

Workers' skills and product innovation

Knowledge stocks include both explicit and tacit knowledge. Explicit knowledge stock is knowledge that has been coded and usually incorporated into corporate databases (Lee et al. 2020). Workers' skills forms part of the firm's tacit knowledge stock (Caloghirou et al.

2018).

Accessing skilled workers' tacit knowledge is crucial to increasing product innovation (Buenstorf and Heinisch 2020). For instance, Ryan et al. (2018) stress that individuals are one of the microfoundations of innovation. Capability evolution in innovative firms is a consequence of the mindful behaviour and interactions of individuals (Salvato and Rerup 2011). The knowledge stock accumulated by workers is the foundation from which organizations innovate. Innovations emerge based on the knowledge stock accumulated and through recombination of this knowledge stock (Galunic and Rodan 1998). Knowledge stock is thus a central enabler of innovation, implying that "the innovative efforts are the right consequence of the investment in knowledge and knowledge workers" (Carneiro 2000, p. 92).

Prior studies that analyse the relationship between skilled workers and product innovation in different ways find a direct relationship between the two constructs (Caloghirou et al. 2018). Engelman et al. (2017) analyse how absorptive capacity mediates the relation between the two constructs. Xie et al. (2016), in contrast, analyse how workers' potential relative to their skills moderates the relationship between knowledge inertia and product innovation. The product innovation literature has previously used labour skills as a fundamental variable to determine the organization's innovative potential. Based on this, we formulate the following hypothesis:

H1. The greater the workers' skills, the greater the firm's product innovation performance.

Manager's experience and product innovation

Manager experience encompasses skills and knowledge as well as the top management team's competency (Kor 2003). Managers' experience thus forms part of the firm's tacit knowledge stock (Caloghirou et al. 2018). The importance of the top manager (or CEO in the

corporate world) in determining the firm's performance has continued to grow over time (Quigley and Hambrick 2015).

Upper Echelons Theory (Hambrick 2007) is the fundamental theoretical framework, under the premise of bounded rationality, for analysing whether seniors managers' characteristics are the factors that condition the firm's decisions (Hambrick and Mason 1984). Managers' importance in determining the firm's level of innovation has also been theorized in this context (Yadav et al. 2007). The CEO's experience in the sector is considered as essential for product innovation (Matzler et al. 2008). The firm's top management must also possess expertise in the industry (Ruiz-Jiménez et al. 2016) and have sufficient experience in managing private companies (Ortin-Angel and Vendrell-Herrero 2014). These qualifications ensure that efforts are made in the right direction and that the firm's structure and organization are adapted to the needs of an innovative organization (Mohan et al. 2017). Along these lines, Custodio et al. (2019) confirm that the CEO's experience spurs innovation due to the knowledge the CEO acquires and the skill he/she develops. Based on these arguments, we formulate the following hypothesis:

H2. The greater the manager's experience, the greater the firm's product innovation performance.

Interaction between workers' skills and manager's experience in determining product innovation

One of the growing debates in business management is to understand how different business practices interact with each other to achieve higher (or lower) levels of innovation (Laursen and Foss, 2003), productivity (Delmas and Pekovic, 2018) and business performance (Crifo et al. 2016). In this section, we analyse through the RBV and KBV lenses the interrelation between workers' skills and manager's experience.

RBV argues that the firm's resources and capabilities can interact in two directions. Some of the firm's resources may be complementary and, when combined, generate synergy amongst themselves (Delgado-Verde et al. 2017). Other resources, in contrast, may replace each other. The latter possibility has received much less attention, as it contradicts initial RBV postulates suggesting that a resource must be not only valuable, rare and non-imitable, but also non-substitutable (Barney 1991).

The interaction that occurs between resources depends on the different use the resources have. If these two resources are ultimately used for the same end in the firm, their relationship will be one of substitutability (Peteraf and Bergen 2003). One example is the relationship between mental capability to perform large mathematical operations and any electronic computer system. These two resources may be substituted for each other to obtain the same service. If resources are used such that they coordinate and cooperate in synergy to perform a service together, the resources are complementary. For example, it is usually said that having high potential absorptive capacity does not improve a firm's performance if this capacity is not complemented by realized absorptive capacity (e.g., Jiménez-Barrionuevo et al. 2019).

Ideas advanced by Conner and Prahalad (1996) can be applied to the firm's workers and manager when their knowledge is applied to innovation. Since the knowledge substitution effect is ultimately applied at work, organizations exist because workers see their knowledge replaced by superior knowledge (the knowledge available in the organization), giving to the organization a competitive advantage over markets in which this effect does not occur (Conner and Prahalad 1996).

According to the KBV, a firm that seeks to innovate has various options. If managers lack sufficient experience, they can hire qualified workers, who bring knowledge with them and can apply it in innovation processes (Falk and Biagi 2017). To some extent, these

managers are buying the knowledge that workers have absorbed in markets with productive factors and will then apply in innovation processes. When managers know the lines of innovation that their organization should follow, however, the manager's knowledge could replace the knowledge applied by the workers, such that the manager's vision guides the innovation processes.

To confirm this view of the substitutability between manager's experience and workers' skills, the theoretical view adopted in this paper predicts that the importance of the workers' skills in innovation decreases as the manager's experience increases. Based on the substitution of resources proposed by the KBV developed by Conner and Prahalad (1996) and considering the substitution effect central to the RBV, we formulate the following hypothesis:

H3: Manager's experience and labour skills are mutually exclusive determinants of product innovation.

In sum, we hypothesize that both manager's experience and workers' skills have an independent, direct and positive relationship to product innovation but that their joint effect reduces likelihood of innovating.

Data and method

Context and database

This study uses the context of Latin America, including the Caribbean, to test the hypotheses. According to the 2019 World Bank indicators (World Bank 2019), the region had an approximate GDP of US$6 trillion in 2017. This GDP accounts for 7.4% of global production, a considerably higher contribution than the region made in 2007 (6.8%). This regional economic growth translates into development of strong metropolitan areas and many firms that are world leaders in their sectors (Aguilera et al. 2017).

Latin America can also serve as a 'natural laboratory' for testing theories developed in the United States and Europe (Aguinis et al. 2020). The region is more homogeneous than Europe and Asia. Countries within the region share an analogous colonial history that is reflected in their common religion (mostly Catholic), legal structures (mostly French legal origin) and language (mostly Spanish and Portuguese) (Vassolo et al. 2011). The region's relative homogeneity of legal and cultural conditions across countries reduces confounding effects and increases comparability (Cuervo-Cazurra 2016). With the exception of Mexico, the region is geographically isolated, which increases the development of more common path dependencies (Vendrell-Herrero et al. 2017). Based on these conditions, Latin America presents unique conditions particularly conducive to theory testing.

Three specific elements that affect key variables of interest (i.e., manager's experience, workers' skills and product innovation) make the context especially suitable to test the knowledge resource substitutability hypothesis. First, an orientation of respect towards elders and holders of higher ranks pervades the organizational culture, accentuating leadership styles based on benevolent paternalism (Davila and Elvira 2012). In these circumstances, the authority/power of an experienced manager is greater than in more-developed economies. Second, since the economic growth experienced in the region, combined with a process of brain drain, produces a lack of qualified workers (Newburry et al. 2014), it is much less common to hire graduates than in other regions of the world, where the workforce tends to be overqualified. Lastly, innovation in the region does not fit traditional high-technology models. Since Latin America's companies tend to face technological and capability gaps and struggle to achieve international standards (Casanova et al. 2016), offering product innovation to the market is an important element in securing market competitiveness in the region.

This study requires survey data that capture operational, strategic and knowledge nuances better than many secondary financial databases. We use the World Bank Enterprise Survey (WBES), a survey specifically conducted to gather information on the business climate in less-developed regions. The WBES has been used extensively in previous studies that analyse strategies of firm innovation (Birhanu et al. 2016; Vendrell-Herrero et al. 2020) and internationalization (Gomes et al. 2018; Nieto et al. 2021) in various developing regions/countries. The survey uses a stratified sampling technique based on firm size, location and sector. It collects detailed information on various firm characteristics, outcomes and strategic choices. Our study uses the most recent survey rounds conducted in the region, which cover the period 2016-18.

By restricting our sample to the most recent WBES in Latin America, we focus on a diverse but limited number of countries. We analyse firms located in 12 different countries, four in Central America Figure 1 maps those countries in the region and shows their relative weight in the sample. For purposes of homogeneity, we restrict the sample to firms in the manufacturing sector. The sample available is of 2,725 manufacturing firms.

[Figure 1 near here]

Key variables

Construction of the dependent variable, *product innovation*, follows the same procedure as the community innovation surveys (Cirera and Muzi 2020) implemented in previous empirical studies using WBES (Goedhuys and Veugelers 2012). The measure of product innovation is based on the question, "*During the last three years, did your establishment introduce any new or significantly improved products in the market?"* The resulting binary variable takes the value "1" for a positive answer ("Yes") and "0" otherwise. Given the nature of our context (emerging markets in Latin America), the types of innovation captured by these measures are likely to be "new to the market" or "new to the firm", rather than "new

to the world" as is usually the case for European countries (Altomonte et al. 2013). Of the firms sampled, 42.9% claim that they obtained product innovation in the last three years. This figure is quite similar to that obtained in other studies that analyse product innovation in developed countries (Martínez-Ros 2019).[1]

The first independent variable is percentage of *Skilled Workers*. Construction of this variable follows previous research that analyses the mix of workers' capabilities, dividing workers into categories according to their skills, that is, considering the occupation or tasks the individual performs rather than his/her qualifications (Falk and Biagi 2017). Here, we consider production workers and calculate what percentage are highly skilled. For example, in an average firm in the sample with 100 workers, approximately 70 will work in the production division, while the remaining 30 fill other positions, including finance, legal or human resources and sales functions. Our variable focuses on the skill distribution of the 70 production workers. Among the firms sampled, the average firm has 26 highly skilled workers, 21 semi-skilled and 23 unskilled. The percentage of highly skilled labour in our sample is thus on average approximately 37% (=26/70). The second independent variable is *Manager's experience.* Following previous studies (e.g. Narteh and Acheampong 2018), we operationalize this variable with the question: "*How many years of experience working in this sector does the top manager have?*" In the WBES, top manager (or CEO) refers to the individual with the highest managerial role in the company, which may be the owner if he/she works as firm manager. In our sample, the average CEO has 25 years of managerial experience.

We add a number of firm and business environment characteristics that serve as control variables in our model. As innovation activities seem to correlate closely, the analysis

[1] While the binary nature of our innovation variables has some limitations, this approach is mainstream in the innovation management literature. More specifically, we built the measure for our dependent variable on the internationally adopted standards proposed by the Oslo Manual (2005), which defines product innovation as "the implementation of a new or significantly improved product".

includes dichotomous variables for *process innovation* and *R&D*. We controlled for number of *workers* because firm size may affect firms' innovation outcomes. Since smaller firms tend to have more limited resources, these firms tend to use different approaches to innovation than larger firms. The average firm size in our sample is 126.1 employees. Firm *age* has been included in previous management studies as an important control variable because it seems to correlate with firm growth. The average firm age in the sample is 27.9 years. For convenience in interpreting parameters, our tables divide number of employees and firm age by 100. Innovation and internationalization seem to be closely connected constructs (see (Altomonte et al. 2013). To control for this correlation, we introduce *export intensity*, computed as foreign sales over total sales. On average, foreign sales account for 12.6% of sales in the firms sampled. Geographical proximity to external knowledge in firms with intensive business services (KIBS) is another variable that influences product firms' innovation outcomes (Lafuente et al. 2019). We therefore control for the percentage of knowledge-based service firms in the city where the manufacturer is located, operationalizing a city-level measure of *KIBS co-location* with the measure presented in Vendrell-Herrero et al. (2020). We then take the total number of service firms in communications and business services (COMMS) as a share of the total number of service firms (TOTSERVICES) in the city (c). Our measure of KIBS co-location thus takes the form $KIBS_c = COMMS_c / TOTSERVICES_c$ and produces an average of 0.128 for this sample. Finally, production firms usually have slack resources that enable them to increase production if demand rises but that increase fixed costs (George, 2005). We operationalize slack resources using the WBES measure for *capacity utilization*. Firms in the sample use 71.04% of their capacity. Table 1 displays the variables' means, standard deviations and correlations.

[Table 1 near here]

Results

Binary choice regression analysis

The aim of this research is to understand how hiring strategies and manager's experience influence a firm's innovation outcome. Since we use a dummy variable to measure our dependent variable, binary choice regression (Logit) is the appropriate method to estimate a firm's probability of achieving product innovation. We aim to test the joint effect of hiring skilled workers (W) and manager's experience (M) on the firm's likelihood of innovating (P). Equation 1 describes our empirical model, where subindex *i* refers to the firm; Ω_i is the vector of control variables; $\vartheta_s, \vartheta_c, \vartheta_t$ indicate sector, country and year dummies; and ε_i is the error term. According to Hypothesis 1, higher rates of skilled workers lead to higher innovation propensity, suggesting that β_1 will be positive. Similarly, since we hypothesized (H2) that manager's experience is conducive to product innovation, we expect β_2 to be positive. Finally, to confirm the resource substitutability hypothesis (H3), β_3 must be negative. In accordance with the procedures for testing interaction effects suggested by Aiken et al. (1991), the two key independent variables (M and W) were standardized by subtracting their mean and dividing by their standard deviation, so we reduced possible distortion caused by strong correlations between the interaction term and its components.

$$P_i = \alpha + \beta_1 W_i + \beta_2 M_i + \beta_3 W * M_i + \Omega_i + \vartheta_s + \vartheta_c + \vartheta_t + \varepsilon_i \quad (1)$$

Table 2 presents the main results for the specification in Equation 1. The results are presented in hierarchical order, starting with the baseline model that contains control variables (Model 1), then including independent variables in Model 2, and finally estimating a full model that adds the interaction term (Model 3). Various ex-post exercises validate the fit of this full model. When imposing a cut-off level equal to the probability of achieving product innovation in the sample (43.9%), Model 3 correctly classifies 66.6% of the

observations, with a distribution balanced between specificity (68.6%) and sensitivity (63.9%). Further, the C-statistic of 0.7239 (higher than the commonly accepted threshold of 0.7) and the non-significant Hosmer-Lemeshow goodness-of-fit test indicate good fit (Prob > chi2 = 0.3019). The other models show similar fit indices. Overall, these tests suggest that our model specifications are appropriate for the data.

[Table 2 near here]

We start analysing the relationship between skilled production workers and the likelihood of being a product innovator. The skilled worker coefficient is positive in all estimations. Although this coefficient is non-significant (β_1=0), leading to reject Hypothesis 1. We also analyse the direct relationship between manager's experience and likelihood of being a product innovator. The parameter is also non-significant (β_2=0), rejecting Hypothesis 2 as well.

The data do not support Hypotheses 1 and 2, but the substance of the analysis lies in testing the interaction effect. Hypothesis 3 proposes a substitution effect between skilled workers and manager experience in explaining probability of innovating, and this effect is analysed through the interaction term, β_3. As hypothesized, the parameter is negative and statistically significant in all models. According to the full model, if the other variables remain constant (et ceteris paribus), an increase of 1% in the value of the interaction term leads to a decrease of 0.0143 percentage points in likelihood of innovating. This result is significant at 1% (P-value < 0.01).

Analysis of the coefficients for the control variables obtained shows only R&D and process innovation to be statistically significant. According to Model 3, firms investing in R&D (with process innovation) have a likelihood of obtaining product innovation that is 0.1488 (0.1869) percentage points higher than that of the other firms sampled. Significant at 1% (p-value <0.01), this result is consistent with existing research that stresses that

involvement with R&D activities and process innovation increases the odds of attaining higher levels of product innovation (Goedhuys and Veugelers 2012; Martínez-Ros 2019).

Graphical analysis

Estimation of interactive effects is quite complex in non-linear models, since coefficients have systematic inconsistencies (Ai and Norton 2003). For example, the interaction effect is conditioned by the independent variables and may take different signs for different values of covariates. To correct for this limitation, previous research strongly encourages interpreting the magnitudes of marginal effects through graphical examination (Zelner 2009). The following procedure shows that graphical analysis supplements the main logistic regression analysis. Figure 2 shows this analysis for the estimation in Model 3. The figure is composed of three panels with a common X-axis, the predicted probability that the firm actually is a product innovator. Panel A (on top) shows the correct marginal effects. Panel B (in the middle) shows the statistical significance of this marginal effect. Panel C provides the histogram, showing the fraction of firms with a specific predicted probability of innovating. According to Figure 2 Panel A, the skilled workers – manager's experience interaction effect is especially negative for the firms with a predicted probability of innovating within the range of 0.4-0.6. According to Panel C, 28% of the firms in the sample are in the 0.4-0.6 range (770 firms). For these firms, the marginal effect of the interaction term is on average -0.0040, with a minimum of -0.0042. The negative effect of the interaction term is less severe for firms at the extremes. Predicted probability of innovating is higher than 0.8 for 46 firms and lower than 0.2 for 365. For these firms, the interaction can be as low (in absolute terms) as -0.0015. According to Panel B for all observations, the statistical significance is just below the 5% threshold.

[Figure 2 near here]

To help with practical interpretation of the results, we plot the interaction terms between skilled workers and manager's experience (see Table 2 Model 3). For the sake of interpretability we use the non-standardized form of independent variables. Figure 3 restricts manager's experience to a selection of values: managers without previous experience or apprentices in their first year in the role when surveyed, junior managers with 10 years of experience, senior managers with 30 years of experience and veterans with 50 years of managerial experience. While percentage of skilled workers is still a continuous variable, manager's experience becomes a categorical variable. As per Figure 3, a higher percentage of skilled labour is conducive to product innovation for inexperienced and junior managers. The slope of the curve flattens for senior managers and becomes negative for veteran managers.

[Figure 3 near here]

Robustness test: Interaction vs. substitution effect

Although substitution necessarily involves the interaction of resources, the two activities are not necessarily the same. Interaction between two resources does not necessarily imply the substitution of one for the other--that is, the existence of one resource in the absence of the other. Importantly, in our context, applying the condition of absence to resources is not feasible, since all managers have some experience and nearly all (if not all) firms have some skilled workers. To resolve this problem, Table 3 includes an additional analysis considering relatively high (above mean) and relatively low (below mean) levels of the resources.

[Table 3 near here]

Our results indicate that R&D and Process innovation are the main antecedents of product innovation. Hence, to analyse the substitution effect between manager experience and skilled workers, it is vital to consider the presence/absence of knowledge generation capabilities (R&D) and technical capabilities (process innovation). A first step in Table 3 is thus to produce a 2x2 matrix to interpret the average probability of firms in each quadrant.

Firms with neither R&D nor process innovation have a very low probability of achieving product innovation (25.3% vs. 43.9% in the full sample), whereas firms with both technical and knowledge generation capabilities have a very high probability of achieving product innovation (63.9% vs. 43.9% in the full sample). In none of these quadrants do manager's experience and workers' skills seem to have an effect in determining product innovation. We find more nuances, however, when we analyse the intermediate cases, in which the firm shows the presence of one capability and absence of the other.

First, we analyse the group of firms with technical capabilities but without knowledge-generation capabilities. In this group, the average probability of achieving product innovation is higher than the probability we encounter in the sample (55.3% vs. 43.9%), but this probability changes based on the relative endowment of manager's experience and workers' skills. Firms with high endowments of both resources have an innovation probability of 50%, whereas firms with relatively high (low) endowment of skilled workers and relatively low (high) endowment of manager's skills perform much better, with a 61.1% (56%) average probability of achieving product innovation. Therefore, firms in this quadrant that prioritize one resource relative to the other exhibit a much larger probability of achieving product innovation than do firms with high endowment of both resources. This result indicates a need to choose one resource before the other, suggesting the presence of a substitution effect.

We conclude this analysis with the group of firms that has knowledge generation capabilities but lacks technical capabilities. In this group, the optimal arrangement is to have an experienced manager with a relatively low endowment of skilled workers. This arrangement achieves the highest probability of product innovation in the sample (69.5%) and is clearly superior to the arrangement in which manager's experience and workers' skills are relatively high (58.9%). Again, the results for this quadrant seem to indicate that firms are

better off if they focus attention on one of the resources (in this case, manager's experience) and leave the other resource aside. This finding suggests that a substitution effect occurs.

Discussion of the results

The results do not confirm two of the hypotheses formulated in this study. First, the analysis does not report a positive relationship between having qualified workers and achieving product innovation. The analyses performed contradicts prior results that find a direct and positive relationship between percentage of skilled workers and level of product innovation (González et al. 2016). Second, the analysis does not find a positive relationship between the managerial experience and product innovation. Although this result aligns with those of previous studies (Phung Minh Thu et al. 2018), evidence exists that the CEO's experience does affect innovation positively (Custódio et al. 2019). Since the evidence is contradictory, more in-depth study of this relationship is needed. Overall, our results indicate no direct relationship between any of these variables and product innovation, making it of great interest to study the variables that mediate/moderate the relationship between worker's skills/manager experience and product innovation.

The main result of this study is the interaction between percentage of skilled labour and CEO's experience. Consistently with Conner and Prahalad (1996), the results indicate that product innovation increases in firms with a higher percentage of skilled labour but that this positive relationship decreases as the CEO's experience increases. This negative moderating effect occurs even in the case of senior or veteran managers and determines whether or not skilled labour has a negative effect on product innovation.

We also determine the contextual conditions under which the substitution effect is salient. The most interesting results occur in two particular contexts, namely the R&D absence- Process innovation presence quadrant and the R&D presence-Process innovation absence quadrant. The optimal combination of manager's experience and workers' skills is

Low High in the former and High Low in the latter. This result reinforces the idea that manager's experience and workers' skills function as substitutes for each other in achieving product innovation. This result supports a further interpretation. On the one hand, firms with technical capabilities can obtain superior product innovation by recruiting skilled workers and having a manager with limited (below mean) experience. Technical knowledge exists among the employees with formal education, who need some flexibility to undertake innovation tasks (Ryan et al. 2018; Xie et al. 2016). On the other hand, firms with knowledge-generation capabilities can obtain superior product innovation by recruiting experienced managers but having a less-skilled workforce. Since the manager governs/leads investment in knowledge-generation capabilities, his/her experience seems fundamental to increasing predicted probability of increasing product innovation (Custódio et al., 2019; Quigley and Hambrick, 2015). In this environment, having a workforce with below-mean skills helps, as the manager has more room to enforce his/her leadership.

Conclusion

Academic implications

Most prior studies in the literature on resources and capabilities assume that two resources or capabilities have positive individual effects on performance, and that the more we invest in developing and acquiring both, the better the end result will be for the organization, even producing an effect of synergy (González et al., 2016). Our study proves this generalized assumption wrong through a counterexample. According to our study results, the substitution effect that occurs between two resources (workers' skills and CEO's experience) shows that this accumulation of resources can be undesirable under certain conditions. In our context, this negative effect occurs because of different costs for the firm. Whereas skilled workers are a sunk cost associated with standardization processes that firms attempt to recover (Lai et al. 2010), senior managers both cost less and are easier to replace. These results show why it

is advisable for firms to adjust the capabilities of senior managers and skilled workers to avoid a substitution effect between them.

Our findings have important implications for RBV. Although the very origins of this theory postulate the importance of possible substitution effects among the resources and capabilities to determine their potential to generate competitive advantages (Barney 1991; Peteraf and Bergen 2003), further studies of possible interaction among firms' resources and capabilities have been neglected almost systematically. Our findings open a very extensive field of research on the real effects of accumulation of resources and capabilities on business performance by considering the effects of the interactions among them on performance.

The results are also important for the KBV of the firm. First, these results support the theory of the KBV developed by Conner and Prahalad (1996). Despite its theoretical importance, this view has not received sufficient empirical analysis. Second, the maxim that more knowledge is always better should be reviewed, since the interaction and substitution effects between different stocks of knowledge can lead to unexpected results. In the previous literature, only the fact that acquisition costs are greater than their value for the company has been considered (Delgado-Verde et al. 2017). Our results suggest not only that financial performance may ultimately be diminished by the difference between costs and benefits, but that even overall performance can be diminished if the associated costs are not considered.

This study also makes important contributions to the product innovation literature. On the one hand, the study sheds light on the need to analyse in greater depth the effect of complementary resources on innovation, since the interaction among resources plays a determining role in appropriation of profits from innovation (Stieglitz and Heine 2007). Moreover, the results underscore the need to deepen knowledge of the substitution effect among resources, since complementarity of resources is one of the crucial mechanisms that firms possess to establish barriers to imitation (Dierickx and Cool 1989). Finally, the results

generate significant consequences for establishing synergistic effects among resources as the basis for innovation. As Stieglitz and Heine (2007) indicate, the substitutive effect of one specific resource reduces the marginal benefit of another that should hypothetically increase benefit. The same occurs in our study.

Managerial implications

The study offers various managerial implications. First, findings suggest that boards of directors need to consider firm's knowledge stock when assessing new and current investments. Greater investment in improving the percentage of skilled workers or in hiring managers with more experience does not necessarily result in greater product innovation, due to the substitution effect between these two resources. More, therefore, is not always better. One must analyse how the firm's current resources mesh with each other, since there is some trade-off between increasing the percentage of skilled workers and having a CEO with more experience when improving product innovation. Understanding the final result of a business decision is even more complicated, as its result depends on the current firm's resource configuration.

Second, our robustness analysis show that those companies with a product innovation orientation should consider their strengths before implementing a recruiting strategy. Companies with more technical/operational strengths should create a balanced team in which the skills of the leader do not stand out above the other members. In Taylor and Greve's (2006) terminology this would mean recruiting a 'Fantastic Four'. Conversely, in companies with a focus on generating knowledge, our results suggest recruiting a leader who stands out above the other team's members, in Taylor and Greve's (2006) words this would imply recruiting a 'Superman'.

Finally, our results can be reconciled with previous studies suggesting that knowledge stocks are complementary. Our findings indicate that knowledge stock mutually exclusive

effect happens in exploration activities (e.g. innovation), however, previous research has found that knowledge stocks are complementary in exploitation activities (e.g. financial performance) (e.g. Choi et al. 2008; Cohen et al. 2015). This would mean that the optimal management of knowledge resource is contingent to the firm's objective. This is an important line of research that remains open for more investigation.

Limitations and future research avenues

The study has methodological implications, due in large part to the nature of the WBES database. For example, the cross-sectional nature of the database permits neither determining the dynamic change in resources nor timing the cause-effect relationship between resources and innovation. Similarly, by construction, the sample used in this study includes only product firms, not service firms, whose skills and experience may (or may not) be complementary. Finally, this study presents only a single case of resource substitutability, but this case may apply to other types of resources and outcome variables. Future research should consider longitudinal approaches in a wider spectrum of industries and resources.

The results of this study also open a number of lines of theoretical and empirical inquiry. First, it seems necessary to analyse which variables affect the interaction among the different knowledge stocks and whether contingency theory can modulate or change the relationship among them from substitutive to complementary or the reverse based on these variables. Second, analysing how the different knowledge flows and stocks relate to variables other than innovation or how the firm's strategic orientation affects them would enable us to deepen knowledge in this line of research. Finally, the results are specific to Latin America. Future studies should corroborate our findings in other developing countries (e.g. Africa) since they are a storehouse of evidence for established theories that have been developed and tested in more stable contexts (Teagarden et al., 2018).

References

Aguilera, R. V., Ciravegna, L., Cuervo-Cazurra, A., & Gonzalez-Perez, M. A. (2017). Multilatinas and the internationalization of Latin American firms. *Journal of World Business*, *52*(4), 447-460. https://doi.org/10.1016/j.jwb.2017.05.006

Aguinis, H., Villamor, I., Lazzarini, S. G., Vassolo, R. S., Amorós, J. E., & Allen, D. G. (2020). Conducting management research in Latin America: why and what's in it for you?. *Journal of Management*, *46*(5), 615-636. https://doi.org/10.1177/0149206320901581

Ai, C., & Norton, E. C. (2003). Interaction terms in logit and probit models. *Economics Letters*, *80*(1), 123-129. https://doi.org/10.1016/S0165-1765(03)00032-6

Aiken, L.S., West, S.G., & Reno, R.R. (1991), *Multiple Regression: Testing and Interpreting Interactions*, Sage Publications, Newbury Park, CA.

Ainuddin, R. A., Beamish, P. W., Hulland, J. S., & Rouse, M. J. (2007). Resource attributes and firm performance in international joint ventures. *Journal of World Business*, *42*(1), 47-60. https://doi.org/10.1016/j.jwb.2006.11.001

Albury, D. (2005). Fostering innovation in public services. *Public Money and Management*, *25*(1), 51-56. https://doi.org/10.1111/j.1467-9302.2005.00450.x

Altomonte, C., Aquilante, T., Békés, G., & Ottaviano, G. I. (2013). Internationalization and innovation of firms: evidence and policy. *Economic Policy*, *28*(76), 663-700. https://doi.org/10.1111/1468-0327.12020

Andreeva, T., & Kianto, A. (2011). Knowledge processes, knowledge-intensity and innovation: a moderated mediation analysis. *Journal of Knowledge Management, 15*(6), 1016-1034. https://doi.org/10.1108/13673271111179343

Arias-Aranda, D., & Molina-Fernández, L. M. (2002). Determinants of innovation through a knowledge-based theory lens. *Industrial Management & Data Systems, 102*(5), 289-296. https://doi.org/10.1108/02635570210428320

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120. https://doi.org/10.1177/014920639101700108

Baskerville, R., & Dulipovici, A. (2006). The theoretical foundations of knowledge management. *Knowledge Management Research & Practice*, *4*(2), 83-105. https://doi.org/10.1057/palgrave.kmrp.8500090

Birhanu, A. G., Gambardella, A., & Valentini, G. (2016). Bribery and investment: firm-level evidence from Africa and Latin America. *Strategic Management Journal, 37*(9), 1865-1877. https://doi.org/10.1002/smj.2431

Buenstorf, G., & Heinisch, D. P. (2020). When do firms get ideas from hiring PhDs?. *Research Policy*, *49*(3), 103913. https://doi.org/10.1016/j.respol.2019.103913

Bustinza, O. F., Gomes, E., Vendrell-Herrero, F., & Baines, T. (2019). Product–service innovation and performance: the role of collaborative partnerships and R&D intensity. *R&D Management*, *49*(1), 33-45. https://doi.org/10.1111/radm.12269

Caloghirou, Y., Giotopoulos, I., Korra, E., & Tsakanikas, A. (2018). How do employee training and knowledge stocks affect product innovation?. *Economics of Innovation and New Technology*, *27*(4), 343-360. https://doi.org/10.1080/10438599.2017.1362796

Caner, T., & Tyler, B. B. (2015). The effects of knowledge depth and scope on the relationship between R & D alliances and new product development. *Journal of Product Innovation Management*, *32*(5), 808-824. https://doi.org/10.1111/jpim.12224

Carneiro, A. (2000). How does knowledge management influence innovation and competitiveness?. *Journal of Knowledge Management*, 4, 87-98. https://doi.org/10.1108/13673270010372242

Casanova, L., Dayton-Johnson, J., Fonstad, N. O., & Jain, S. (2016). Innovation in emerging markets: the case of Latin America. In *Innovation in Emerging Markets* (pp. 72-86). Palgrave Macmillan, London. https://doi.org/10.1057/9781137480293_4

Choi, B., Poon, S. K., & Davis, J. G. (2008). Effects of knowledge management strategy on organizational performance: a complementarity theory-based approach. *Omega, 36*(2), 235-251. https://doi.org/10.1016/j.omega.2006.06.007

Cirera, X., & Muzi, S. (2020). Measuring innovation using firm-level surveys: evidence from developing countries. *Research Policy*, *49*(3), 103912.

https://doi.org/10.1016/j.respol.2019.103912
Clarysse, B., Bruneel, J., & Wright, M. (2011). Explaining growth paths of young technology-based firms: structuring resource portfolios in different competitive environments. *Strategic Entrepreneurship Journal*, *5*(2), 137-157. https://doi.org/10.1002/sej.111
Cohen, J. F., & Olsen, K. (2015). Knowledge management capabilities and firm performance: a test of universalistic, contingency and complementarity perspectives. *Expert Systems with Applications, 42*(3), 1178-1188. https://doi.org/10.1016/j.eswa.2014.09.002
Conner, K. R., & Prahalad, C. K. (1996). A resource-based theory of the firm: knowledge versus opportunism. *Organization Science*, *7*(5), 477-501. https://doi.org/10.1287/orsc.7.5.477
Corso, M., Martini, A., Paolucci, E., & Pellegrini, L. (2001). Knowledge management in product innovation: an interpretative review. *International Journal of Management Reviews*, *3*(4), 341-352. https://doi.org/10.1111/1468-2370.00072
Crifo, P., Diaye, M. A., & Pekovic, S. (2016). CSR related management practices and firm performance: an empirical analysis of the quantity–quality trade-off on French data. International. *International Journal of Production Economics, 171*, 405-416. https://doi.org/10.1016/j.ijpe.2014.12.019
Crossan, M. M., & Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: a systematic review of the literature. *Journal of Management Studies*, *47*(6), 1154-1191. https://doi.org/10.1111/j.1467-6486.2009.00880.x
Cuervo-Cazurra, A. (2016). Multilatinas as sources of new research insights: the learning and escape drivers of international expansion. *Journal of Business Research*, *69*(6), 1963-1972. https://doi.org/10.1016/j.jbusres.2015.10.142
Curado, C., Muñoz-Pascual, L., & Galende, J. (2018). Antecedents to innovation performance in SMEs: a mixed methods approach. *Journal of Business Research*, *89*, 206-215. https://doi.org/10.1016/j.jbusres.2017.12.056
Custódio, C., Ferreira, M. A., & Matos, P. (2019). Do general managerial skills spur innovation?. *Management Science*, *65*(2), 459-476. https://doi.org/10.1287/mnsc.2017.2828
Damanpour, F., & Gopalakrishnan, S. (2001). The dynamics of the adoption of product and process innovations in organizations. *Journal of Management Studies*, *38*(1), 45-65. https://doi.org/10.1111/1467-6486.00227
Damanpour, F., Sanchez-Henriquez, F., & Chiu, H. H. (2018). Internal and external sources and the adoption of innovations in organizations. *British Journal of Management*, *29*(4), 712-730. https://doi.org/10.1111/1467-8551.12296
Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, *23*(12), 1095-1121. https://doi.org/10.1002/smj.275
Davila, A., & Elvira, M. M. (2012). Humanistic leadership: lessons from Latin America. *Journal of World Business*, *47*(4), 548-554. https://doi.org/10.1016/j.jwb.2012.01.008
Delgado-Verde, M., Martin de Castro, G., Navas-López, J. E., & Amores-Salvadó, J. (2014). Vertical relationships, complementarity and product innovation: an intellectual capital-based view. *Knowledge Management Research & Practice*, *12*(2), 226-235. https://doi.org/10.1057/kmrp.2012.59
Delmas, M. A., & Pekovic, S. (2018). Organizational configurations for sustainability and employee productivity: a qualitative comparative analysis approach. *Business & Society, 57*(1), 216-251. https://doi.org/10.1177/0007650317703648
Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, *35*(12), 1504-1511. https://doi.org/10.1287/mnsc.35.12.1504
Engelman, R. M., Fracasso, E. M., Schmidt, S., & Zen, A. C. (2017). Intellectual capital, absorptive capacity and product innovation. *Management Decision*, *55*(3), 474-490. https://doi.org/10.1108/MD-05-2016-0315
Falk, M., & Biagi, F. (2017). Relative demand for highly skilled workers and use of different ICT technologies. *Applied Economics*, *49*(9), 903-914. https://doi.org/10.1080/00036846.2016.1208357
Galunic, D. C., & Rodan, S. (1998). Resource recombinations in the firm: knowledge structures and the potential for Schumpeterian innovation. *Strategic Management Journal*, *19*(12), 1193-

1201. https://doi.org/10.1002/(SICI)1097-0266(1998120)19:12<1193::AID-SMJ5>3.0.CO;2-F

George, G. (2005). Slack resources and the performance of privately held firms. *Academy of Management Journal*, *48*(4), 661-676. https://doi.org/10.5465/amj.2005.17843944

Goedhuys, M., & Veugelers, R. (2012). Innovation strategies, process and product innovations and growth: firm-level evidence from Brazil. *Structural Change and Economic Dynamics*, *23*(4), 516-529. https://doi.org/10.1016/j.strueco.2011.01.004

Gomes, E., Vendrell-Herrero, F., Mellahi, K., Angwin, D., & Sousa, C. M. (2018). Testing the self-selection theory in high corruption environments: evidence from African SMEs. *International Marketing Review*, *35*(5), 733-759. https://doi.org/10.1108/IMR-03-2017-0054

González, X., Miles-Touya, D., & Pazó, C. (2016). R&D, worker training and innovation: firm-level evidence. *Industry and Innovation*, *23*(8), 694-712. https://doi.org/10.1080/13662716.2016.1206463

Grant, R. M. (1996). Prospering in dynamically-competitive environments: organizational capability as knowledge integration. *Organization Science*, *7*(4), 375-387. https://doi.org/10.1287/orsc.7.4.375

Hambrick, D. C. (2007). Upper echelons theory: an update. *Academy of Management Review*, *32*(2), 334-343. https://doi.org/10.5465/AMR.2007.24345254

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: the organization as a reflection of its top managers. *Academy of Management Review*, *9*(2), 193-206. https://doi.org/10.5465/amr.1984.4277628

Jiménez-Barrionuevo, M., Molina, L. M., & García-Morales, V. J. (2019). Combined influence of absorptive capacity and corporate entrepreneurship on performance. *Sustainability*, *11*(11), 3034. https://doi.org/10.3390/su11113034

Khaksar, S. M. S., Chu, M. T., Rozario, S., & Slade, B. (2020). Knowledge-based dynamic capabilities and knowledge worker productivity in professional service firms the moderating role of organisational culture. *Knowledge Management Research & Practice*, In Press. https://doi.org/10.1080/14778238.2020.1794992

Kor, Y. Y. (2003). Experience-based top management team competence and sustained growth. *Organization Science*, *14*(6), 707-719. https://doi.org/10.1287/orsc.14.6.707.24867

Lafuente, E., Vaillant, Y., & Vendrell-Herrero, F. 2019). Territorial servitization and the manufacturing renaissance in knowledge-based economies. *Regional Studies*, *53*(3), 313-319. https://doi.org/10.1080/00343404.2018.1542670

Lages, L. F., Silva, G., & Styles, C. (2009). Relationship capabilities, quality, and innovation as determinants of export performance. *Journal of International Marketing*, *17*(4), 47-70. https://doi.org/10.1509/jimk.17.4.47

Lai, H. C., Chiu, Y. C., Liaw, Y. C., & Lee, T. Y. (2010). Technological diversification and organizational divisionalization: the moderating role of complementary assets. *British Journal of Management*, *21*(4), 983-995. https://doi.org/10.1111/j.1467-8551.2009.00630.x

Laursen, K., & Foss, N. J. (2003). New human resource management practices, complementarities and the impact on innovation performance. *Cambridge Journal of economics, 27*(2), 243-263. https://doi.org/10.1093/cje/27.2.243

Lavie, D. (2006). The competitive advantage of interconnected firms: an extension of the resource-based view. *Academy of Management Review*, *31*(3), 638-658. https://doi.org/10.5465/amr.2006.21318922

Lee, O. K. D., Choi, B., & Lee, H. (2020). How do knowledge management resources and capabilities pay off in short term and long term?. *Information & Management*, *57*(2), 103166. https://doi.org/10.1016/j.im.2019.05.001

Lloréns, F. J., Jover, A. V., & Fernandez, L. M. M. (2003). Factors affecting the relationship between total quality management and organizational performance. *International Journal of Quality & Reliability Management, 20*(2), 189-209. https://doi.org/10.1108/02656710310456617

Mairesse, J., & Mohnen, P. (2010). Using innovation surveys for econometric analysis. In *Handbook of the Economics of Innovation* (2, pp. 1129-1155). Social Science Research Network, Rochester, NY. https://doi.org/10.2139/ssrn.1611768

Martínez-Ros, E. (2019). Revisiting product and process innovations. *International Journal of*

Business Environment, *10*(3), 270-280. https://doi.org/10.1504/IJBE.2019.097983
Matzler, K., Schwarz, E., Deutinger, N., & Harms, R. (2008). The relationship between transformational leadership, product innovation and performance in SMEs. *Journal of Small Business & Entrepreneurship*, *21*(2), 139-151. https://doi.org/10.1080/08276331.2008.10593418
Mohan, M., Voss, K. E., & Jiménez, F. R. (2017). Managerial disposition and front-end innovation success. *Journal of Business Research*, *70*, 193-201. https://doi.org/10.1016/j.jbusres.2016.08.019
Narteh, B., & Acheampong, G. (2018). Foreign participation and internationalization intensity of African enterprises. *International Marketing Review*, *35*(4), 560-579. https://doi.org/10.1108/IMR-12-2015-0273
Newburry, W., Gardberg, N. A., & Sanchez, J. I. (2014). Employer attractiveness in Latin America: the association among foreignness, internationalization and talent recruitment. *Journal of International Management*, *20*(3), 327-344. https://doi.org/10.1016/j.intman.2014.01.001
Nieto, M. J., Rodríguez, A., & Hernández, V. (2021). Home country institutions and exports of firms in transition economies: does innovation matter? *Long Range Planning*, 102087. https://doi.org/10.1016/j.lrp.2021.102087
Ortín-Ángel, P., & Vendrell-Herrero, F. (2014). University spin-offs vs. other NTBFs: total factor productivity differences at outset and evolution. *Technovation*, *34*(2), 101-112. https://doi.org/10.1016/j.technovation.2013.09.006
Paradkar, A., Knight, J., & Hansen, P. (2015). Innovation in start-ups: ideas filling the void or ideas devoid of resources and capabilities?. *Technovation*, *41-42*, 1-10. https://doi.org/10.1016/j.technovation.2015.03.004
Peteraf, M. A., & Bergen, M. E. (2003). Scanning dynamic competitive landscapes: a market-based and resource-based framework. *Strategic Management Journal*, *24*(10), 1027-1041. https://doi.org/10.1002/smj.325
Phung, T. M. T., Vermeulen, P. A. M., Knoben, J., & Dat, T. T. (2018). Made in Vietnam: internal, collaborative, and regional knowledge sources and product innovation in Vietnamese firms. *European Journal of Innovation Management*, *21*, 581-600. https://doi.org/10.1108/EJIM-10-2017-0134
Priem, R. L., & Butler, J. E. (2001). Is the resource-based "view" a useful perspective for strategic management research?. *Academy of Management Review*, *26*(1), 22-40. https://doi.org/10.5465/amr.2001.4011928
Quigley, T. J., & Hambrick, D. C. (2015). Has the "CEO effect" increased in recent decades? A new explanation for the great rise in America's attention to corporate leaders. *Strategic Management Journal*, *36*(6), 821-830. https://doi.org/10.1002/smj.2258
Ritter, T., & Gemünden, H. G. (2003). Network competence: its impact on innovation success and its antecedents. *Journal of Business Research*, *56*(9), 745-755. https://doi.org/10.1016/S0148-2963(01)00259-4
Roper, S., & Hewitt-Dundas, N. (2015). Knowledge stocks, knowledge flows and innovation: evidence from matched patents and innovation panel data. *Research Policy*, *44*(7), 1327-1340. https://doi.org/10.1016/j.respol.2015.03.003
Ruiz-Jiménez, J. M., del Mar Fuentes-Fuentes, M., & Ruiz-Arroyo, M. (2016). Knowledge combination capability and innovation: the effects of gender diversity on top management teams in technology-based firms. *Journal of Business Ethics*, *135*(3), 503-515. https://doi.org/10.1007/s10551-014-2462-7
Ryan, P., Geoghegan, W., & Hilliard, R. (2018). The microfoundations of firms' explorative innovation capabilities within the triple helix framework. *Technovation*, *76*, 15-27. https://doi.org/10.1016/j.technovation.2018.02.016
Salvato, C., & Rerup, C. (2011). Beyond collective entities: multilevel research on organizational routines and capabilities. *Journal of Management*, *37*(2), 468-490. https://doi.org/10.1177/0149206310371691
Segarra-Ciprés, M., Roca-Puig, V., & Bou-Llusar, J. C. (2014). External knowledge acquisition and innovation output: an analysis of the moderating effect of internal knowledge transfer. *Knowledge Management Research & Practice*, *12*(2), 203-214.

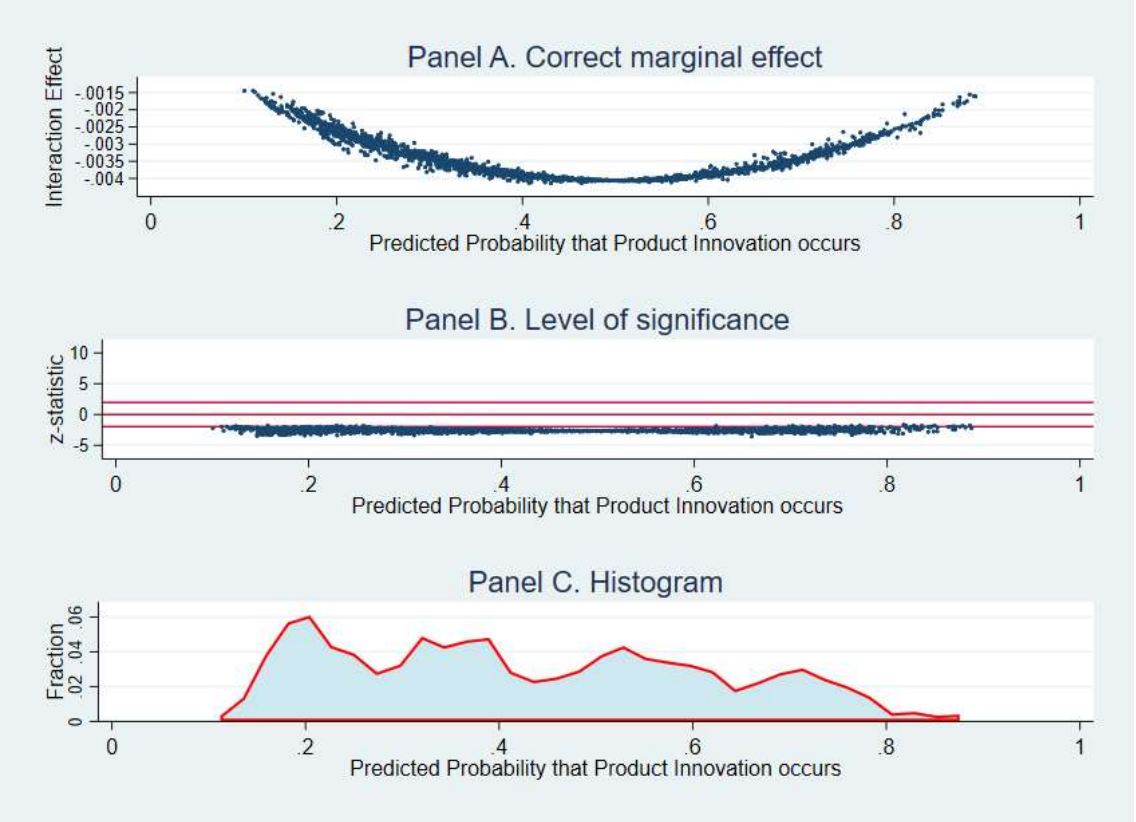
https://doi.org/10.1057/kmrp.2012.55
Sirmon, D. G., Hitt, M. A., & Ireland, R. D. (2007). Managing firm resources in dynamic environments to create value: looking inside the black box. *Academy of Management Review*, *32*(1), 273-292. https://doi.org/10.5465/amr.2007.23466005
Stieglitz, N., & Heine, K. (2007). Innovations and the role of complementarities in a strategic theory of the firm. *Strategic Management Journal*, *28*(1), 1-15. https://doi.org/10.1002/smj.565
Sun, Q., & Hou, R. (2017). Knowledge forms and enterprise innovation performance: an evidence from the dimensions of stock and flow. *International Journal of Knowledge Management*, *13*(3), 55-70. https://doi.org/10.4018/IJKM.2017070104
Taylor, A., & Greve, H. R. (2006). Superman or the fantastic four? Knowledge combination and experience in innovative teams. *Academy of Management Journal, 49*(4), 723-740. https://doi.org/10.5465/amj.2006.22083029
Teagarden, M. B., Von Glinow, M. A., & Mellahi, K. (2018). Contextualizing international business research: enhancing rigor and relevance. *Journal of World Business*, 53(3), 303-306. https://doi.org/10.1016/j.jwb.2017.09.001
Tortoriello, M., Reagans, R., & McEvily, B. (2012). Bridging the knowledge gap: the influence of strong ties, network cohesion, and network range on the transfer of knowledge between organizational units. *Organization Science*, *23*(4), 1024-1039. https://doi.org/10.1287/orsc.1110.0688
Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation *Omega*, *3*(6), 639-656. https://doi.org/10.1016/0305-0483(75)90068-7
Vassolo, R. S., De Castro, J. O., & Gomez-Mejia, L. R. (2011). Managing in Latin America: common issues and a research agenda. *Academy of Management Perspectives*, *25*(4), 22-36. https://doi.org/10.5465/amp.2011.0129
Vendrell-Herrero, F., Darko, C. K., & Ghauri, P. (2020a). Knowledge management competences, exporting and productivity: uncovering African paradoxes. *Journal of Knowledge Management*, *24*(1), 81-104. https://doi.org/10.1108/JKM-07-2018-0433
Vendrell-Herrero, F., Gomes, E., Mellahi, K., & Child, J. (2017). Building international business bridges in geographically isolated areas: the role of foreign market focus and outward looking competences in Latin American SMEs. *Journal of World Business*, *52*(4), 489-502. https://doi.org/10.1016/j.jwb.2016.08.007
Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171-180. https://doi.org/10.1002/smj.4250050207
World Bank. (2019). *World Development Indicators Database*. Washington, D.C.
Xiao, L., & Ramsden, M. (2016). Founder expertise, strategic choices, formation, and survival of High-Tech SMEs in China: a resource-substitution approach. *Journal of Small Business Management*, *54*(3), 892-911. https://doi.org/10.1111/jsbm.12230
Xie, X., Fang, L., Zeng, S., & Huo, J. (2016). How does knowledge inertia affect firms product innovation?. *Journal of Business Research*, *69*(5), 1615-1620. https://doi.org/10.1016/j.jbusres.2015.10.027
Yadav, M. S., Prabhu, J. C., & Chandy, R. K. (2007). Managing the future: CEO attention and innovation outcomes. *Journal of Marketing*, *71*(4), 84-101. https://doi.org/10.1509/jmkg.71.4.084
Youndt, M. A., Subramaniam, M., & Snell, S. A. (2004). Intellectual capital profiles: an examination of investments and returns. *Journal of Management Studies*, *41*(2), 335-361. https://doi.org/10.1111/j.1467-6486.2004.00435.x
Zelner, B. A. (2009). Using simulation to interpret results from logit, probit, and other nonlinear models. *Strategic Management Journal*, *30*(12), 1335-1348. https://doi.org/10.1002/smj.783

List of Figures

Figure 1 Countries included in the study

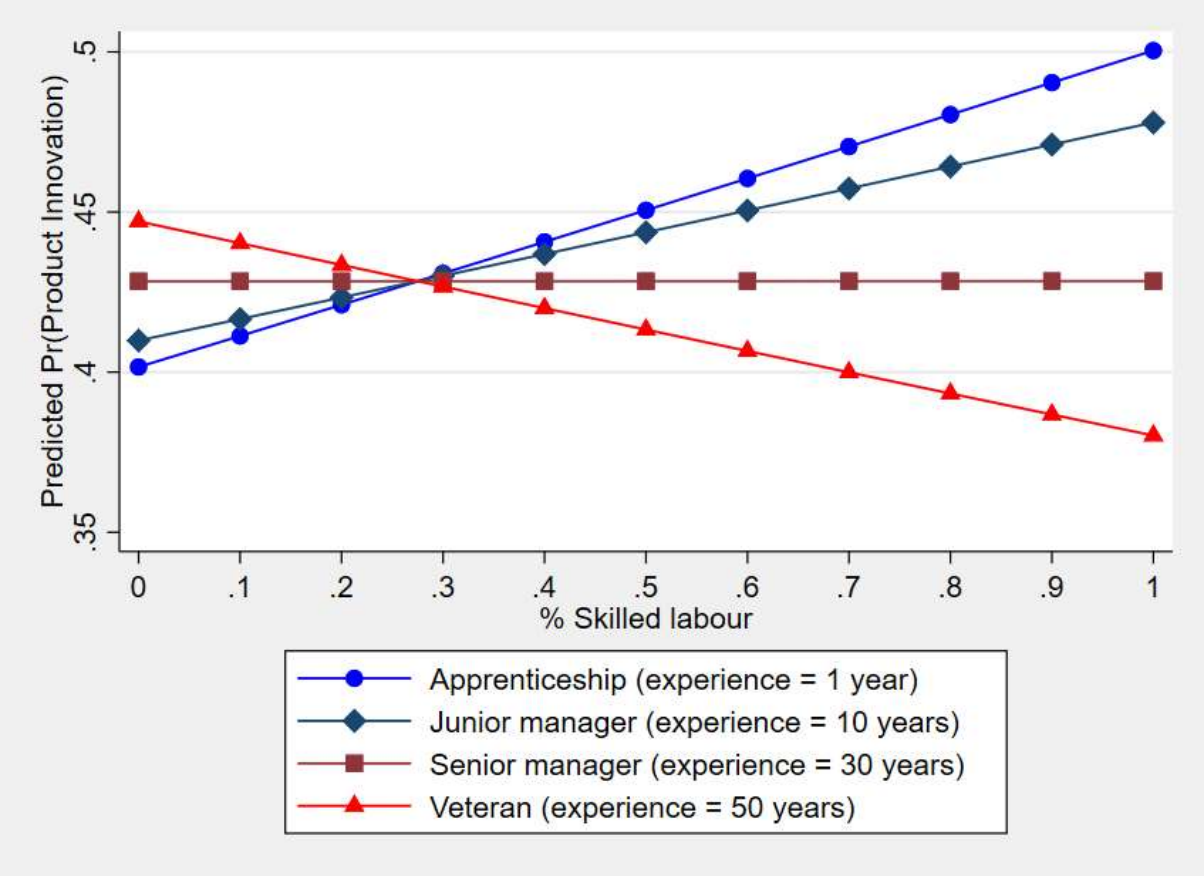
Note: Scale of grey refers to the number of observations from the country in the region. Acronyms refer to French Guiana (GUF), Guyana (GUY), Suriname (SUR), Venezuela (VEN), Argentina (ARG), Bolivia (BOL), Brazil (BRA), Chile (CHL), Ecuador (ECU), Paraguay (PRY), Peru (PER), Uruguay (URY), Guatemala (GTM), Mexico (MEX), Belize (BLZ), Colombia (COL), Costa Rica (CRI), El Salvador (SLV), Honduras (HND), Nicaragua (NIC), Panama (PAN). Map includes only Latin American region, not the Caribbean. This means that the Dominican Republic (a Caribbean country with 58 observations in the sample) is not highlighted on the map.

Figure 2 Graphical interpretation of interaction effect of manager's experience and % skilled workers on product innovation



*Estimation based on Model 3 Table 2

Figure 3 Moderating role of manager's experience



List of Tables

Table 1 Correlation matrix

	Variable name	Mean	St. Dev.	1	2	3	4	5	6	7	8	9	10
(1)	**Product Innovation**	0.429	0.495	1									
(2)	**% Skilled Workers**	0.369	0.347	-0.0284	1								
(3)	**Manager's Experience**	25	12.31	0.0067	0.0369	1							
(4)	**#Workers/100**	1.261	3.538	0.0549*	-0.0644*	-0.017	1						
(5)	**R&D**	0.264	0.441	0.2259*	-0.0962*	0.0168	0.1816*	1					
(6)	**Process Innovation**	0.447	0.497	0.2872*	-0.0802*	0.0329	0.0803*	0.2786*	1				
(7)	**Firm's Age/100**	0.279	0.2	0.0151	-0.0424*	0.2350*	0.1877*	0.1051*	0.0139	1			
(8)	**Export Intensity**	12.65	27.26	0.0517*	-0.0383*	-0.0032	0.2486*	0.0982*	0.0489*	-0.0207	1		
(9)	**% KIBS Co-location**	0.128	0.077	0.0952*	-0.1407*	0.0053	-0.0420*	0.1262*	0.1309*	0.0477*	-0.1358*	1	
(10)	**Capacity utilization**	71.04	21.09	0.0017	0.0112	-0.0574*	0.1351*	0.0021	0.0460*	-0.0168	0.0917*	-0.0493*	1

* $p<0.05$

Table 2 Product innovation regression: Logit model

	Model 1		**Model 2**		**Model 3**	
	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
% Skilled Workers (SW)			0.0234	0.0049	*0.0276*	0.0058
			(0.040)	(0.008)	*(0.042)*	(0.009)
			0.5552	0.5550	*0.5120*	0.5118
Manager's Experience (ME)			-0.0154	-0.0032	*-0.0187*	-0.0039
			(0.050)	(0.010)	*(0.050)*	(0.011)
			0.7572	0.7569	*0.7105*	0.7101
SW * ME					-0.0679***	-0.0143***
					(0.026)	(0.006)
					0.0094	0.099
R&D	0.7076***	0.1480***	0.7090***	0.1483***	0.7120***	0.1488***
	(0.074)	(0.015)	(0.075)	(0.015)	(0.075)	(0.015)
	0.0000	*0.0000*	*0.0000*	0.0000	*0.0000*	0.0000
Process Innovation	0.8897***	0.1861***	0.8921***	0.1866***	0.8947***	0.1869***
	(0.080)	(0.015)	(0.080)	(0.015)	(0.081)	(0.015)
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
#Workers/100	0.0020	0.0004	0.0021	0.0004	0.0022	0.0005
	(0.017)	(0.004)	(0.016)	(0.003)	(0.016)	(0.003)
	0.9058	*0.9058*	*0.8987*	*0.8987*	*0.8894*	*0.8894*
Firm's Age/100	0.0138	0.0029	0.0350	0.0073	0.0331	0.0069
	(0.193)	(0.040)	(0.219)	(0.046)	(0.215)	(0.045)
	0.9427	*0.9427*	*0.8730*	*0.8729*	*0.8776*	*0.8775*
Export Intensity	0.0018	0.0004	0.0018	0.0004	0.0018	0.0004
	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
	0.5001	*0.5000*	*0.4896*	*0.4894*	*0.4879*	*0.4877*
KIBS Co-location	0.3286	0.0687	0.3262	0.0682	0.2997	0.0626
	(0.533)	(0.112)	(0.551)	(0.115)	(0.549)	(0.115)
	0.5373	*0.5379*	*0.5538*	*0.5545*	*0.5851*	*0.5856*
Capacity Utilization	-0.0004	-0.0001	-0.0005	-0.0001	-0.0006	-0.0001
	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)
	0.8793	*0.8793*	*0.8638*	*0.8639*	*0.8328*	*0.8329*
Constant	-1.3779***		-1.3790***		-1.3852***	
	(0.439)		(0.439)		(0.438)	
	0.0017		0.0017		0.0015	
Industry dummies	YES		YES		YES	
Country dummies	YES		YES		YES	
Year dummies	YES		YES		YES	
Observations	2,725		2,725		2,725	
Pseudo R^2	0.1120		0.1121		0.1128	
Log-Likelihood	-1653.0		-1652.7		-1651.5	
Area under ROC	0.7232		0.7236		0.7239	
Correctly classified (cut off = 43.9%)						
o Sensitivity	64.02%		64.14%		63.93%	
o Specificity	68.36%		68.55%		68.62%	
o Overall	66.50%		66.68%		66.61%	

Dependent variable: **Product innovation**.
Level of statistical significance: *** p<0.01, ** p<0.05, * p<0.1
Robust standard errors clustered by industry in parentheses.
P-values in *italics*.

Table 3 Mean product innovation by relevant subsamples

		R&D (Knowledge generation capabilities)	
Process innovation (Technical capabilities)		**Absence**	**Presence**
	Absence	**Overall (Obs 1,275): Pr = 25.3%** Low ME Low SW (Obs 373): Pr = 23.6% High ME Low SW (Obs 296): Pr = 25.7% Low ME High SW (Obs 361): Pr = 25.7% High ME High SW (Obs 245): Pr = 26.9%	**Overall (Obs 231): Pr = 56.7%** Low ME Low SW (Obs 89): Pr = 50.5% High ME Low SW (Obs 69): Pr = 69.5% Low ME High SW (Obs 34): Pr = 44.1% High ME High SW (Obs 39): Pr = 58.9%
	Presence	**Overall (Obs 731): Pr = 55.3 %** Low ME Low SW (Obs 254): Pr = 53.9% High ME Low SW (Obs 198): Pr = 56.0% Low ME High SW (Obs 149): Pr = 61.1% High ME High SW (Obs 130): Pr = 50.0%	**Overall (Obs 488): Pr = 63.9%** Low ME Low SW (Obs 180): Pr = 63.9% High ME Low SW (Obs 154): Pr = 62.3% Low ME High SW (Obs 75): Pr = 65.3% High ME High SW (Obs 79): Pr = 65.8%

* ME refers to manager's experience, SW to the percentage of skilled workers. High and low denote above or below the mean, respectively. Pr is the average probability of achieving a product innovation by cohort.