

# Managing Knowledge Towards firm Performance: The Moderation role of the Business Environment

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**Abstract:** The prominence of the knowledge economy technological innovation and economic development globally cannot be questioned. However, not all firms especially from Central and Eastern European to tap into the benefits coupled with new knowledge for improvement in firm innovation performance. Mostly, this is due to environmental factors confronting the firms. This study focused on the impact of External Knowledge (EK), R&D expenditure and ICT usage on firm innovation performance with the moderation role of informal competition. We used Resource Dependency Theory and Contingency theory as the theoretical background. A cross sectional data from the World Bank Enterprise Survey (WBES) 2019 on 3105 firms from CEE regions namely Czech Republic, Hungary, Slovakia, and Poland was analysed using logistic regression. These countries were selected because firms face elevated level of informal competition in the business environment. The study confirmed the hypotheses that, internal R&D, external knowledge and website availability and usage have positive and significant direct effect on technological innovation. Our study contributes to the literature of R&D and firm performance by highlighting the moderating effect of business environment (informal competition).

**Keywords:** Technological innovation, external knowledge, external and internal R&D, website, CEE countries

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## 1. Introduction

Over the century, firms, academic institutions, and governments have invested and continue to invest hugely in research and development (R&D), acquisition of external knowledge and information and communication infrastructure. New knowledge, collaboration, and innovation are key determinants of competitiveness in the era of a knowledge-based economy (Prokop, Hajek, & Stejskal, 2021). Firms have therefore found the need since early 1980s to assess the outcomes and impacts of R&D expenditure (Cho, 2018), external knowledge (Mina et al., 2014) and ICT (Yunis et al., 2018) on their innovation performance. Innovation literature has classified innovation into technological and non-technological innovation (Mothe, and Thi, 2010). Technological innovation assumes the form of new products and services while non-technological innovation is related to the novel changes in the organization and marketing activities of the business. This study focuses on technological innovation. This is because it is the main innovation output activity performed by firms. According to Gogokhia, and Berulava (2021), an important prerequisite for economic development and technological innovation is the firm's capability of learning and appropriating knowledge in the business environment to earn more profits. Thus, extant literature posits the impact of R&D expenditure, external knowledge, and ICT on technological innovation, however, the indirect role of the business environment cannot be questioned in (Alam et al., 2020). For instance, Jia (2020) investigated how informal competition moderates the relationship between cooperate social responsibility and firm performance. On the other hand, Pérez et al., (2019) examined how informal competition impact on the innovation in formal firms.

To the best of our knowledge, no study has investigated the impact of R&D expenditure, external knowledge, ICT on firm technological innovation and how the informal competition moderates the relationship between R&D expenditure and technological innovation. This is the gap our study seeks to fill. A cross sectional data from the WBES 2019 on 3106 firms from the CEE namely Czech Republic, Slovakia, Hungary Poland was analysed using logistic regression. These countries were selected because firms face high number of competitors in the business environment of several catching-up economies in South-East Europe and Central Asia (Williams & Bezeredi, 2018). It is therefore interesting to investigate firms among the selected countries that fall within the catching-up economies to see how informal competition in the business environment would impact the relationship between R&D and firm performance. Also, our study was theoretically built on the contingency theory (CT) and the resource dependency theory (RDT). The CT suggests that the relationship between two variables is contingent on the level of a third variable (Adomako et al., 2021). This implies that, the introduction of a moderator variable into the relationship between two variables may allow specific understanding and prevent misleading conclusions regarding the contingency relationships. Similarly, RDT suggests that external environmental factors influence the organization's behaviour (Hillman, Withers and Collins, 2009; Adomako et al., 2021). A key assumption of RDT is that reliance on 'critical' and important resources influence firm behaviour

and organizational decisions and actions. Thus, the focus of this study is to investigate whether the informal competition moderates the relationship between R&D expenditure and technological innovation in selected CEE countries using the RDT and contingency theories.

Our study contributes to literature in three (3) ways. First, it integrates ideas from the literature on R&D expenditure, external knowledge, ICT infrastructure with informal competition in perspective (Gogokhia & Berulava, 2021). Second, our study fills an important gap in literature, specifically the dearth of research on how the level of informal competition in a firm's business environment moderates the relationship between R&D expenditure. Third, our study theoretically extends the body of knowledge on RDT and contingency theories. Our findings have key implications for firm managers in CEE and globally.

The next section is the theoretical framework which discusses extant literature and formulate the hypothesis of the study. Section 3 discusses the empirical model, data and methodology used for the study. Results and discussion are captured in section 4 while section 5 gives the conclusion of the study.

## **2. Conceptual background and hypothesis**

New knowledge is created through R&D and shared through various process to create value for firm's product and service (Cho,2018) leading to economic growth (Zhylynska, 2020). The R&D process is capital intensive and requires huge expenditure to carry it out. Both internal and external R&D have positive impact on patent (Artz et al., 2010), process and product (Damanpour & Gopalakrishan, 2001). On R&D, our study focused on firms' internal and external expenditure made on research and development (R&D) activities. External R&D has positive and significant impact on process innovation (Medda et al, 2020). Medda et al., (2020) did not indicate how elements in the business environment affect the relationship between external R&D and product innovation. It is also pertinent to note that, the ability of firms to invest in R&D is dependent on the resource available to the firm. We examine how external and internal R&D influence technological innovation of firms with informal competition moderating the impact of the relationship.

Development from within is gradually shifting to development from without. Firms are increasingly developing outwards strategies to engage other firms externally through interfirm cooperation and collaboration. This is to gain external knowledge and share ideas to promote innovation. Service firms have been found to be leveraging on external knowledge for their innovation than manufacturing firms (Mina et al., 2014). The search for external knowledge is also influenced by several factors such as proximity (Belderbos et al., 2021) and cost (Mina et al., 2014). While firms are likely to cooperate with other firms closer to them for external knowledge, it is important to note that, the search for external knowledge is not costless. The varied preferences of customers and the need to maintain customer loyalty and remain competitive in the business environment influence firms to seek more knowledge outside their jurisdiction and manage it effectively towards technological innovation. The more diverse external knowledge, the better its impact on productivity. Acquisition of external knowledge is not necessarily a guarantee to innovation, but its strategic use is also vital. The more complex an innovation, the broader knowledge is required, and the more likely firm will seek external knowledge (Mina at al., 2014). External knowledge is good for firms, but they should not be sought at the expense of internal knowledge. Firms therefore need to have a good balance developing internal knowledge and effectively incorporating external knowledge into their innovation activities (Gallego et al., 2013).

Distance among firms create is a barrier to collaboration and partnership. Knowledge diffusion through labour mobility facilitates transfer of knowledge from one firm to another. However, the use of ICT creates more avenue for transfer of knowledge among firms to promote technological innovation. In the current knowledge and digitized economy, businesses, households, and individuals use information and communication technology (ICT) to make activities effective. ICT on its own cannot create the needed potency towards innovation and businesses profitability. ICT usage is a major determinant in product, service, and process innovation. Although it was found that ICT can be a substitute for geographical proximity, this requires strategic management to coordinate knowledge transfers related issues (Omobhude & Chen,2019). ICT and the digitization of organizations give opportunities for people to work from remote locations (Li, Lee& Kong2019) and firms to cooperate with ease regardless of the distance. The cost of acquiring ICT infrastructure could be a hindrance to several firms the incorporate ICT in their production activities. The foregoing arguments show that internal R&D, External R&D, external knowledge, and ICT usage influence firm technological innovation. Therefore, we hypothesize that:

*H1a: External R&D has positive and significant effect on technological innovation of firms.*

*H1b: Internal R&D activities positively influence technological innovation of firms.*

*H2: There is a positive and significant relationship between external knowledge and technological innovation of firms.*

*H3: The use of internet positively influences firms' technological innovation.*

### **2.1 The moderating role of business environment (informal competition)**

Firms do not operate in a vacuum. They depend on the current happenings in the business environment for survival. While dynamic business environments have a positive moderating effect on firm's innovation performance, industry competition in business environments abate this relationship (Gogokhia & Berulava, 2021). Also, other previous researchers have acknowledged that, disturbances in the business environment can moderate the extent market orientation affects firm performance (Gogokhia & Berulava, 2021). Employees, technology, government regulations, suppliers and competitors are elements in the business environment (Kozubíková., Dvorský, & Ključnikov, 2020) which influence activities of firms into loss or profitability. This study suggests the moderating role of the informal competition in the business environment rather than its direct effect on firm technological innovation. The case of catching-up economies provides a good example for illustration of business environment variability across countries. The contingency theory as well as resource dependency theory posit that, firm's actions are influenced by the external environment (Adomako et al., 2021) leading to improvement or otherwise productivity. This study introduced informal competition in a firms' external environment as a moderator between R&D expenditure (internal and external) and firm technological innovation. This supports the axiom of the contingency theory. Similarly, firms could depend on the opportunities that informal competition in the business environment presents to innovate their product, process and marketing systems. Cooperation is an important determinant that helps to spread the existing knowledge and to create new knowledge (Stejskal, Hájek & Prokop, 2018) to improve technological innovation among firms.

By implication, a firm's strategic decisions in handling the level of informal competition in the external environment has unrestrained consequences on the overall innovation output. Informal competition in the business environment brings about heterogeneity in consumer choices and preferences and firms must always be innovative enough to keep and add to the customer base. Following the above arguments, we expect industry competition to moderate the relationship between R&D expenditure and technological innovation. We therefore hypothesize that:

*H4a: The positive and significant relationship between external R&D expenditure and technological innovation of firm is moderated by informal competition*

*H4b: The positive relationship between internal R&D expenditure and technological innovation of firm is moderated by informal competition*

The prediction equation is

$$\log(p/1-p) = \beta_0 + \beta_1(\text{ext\_RD}) + \beta_2(\text{int\_RD}) + \beta_3(\text{ext\_know}) + \beta_4(\text{website})\dots\dots (1)$$

$\log(p/1-p)$  denotes the dependent variable;  $\beta_0$  is constant;  $\beta_1 + \beta_2 + \beta_3 + \beta_4$  denote the independent variables

The prediction equation after introduction of an interactive term is

$$\log(p/1-p) = b_0 + \beta_1(\text{ext\_RD}*\text{info\_compt}) + \beta_2(\text{int\_RD}*\text{infor\_compt}) + \beta_3(\text{ext\_know}) + \beta_4(\text{website})\dots (2)$$

$\log(p/1-p)$  denotes the dependent variable;  $b_0$  is constant;  $\beta_1$  and  $\beta_2$  denote the introduction of interactive variables to the first two independent variable +  $\beta_3$  and  $\beta_4$  denote the independent variables without interactive variables

### 3. Data and methodology

#### 3.1 Data

We used cross sectional firm-level data from the World Bank Enterprise Survey (WBES) 2019 database. The WBES contains firm level data about R&D, informal competition, external knowledge, website, innovation and management. WBES provides data about enterprises in the manufacturing and service sectors using globally accepted standardized survey instruments and uniform sampling methodology (Prokop et al., 2021). The data from 3105 firms was obtained from four CEE countries-Czech Republic, Hungary, Slovakia, and Poland. To estimate the impact of external R&D, internal R&D, external knowledge, and website on technological innovation, we considered firms that have spent on research and development activities either in-house or contracted with other companies (Jose et al., 2019), engaged with other firms for external knowledge and have website.

#### 3.2 Description of variables

We discuss the operationalization of the variables included in our model next and present a summary in table 2.

**Table 1:** Variables and measures

Conceptual variable	Notation	Operationalization	Sample reference
<i>Dependent variable</i>	DV		
Technological innovation	Techinno.	This is the introduction of new or improved product or service by the establishment in the last three years	Jia, 2020
<i>Independent variable</i>	IV		
External R&D	Ext._RD	Expenditure of the establishment on research and development activities contracted with other companies	Singh et al., 2021
Internal R&D	Int._RD	Expenditure on research and development within the establishment	Anzola-Román et al.,2018
External knowledge	Ext._Know	Expenditure on acquisition of external knowledge such as purchase of patent and non-patent inventions and know-how from other companies	Hipp, 2010 Mina et al., 2014
Website	Website	The establishment having its own and functional website	Omohude & Chen,2019
<i>Moderating variable</i>	MV		
Informal competition	Info._compt	The establishment competing against unregistered or informal establishments	Gogokhia & Berulava, 2021
<i>Control variable</i>	CV		
Country	Country	1-Slovakia 2-Poland 3-Hungary 4-Czech Republic	Prokop, Hajek, & Stejskal, 2021

Note: WBES (2019) is the data source

The focus of our study was to investigate the extent to which the parameters of the study impact technological innovation and to assess moderating effect of informal competition on the impact. We used external R&D, internal R&D, external knowledge, and website as the independent variables. Technological innovation was used as the dependent variable, informal competition as the moderating variable and country as controlled variable. Except for the four countries which were assigned values from 1 to 4, all other variables were dummy variables which took the value 1 if the event happened and 0 if the event did not occur. The Informal competition was used as the proxy for business environment, website as the proxy for ICT and internal R&D and external R&D as proxies for R&D expenditure. We controlled for country because the sizes of the four countries differ (Prokop, Hajek, & Stejskal, 2021). The action was to limit its interference in the relationship and impact of the independent variable on the dependent variable.

#### 4. Data analysis and results

We used logistic regression to test our hypotheses and estimate the influence of external and internal R&D, external knowledge and website on technological innovation. Logistic regression was used due to the dummy variables used in the study (Costa e Silva et al., 2020).

**Table 2:** Logistic regression analysis and the interactive term

Variable	Co-efficient	Std Error	P-value	z
Ext_RD	.2556847	.1890239	0.176	1.35
Ext_RD*Info_Compt	.5842303	.465751	0.210	1.25
Int_RD	1.05287	.1409518	0.000	7.47
Int_RD*Info_Compt	-.6652711	.3203523	0.038	-2.08
Ext_Know	.8415959	.1594443	0.000	5.28
Website	.7902477	.1523783	0.000	5.19
Info_Compt	.3776643	.1345607	0.005	2.81
Country				
2	-.1545934	.1567581	0.324	-0.99
3	.3013064	.2018669	0.136	1.49
4	.535508	.1707072	0.002	3.14
Pseudo R2	0.1152	Prob > chi2	0.0000	

Note: Significant at  $p < 0.05$  level

The coefficient values indicate the relationship between technological innovation and external R&D, internal R&D, external knowledge and website. The p-values indicate the significant level of the relationship at  $p < 0.05$ . Our hypothesis 1a sought to examine the direct and significant effect of external R&D on technological innovation of firms. As indicated in Table 2, although the relationship between external R&D and technological innovation is positive, there effect on technological innovation is not statistically significant ( $\beta = 0.2556847$ ,  $p = 0.176$ ). On the other hand, hypothesis 1b assessed the extent to which internal R&D activities positively influence technological innovation of firms. The results indicate a positive and statistically significant relationship between internal R&D and technological innovation ( $\beta = 1.05287$ ,  $p = 0.000$ ). This means hypotheses 1a is rejected because it does not support our model but 1b is accepted because it supports our model.

The results ( $\beta = 0.8464884$ ,  $p = 0.000$ ) support hypothesis 2 that, there is positive and statistically significant impact of external knowledge and on technological innovation of firms. On the use of website and its impact on technological innovation, hypothesis 3 supported our model because, the results ( $\beta = 0.7591678$ ,  $p = 0.000$ ) showed positive relationship and statistically significant impact of internet website by firms on technological innovation. Our model also sought to assess the extent to which informal competition in the business environment moderates the relationship between R&D expenditure (external R&D and internal R&D) and technological innovation. We therefore introduced an interactive variable to external R&D and internal R&D variables in the model. Hypothesis 4a states that, the positive and significant relationship between external R&D expenditure and technological innovation of firm is moderated by informal competition. Table 2 indicates after the introduction of interactive variable (external R&D\*informal competition), there is positive relationship between the interactive term and technological innovation but the impact of the interactive term on technological innovation is not statistically significant ( $\beta = .5842303$ ,  $p = 0.210$ ). The coefficient for external R&D before the interactive variable has increased from 0.2556847 to 0.5842303 after introducing the interactive term. This means the presence of informal competition has positively improved the relationship between external R&D and technological innovation although the p-value is not statistically significant. Hypothesis 4a is therefore rejected. On the other hand, after introducing an interactive term, the results show that ( $\beta = -.6652711$ ,  $p = 0.038$ ) there is negative relationship between internal R&D and technological innovation but the impact of the interactive term on technological innovation is statistically significant. This means the results support our hypothesis 4b.

**Table4:** Test for robustness

Variable	Robust			
	Co-efficient	Std Error	P-value	z
Ext_RD	.2556847	.195891	0.380	0.88
Int_RD	1.05287	.1459258	0.000	7.56
Ext_Know	.8464884	.1605655	0.000	5.23
Website	.7591678	.1442025	0.000	5.22

Variable	Robust			
	Co-efficient	Std Error	P-value	z
Country				
2	-.1555555	.1498535	0.300	-1.04
3	.3068353	.1916902	0.131	1.51
4	.5141331	.1651935	0.002	3.11
Pseudo R2= 0.1046 Wald chi2 261.49 Prob > chi2 = 0.0000				

Note: Significant at  $p < 0.05$  level

Except for external R&D, all variables in the model were statistically significant. The test for robustness of the model in table 3 showed Pseudo  $R^2 = 0.1046$  and Wald  $\chi^2 261.49$  at  $p = 0.000$ . According to Mehmetoglu, and Jakobsen (2022) Pseudo  $R^2$  explains the extent of variations of the explanatory variables in the model. Pseudo  $R^2$  of 0.1046 therefore means, all other things being equal, our model explains 10.46% of the variation in the independent variables. Also, the Wald  $\chi^2$  is statistically significant at  $p = 0.000$ . This means that, the independent variables used in the model namely external R&D, internal R&D, external knowledge, and website availability collectively contribute significantly to the model of the study.

**Table 4:** Results of marginal effects

Variable	Delta-method			
	dy/dx	Std Error	Prob.	z
Ext_RD	.0269294	.030635	0.379	0.88
Int_RD	.1732429	.0219475	0.000	7.89
Ext_Know	.1319366	.024698	0.019	5.34
Website	.1213006	.0231799	0.000	5.23

Table 4 shows the marginal effect (dy/dx) of the explanatory variables on the technological innovation of firms. On external R&D, it shows that, a unit change in external R&D results in 2.69% change in technological innovation while a unit change in internal R&D shows 17.325% change in technological innovation. Also, a unit change in external knowledge results in 13.19% change in technological innovation. This is more than a unit change in website which results in 12.13% change in technological innovation. It shows that all the explanatory variables affect technological innovation at various degrees when there is one unit change in any of the independent variables. It is important to note that, among the variables in the model, internal R&D is the bigger predictor of technological innovation.

## 5. Discussion and conclusion

Past research on firm level technological innovation has focused on key factors such as R&D expenditure having a positive effect on technological innovation in Czech Republic, Slovakia, Hungary and Poland. These researchers failed to assess the impact of elements in the business environment on the relationship of these key factors with technological innovation. Our study has dealt with not only the extent R&D expenditure (internal and external), external knowledge and website availability on technological innovation. Our results reveal that, there is internal R&D has a positive and significant impact on technological innovation. This confirms Medda (2020) findings on R&D expenditure and its impact on technological innovation. However, on external R&D, our results surprisingly showed that, it is not statistically significant. But when informal competition was introduced to the model, it had two different effects. First, it changed the positive relationship between internal R&D and technological innovation to negative. Second it strengthened the positive relationship between external R&D and technological innovation. This means that, firms tend to rely more on internal R&D in the monopolistic market or markets with less informal competition. However, in a market where there is high level of informal competition, firms rely less on internal R&D but more on external R&D to promote technological innovation.

This further extends Jia's (2020) work on industry competition having a moderation effect on the relationship between cooperate social responsibility and firm innovation performance. Our study further confirmed the support of hypotheses 2 and 3 that there is a positive and significant impact on the relationship between external knowledge and website availability and technological innovation. That firms in selected the CEE countries rely on external knowledge for technological innovation in either in an environment with or without informal competitors. The use of ICT in the operations of firms remain vital to the promotion of technological innovation. Our finding supports studies by Kong et al. (2019) and Yunis et al., (2018) that the use of ICT such as firms having a functional website promotes technological innovation.

In addition, the findings highlight several theoretical and practical implications. The examination of the explanatory variables and the moderating factor suggest that their relationships are contingent on the level of informal competition. This reflects an axiom in the contingency theory that, the relationship between two variables depends on the level of a third variable (Adomako et al., 2021). The addition to this theory stems from the fact that, informal competition is a contingent variable that determines how strong or weak external R&D and internal R&D, external knowledge and website could impact technological innovation. This is a novelty in relation to extant literature. On the other hand, the RDT theory posits that elements in the external environment could serve as critical resource in determining the decision performance of a firm. Firms could depend on the informal competition and collaborate and develop a wide range of network relationships with stakeholders and other firms of similar interest to boost technological innovation. How a firm manages the level of industry competition in the business environment could be a valuable resource to improve innovation or a threat to the firm's innovativeness. By implication, managers and stakeholders of firms should have a critical assessment of the effects informal competition presents in the business environment. And develop strategies to compete effectively to the advantage of the firm. If managers remain oblivious of the opportunities and threats informal competition poses to firm innovation, the value of expenditure innovation would be stifled and be competed out of business. In an era where the business environment is witnessing keen competition from both local and foreign firms, the actors in the firms must be abreast of the current issues in the business environment to promote technological innovation.

### **5.1 Limitations and future research**

Although our findings were supported by our hypotheses, it is important to interpret those findings in-line with the limitations of the study. First, the cross-sectional nature of research does not allow for the drawing of causal claims. We therefore suggest that future researchers to use longitudinal research method to further examine the moderating effect of informal competition between R&D expenditure, external knowledge website and technological innovations. Second, since most of the CEE are still catching-up in terms of development and support government give to firms as compared to countries from Western Europe, we suggest a comparative study with the Western European countries. This allows for an opportunity to examine whether strategies put in place by firms to manage informal completion is the same or different between the two blocs and how they could learn from each other. Our study contributes to the RDT and contingency theories by providing specific conditions under which informal competition could be a dependent resource to firms and the extent to which firms could use it as an opportunity or succumb to it as a threat in the business environment.

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