



# International and domestic external knowledge in the innovation performance of firms from transition economies: The role of institutions

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## ABSTRACT

In this study, we analyze how the acquisition of domestic and international external knowledge contributes to the innovation performance of firms in transition economies and how the institutional conditions of the home country may affect these relations. We test our hypotheses via the responses of 645 firms from 18 Central and Eastern European countries. Our findings show that both external knowledge sources—domestic and international—contribute positively to the number of new products in transition economies. Our results also indicate that a country's governance imperfections positively moderate the relations between both domestic and international external knowledge and the number of new products. Additionally, our findings highlight that the benefits of international external knowledge for product innovation are greater in contexts with weaker institutional conditions than in environments with stronger institutional conditions. In contrast, the benefits of domestic external knowledge for product innovation do not vary substantially between scenarios with stronger institutional conditions and those with weaker ones. These findings lead us to conclude that the institutional conditions of transition economies moderate the relation between domestic and international external knowledge and innovation performance differently, with international external knowledge proving particularly valuable for product innovation when these conditions are weak.

## 1. Introduction

Innovation is crucial for competitiveness. Not all environments, though, promote the development of an innovation strategy. Specifically, the innovation performance of firms in transition economies is a current topic of debate for academics and practitioners (Crowley and McCann, 2018; Maksimov et al., 2017; Ramadani et al., 2017; Wadhwa et al., 2017). The institutional transition from centrally-planned to an open and market-oriented economic system has pushed firms in these contexts to learn new ways of doing business and to strengthen their competitive positions at home (Chen, Tan and Jean, 2016; Shinkle and Kriauciunas, 2012), as well as providing incentives for them to generate innovations (Crowley and McCann, 2018). In these contexts, recent studies view the role of knowledge sources (Chen et al., 2016; Ramadani et al., 2017) and the contingent effect of local institutional development (Krammer et al., 2018; Xiao and Park, 2018) as factors that affect firm competitiveness. However, questions such as the potential impact of external knowledge—domestic and international—on innovation performance remain unexplored. In this paper, we examine the role of these

two types of external knowledge on the innovation performance of firms in Central and Eastern European (CEE) transition economies and the impact of levels of institutional development. As many CEE countries have become new members of the European Union (EU) and others are potential candidates, firms from these countries are simultaneously experiencing the opening of new opportunities and increasing pressures to maintain their competitiveness. These countries provide a context that is distinct from developed economies in which these questions have been studied more deeply (Ramadani et al., 2019).

Obtaining innovation results in transition economies is especially challenging due to these countries' communist heritage (Maksimov et al., 2017). Despite the fall of communism decades ago, firms in these countries are still affected by this heritage at an organizational level (Banalieva et al., 2017). Product innovation has not traditionally been encouraged in transition economies. Indeed, many of these firms still lack an innovation and market-oriented organizational culture and often adopt a relatively short-term outlook that does not encourage investment in R&D (Crowley and McCann, 2018; Leskovar-Spacapan and Bastic, 2007). Transition environments have maintained resource

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constraints over time that raise obstacles to organizational transformation and the exploitation of innovative potential (Dixon et al., 2010; Musteen et al., 2014; Wadhwa et al., 2017). For these reasons, firms in these contexts face difficulties to innovate on their own (Radosevic, 2004). Although innovation can be hard, firms from countries with weaker institutional frameworks can produce successful innovation results (Fleury et al., 2013; Govindarajan and Ramamurti, 2011). In fact, the competitiveness of transition countries depends on the ability of their firms to develop successful new products (Bastic, 2004). Accordingly, we set out to understand how firms can improve innovation performance by acquiring external knowledge. To do this, we analyze how different types of external knowledge sources may allow firms in transition economies to reach their innovation objectives in a more efficient way.

Institutional conditions in transition economies have not typically promoted innovation (Dixon et al., 2010; Leskovar-Spacapan and Bastic, 2007) and the change from communist to market systems has not removed all traces of governance imperfections (Bruton et al., 2014; Gelbuda et al., 2008). Gaining access to external knowledge is one way for firms to overcome the inherent obstacles to innovation that exist in transition economies. The integration of firms from transition countries into the global economy has enabled them to tap into a greater variety of international knowledge (Ernst and Kim, 2002) and reap the benefits of globalization (UNIDO, 2000). Moreover, the increasingly open markets in CEE transition economies have attracted a significant amount of foreign direct investment (FDI) (Bevan and Estrin, 2004; Dikova and van Wittleoostuijn, 2007; Tihanyi and Roath, 2002).

From the knowledge-based view, transaction costs economics and institutional approaches, we advance our understanding of the relative importance of domestic and international external knowledge and how the effect of these external knowledge sources varies depending on local institutional factors. These aspects are particularly relevant in the former communist bloc, where institutional problems related to volatility, political risk, corruption, and other factors may still exist (Krasniqi and Desai, 2016) and continue to affect business decisions (Bruton et al., 2014). To perform our analysis, we use data from the Business Environment and Enterprise Performance Survey (BEEPS), conducted by the European Bank for Reconstruction and Development and the World Bank.<sup>1</sup> These surveys collect information on Eastern European countries in 2012; specifically, we use data on 645 firms from 18 CEE countries. Analyzing this setting allows us to focus on firms that share contextual antecedents and unique challenges (Krammer and Jiménez, 2020; Lee et al., 2015), while simultaneously enabling us to examine the implications for them of operating in countries at different phases of transition and with different institutional conditions. The availability of data from a wide range of transition economies enables us to reach conclusions that may be generalizable to other transition contexts with different levels of institutional development.

In this study we contribute to two streams of research. First, we contribute to the discussion on the relevance of external knowledge in the innovation performance of firms in transition economies by identifying the origin of this knowledge. In focusing on CEE transition economies, we analyze the role of external knowledge in the innovativeness of firms in contexts that offer specific conditions for innovation (Crowley and McCann, 2018; Lee et al., 2015; Ramadani et al., 2019). Previous studies highlight the importance of external sources of knowledge for innovation in transition countries (Radosevic, 2004; EBRD, 2014). While much of the literature suggests that firms in these contexts will learn more from international partners, some of these studies find that this learning is not always relevant to the local setting (Danis and Shipilov, 2012). To cast light on this debate, then, studies of external knowledge should distinguish if its origin is domestic or international. By differentiating between domestic and international origins of

external knowledge, we advance our understanding of the crucial role of this knowledge in developing innovations in firms in transition countries with unique home-country conditions.

Second, we contribute to the literature on institutions by analyzing how institutional development affects the relation between external knowledge and innovation. In this way, we advance in the research stream that examines the impact of institutional conditions on firm competitiveness (Krammer, 2019; Krammer et al., 2018; Shinkle and Kriauciunas, 2012; Xiao and Park, 2018). International business research highlights the importance of considering home-country institutions as moderators in the relations between international strategies and firm innovation and performance (Marano et al., 2016; Rosenbusch et al., 2019). We also respond to the call in recent literature to explore the role of formal institutions in moderating knowledge spillovers from FDI and their potential outcomes (Perri and Peruffo, 2016). Our findings allow us to reach conclusions and recommendations that are useful to practitioners and policy makers who seek to boost the innovation performance of firms in transition countries with different levels of institutional development.

The paper is structured as follows. First, we address the theoretical background and research hypotheses. Second, we go on to describe the sample, variables, and methodology. Third, we discuss the results and their implications, state our conclusions, and outline the paper's limitations along with some future lines of research.

## 2. Theoretical background and hypotheses

### 2.1. External knowledge and innovation in transition economies

Firms in search of innovation results typically need to turn to different knowledge sources (Fey and Birkinshaw, 2005; Leiponen and Helfat, 2011; Phene et al., 2006). Although knowledge generated within the firm is important for innovation performance, numerous studies find that external knowledge sources also exert a significant impact on results (Katila, 2002; Katila and Ahuja, 2002; Laursen and Salter, 2006; Parrilli and Radicic, 2020). The integration of this external knowledge enables firms to develop more successful innovations (Gemünden et al., 1992), with higher levels of novelty (Amara and Landry, 2005), and better returns on R&D investments (Nadiri, 1993). Among other reasons for these benefits, combining internal and external knowledge in this way presents an opportunity to share resources, ideas, and improved technologies and product developments (Arora et al., 2001; Chesbrough, 2003; Su et al., 2009).

The context in which firms operate, however, can affect the benefits that the acquisition of external knowledge produces on innovation performance (Santamaria, Nieto and Barge-Gil, 2009; Vega-Jurado et al., 2009). The innovation systems literature studies how firms innovate based on their economic, institutional and social context (Cooke, 2001; Lundvall et al., 2002), while also identifying specific patterns of innovation systems at national and subnational levels (Asheim and Gertler, 2006; Lundvall, 2007; Parrilli, Balavac and Radicic, 2020). Institutional specificities play a role in the configuration of different national business systems and constitute the context in which firms and the mechanisms of learning, knowledge accumulation and appropriation operate (Asheim and Herstad, 2003). In the particular case of regional innovation systems, Zukauskaitė, (2018) identifies key institutional features that shape and constrain innovation activities.

The innovation system approach views innovation as a complex and interactive process in which firms engage with other organizations and institutions and in which mutual interactions and knowledge exchange contribute to the development of innovation capacity and the diffusion of new technologies. This is a process in which the specific technological patterns, mechanisms and rules serve as codes of conduct to coordinate the behavior of the different actors. When these mechanisms do not work efficiently, systemic imperfections can result that may block learning and innovation by firms (Woolthuis et al., 2005).

<sup>1</sup> Retrieved from [www.enterprisesurveys.org](http://www.enterprisesurveys.org), accessed April 13, 2016.

Transition economies display institutional characteristics that may be important predictors of the conditions necessary to achieve positive innovation and economic performance (Krammer, 2015; 2019). From an institutional point of view, government policies and decisions have a bearing on innovation results (Choi et al., 2011). Without doubt, transition countries provide less sophisticated legal frameworks (Gelbuda et al., 2008; Kafouros and Aliyev, 2016). Failures in the general legal system, in particular those related to intellectual property rights, are likely to hinder successful innovation (Woolthuis et al., 2005). Countries that offer poorer protection of intellectual property rights suffer from lower innovation performance and investment in technology (Gans et al., 2008). Firms in transition economies, then, need to adapt their systems and strategies to contexts in which technology regulations and markets are not well developed. The institutional voids that exist in these countries may prevent firms from independently building the technological capabilities necessary for innovation (Wu, 2013; Yi et al., 2017).

For their part, regulatory framework conditions exert a decisive impact on innovation in firms, industries and economies; for example, the regulation of natural monopolies and public enterprises has resulted in little innovation in some regulated industries (Blind, 2012). Many transition countries conserve some government involvement in business activity (Bruton et al., 2014), with firms operating under the conditions of former political and economic systems (Leskovar-Spacapan and Bastic, 2007). Thus, firms in these countries suffer from the ‘hangover effect’ of the inherited norms and values of a planned system, while at the same time fighting with the demands of a competitive market economy (Dixon et al., 2010).

Likewise, the level of technological learning differs between developed and developing economies (Lu and Lazonick, 2001; Mu and Lee, 2005; Xie and Wu, 2003). Transition economies are less advanced due to transitional disinvestment and outdated technological specialization, another legacy of former communist regimes in many countries (Krammer, 2009; Maksimov et al., 2017). These specific external factors—related with institutional frameworks and regulatory conditions—may influence the innovation strategy and performance of firms in transition economies. These are all basic elements that may act as system imperfections that affect innovation processes (Woolthuis et al., 2005).

In the context of transition economies, then, firms find more difficulties both to acquire the necessary inputs and ultimately to achieve successful innovations. For this reason, when internal resources are scarce, external knowledge can become an especially important input (EBDR, 2014; Radosevic, 2004), one that enables firms to complement their knowledge and internal endowments to achieve innovation results (Krammer et al., 2018). In fact, previous research points out the importance of spillovers for less R&D intensive contexts such as transition economies (Crowley and McCann, 2018; Krammer, 2010). External knowledge for innovation can come from a domestic or an international source (Kafouros and Forsans, 2012; Qiu et al., 2017; Scalera et al., 2018). The origin of the external source affects the capacity of firms to gain access to this knowledge, as well as their ability to integrate it successfully in innovation processes (Phene et al., 2006; Reuer and Lahiri, 2014). It is also important to bear in mind that these transition contexts, with their weak institutional environments, often imply elevated transaction costs associated with the search for information, negotiation, coordination, and the monitoring and enforcement of contracts (Choi, Lee and Kim, 1999; Henisz and Williamson, 1999).

To take advantage of external knowledge for innovation, firms must be able to integrate it successfully (Cohen and Levintal, 1990). If we discount individual differences among firms, the ability to integrate this knowledge largely depends on factors such as social structures, business networks, national and regional innovation initiatives, and education systems (Perri and Peruffo, 2016). Firms from transition economies tend to base their activities on network-related strategies as an alternative to the heritage of the planned economy (Peng and Heath, 1996). These

firms, then, typically rely on collaboration strategies to overcome internal limitations and external factors (Musteen et al., 2014; Manolova et al., 2010), thereby making it possible to develop capabilities that promote the exchange of knowledge (Hitt et al., 2005). Although firms from these transitional contexts suffer from financial and technological constraints, they do possess high levels of human capital and specific knowledge based on work experience that boost their absorptive capacity (Apanasovich et al., 2016). Thus, these firms are able to acquire, absorb and integrate external knowledge that will be highly valuable for innovation.

Specifically, knowledge from a domestic source may be relatively easy to acquire (Sofka, 2008), as the shared context provided by location in the home country facilitates the assimilation and exploitation of the new information (Phene et al., 2006). The common economic and institutional structures, as well as microeconomic linkages between actors in the same country, are important for innovation (Feldman and Audretsh, 1999; Glaeser et al., 1992). Indeed, some of the interaction patterns, learning processes and knowledge acquired depend on geographical proximity and local institutional frameworks (Asheim and Gertler, 2006; Markusen, 1996). Sharing some types of knowledge with partners in proximate locations contributes significantly to product innovation (Fitjar and Rodríguez-Pose, 2013). In these transition contexts, then, the underlying structures and national values that firms and institutions share facilitate the integration of external domestic knowledge, while at the same time simplifying the search for partners and the negotiation and coordination processes. These arguments lead to our first hypothesis, which posits that firms can take advantage of domestic external knowledge for innovation:

*Hypothesis 1: In CEE transition economies, domestic external knowledge is positively related with the firm's number of new products.*

In recent years in transition contexts, access to international knowledge has become increasingly common (Giroud et al., 2012; Tihanyi and Roath, 2002; Silajdzic and Mehic, 2015). The socio-economic changes in transition economies brought by the adoption of essential market institutions and the specific norms of regional integration with the EU have allowed these markets to become gradually more open and oriented to an international context (Krammer, 2010; UNIDO, 2000). Access to international external knowledge that is valuable for innovation can be obtained by: (i) looking for knowledge overseas—via offshore outsourcing, offshore alliances or captive offshoring (Bertrand and Mol, 2013; Nieto and Rodríguez, 2011) or entry into foreign markets (Boermans and Roelfsema, 2015; Salomon and Jin, 2008); (ii) acquiring knowledge from foreign firms operating in the home country (De Clercq, Hessels and Van Stel, 2008; Tihanyi and Roath, 2002).

Despite these advances, country-specific resource endowments and institutional contexts mean that technology gaps persist. Indeed, in transition countries the size of these technology gaps is double those of developed countries (Kontolaimou et al., 2016). The weak domestic production and innovation systems initially typical of transition economies, however, can be compensated for by international sources of knowledge (Ernst and Kim, 2002). In these contexts, conditions such as the existence of a skilled work force (Apanasovich et al., 2016) and a tradition of firms relying on networks (Krasniqi and Desai, 2016; Maksimov et al., 2017; Musteen et al., 2014) make the integration of such international knowledge possible.

Differences in government policies, levels of investment and education, and supply and demand conditions (Porter and Rivkin, 2012) generate heterogeneous knowledge bases among countries (Cantwell and Mudambi, 2005). International knowledge sources allow firms to gain access to diverse knowledge (Phene et al., 2006), knowledge that will be valuable for innovation but that will also present them with challenges. On the one hand, cognitive, institutional and geographic distances hamper the ability of firms to integrate knowledge from other contexts (Boschma, 2005). On the other hand, firms face high transaction costs that derive from the different environments in which they



must seek information, coordinate and negotiate contracts (Ellram et al., 2008). Regarding advantages, access to heterogeneous knowledge and technologies from other countries opens opportunities to discover new combinations of ideas, points of view and approaches (Narula and Zanfei, 2005). Indeed, distant knowledge bases between actors promote creative and innovative solutions (Messeni Petruzzelli, 2008). In line with this, previous studies show that international knowledge can improve innovation performance (Bertrand and Mol, 2013; Nieto and Rodríguez, 2011; Phene et al., 2006).

Because local firms in these contexts usually possess limited internal knowledge and innovation capabilities (Leskovar-Spacapan and Bastic, 2007), they may seek technological and managerial resources from better endowed international counterparts (Boermans and Roelfsema, 2015; Hitt et al., 2005). Despite the risks associated with sourcing international external knowledge, these foreign resources may be especially valuable for firms in transition contexts looking to innovate. We capture these arguments in our second hypothesis:

*Hypothesis 2: In CEE transition economies, international external knowledge is positively related with the firm's number of new products.*

## 2.2. Domestic and international external knowledge and innovation performance: the role of institutional conditions

In addition to the social and economic modifications that CEE transition economies have undergone, the formal institutions in these countries have also changed—and continue to change—in the last decades (Chari and Banalieva, 2015; Peng, 2003; Dikova and van Witte-loostuijn, 2007). The reform processes, however, have not left all these countries in identical situations (Kafourous and Aliyev, 2016; Hoskisson et al., 2013; Shinkle and Kriauciunas, 2010). Although the starting point for the reform process in CEE transition economies was similar, over time differences among countries have arisen as varying levels of institutional development have appeared (Bruton et al., 2014). Thus, firms from different transition countries face diverse levels of governance imperfections.

Transition economies vary in the volatility and inconsistency or margin of discretion in the implementation of rules (Krasniqi and Desai, 2016). Specifically, weak enforcement of rules in some transition countries contributes to the proliferation of chaotic conditions (Benn, 2001; Hitt et al., 2004). Additionally, governments in some of these countries continue to be involved in business activity to a varying degree (Bruton et al., 2014). Corruption also endures in many of the administrative procedures, due in large part to civil servants supplementing their poor salaries by obtaining bribes and extorting money from firms (Ahlstrom and Bruton, 2010). Moreover, some of these countries continue to find it difficult to establish effective systems to defend intellectual property rights (Javorcik, 2004). Many factors, then, define a country's level of institutional development (Globerman and Shapiro, 2003). Consequently, we adopt a holistic approach to analyze the level of governance imperfections, instead of focusing on only one specific indicator of the regulatory framework (Cherchye and Verriest, 2016).

Given that institutional environments exert an influence on the operational rules of the game in any context (Henisz and Williamson, 1999), we expect varying degrees of governance imperfections to alter the relation between the different sources of external knowledge and innovation results. Thus, we propose that the levels of institutional development of the country of origin will modify the relations between domestic and international external knowledge and innovation performance.

*The moderating role of governance imperfections on the relation between domestic external knowledge and innovation performance*

Firms from markets with weaker institutions face greater misallocations of resources and competitive disadvantages (Cuervo-Cazurra and Genc, 2008). To counter this handicap, sourcing external knowledge can be a useful option, since firms face difficulties to innovate by themselves (Radosevic, 2004). But managers working with

domestic external knowledge in contexts with less-developed institutions may face higher transaction costs. High asset specificity and uncertainty tend to increase transaction costs such as those related to monitoring and coordination (Williamson, 1979). These contexts are also associated with weaker property rights and contract law regimes (Kafourous and Aliyev, 2016). Firms that sign partnership contracts with other enterprises in such environments run the risk that knowledge of innovations will leak out (Henisz and Williamson, 1999; Teece, 1986). And the weaker the contractual control and enforcement mechanisms are, the greater will be the risk of opportunistic behavior (Schneider et al., 2013). Thus, firms in countries with greater governance imperfections will face worse conditions with higher transaction costs, which will in turn affect the utilization and commercialization of this knowledge in terms of new products. In contexts with weaker institutional conditions, then, the potential costs may outweigh the potential benefits this knowledge may have for innovation. For these reasons, we posit in our third hypothesis that the positive relation between domestic external knowledge and the number of product innovations will be weakened in contexts with greater governance imperfections:

*Hypothesis 3: In CEE transition economies, governance imperfections negatively moderate the relation between domestic external knowledge and the firm's number of new products.*

The moderating role of governance imperfections on the relation between international external knowledge and innovation performance

As already posited, international external knowledge may be especially valuable for innovation in transition contexts. This international knowledge can be acquired by local firms in different ways. For example, when firms in transition countries look overseas to access knowledge available across borders. Or when local firms obtain international knowledge from foreign firms operating in the transition country.

Negotiating with foreign partners can be complicated due to the inherent difficulties of asymmetric information and coordination costs (Ellram et al., 2008; Schneider et al., 2013). As governance imperfections in local contexts rise, the likelihood of collaborating with international partners from countries with better institutional conditions grows. When agreements are signed with partners from locations with more developed institutional environments and stronger property rights and contract regimes, the better quality of enforcement reduces governance costs (Henisz and Williamson, 1999). The relative costs of negotiating with international partners become more affordable, then, as the risks of opportunistic behavior and knowledge leakage recede. Thus, firms in countries with greater governance imperfections would compensate for the *ex-ante* difficulties via the improved *ex post* conditions—understood as the perceived reliability of enforcement mechanisms (confidence in the legal system). Consequently, these improved *ex post* conditions will minimize the transaction costs to commercialize this knowledge.

Moreover, local firms can acquire international external knowledge by interacting with multinational companies (MNCs) operating in the local country. The greater legal distance between the home and host country can motivate MNCs to develop links and knowledge transfers with local firms (Rodríguez-Clare, 1996). This is particularly so in highly unstable environments, where foreign entrants have a pressing need for help from local partners (Hitt et al., 2005). Thus, foreign firms operating in transition economies with weaker institutional conditions may depend more on local firms to overcome the liabilities of foreignness, which may in turn provide opportunities for these local firms to source and learn from international knowledge (Krammer, 2010; Silajdzic and Mehic, 2015). In other words, the need to overcome the limitations of greater governance imperfections pushes foreign firms to share knowledge with their local partners. In sum, local firms' 'local knowledge' provides foreign subsidiaries with the incentive to interact with them and learn how to deal with higher levels of governance imperfections in the host country. And thanks to these relationships with foreign subsidiaries, local firms may acquire global knowledge that is useful for

innovation (Un and Rodríguez, 2018a).

Therefore, when firms' origin countries suffer greater governance imperfections, the positive relation between international external knowledge and the number of product innovations will be strengthened—and the extent of this strengthening will depend on the degree to which the benefits for innovation compensate for the increased difficulties of acquiring, integrating and commercializing foreign knowledge.

In conclusion, given that the institutional environment determines the rules of the game and affects economic activities and transactions, we propose that higher levels of governance imperfections in the home country will strengthen the relation between international external knowledge and innovation performance. In line with this, we formulate the following hypothesis:

*Hypothesis 4: In CEE transition economies, governance imperfections positively moderate the relation between international external knowledge and the firm's number of new products.*

### 3. Empirical analysis

#### 3.1. Sample

To develop our analysis, we use data from the Business Environment and Enterprise Performance Survey (BEEPS) compiled by the European Bank for Reconstruction and Development and the World Bank Enterprise Survey. This database has been used previously by researchers to study the behavior and performance of firms in transition countries (Crowley and McCann 2018; Krammer, 2019; Krammer and Jiménez, 2020; McCann and Bahl, 2017). These surveys cover different firm and environmental aspects, as well as data on the degree of competition. The surveys collect data via standardized instruments and a uniform sampling method to minimize measurement errors and yield data that are comparable across different economies. Specifically, we use data from a survey performed in 18 Eastern European transition countries; the countries of origin (grouped by income level) are displayed in table A (see appendix). The information available from the innovation module in the databases allows us to test our hypotheses on a final sample of 645 firms.

In addition, we combine this information with the World Bank Governance Matters database to analyze levels of governance imperfections. This database provides details on each country's level of institutional development via governance indicators measuring political stability, control of corruption, rule of law, accountability, regulatory quality, and government effectiveness. This database is commonly employed to study regulatory or formal institutions (Cuervo-Cazurra and Genc, 2008; Dikova and van Witteloostuijn, 2007; Garrido et al., 2014; Hernández and Nieto, 2015).

#### 3.2. Variables

**Dependent variable.** *Number of new products:* We use the number of product innovations developed by the firm in the last three years. This variable has been employed previously in the literature as an indicator of innovation productivity (Chatterji and Fabrizio, 2014; García et al., 2013; Un and Rodríguez, 2018b).

**Independent variables.** Following prior studies (e.g., Vega-Jurado et al., 2009; Nieto et al., 2015; Santamaría et al., 2012; Rodríguez and Nieto, 2016), we measure external knowledge using dichotomous variables. Specifically, we use two independent variables:

*Domestic external knowledge:* This is a dichotomous variable that takes value 1 when the firm has acquired knowledge such as purchasing or licensing of patents and non-patented inventions, know-how or other types of knowledge from other domestic firms or organizations in the last three years; the variable takes value 0 otherwise.

*International external knowledge:* This is a dichotomous variable that takes value 1 when the firm has acquired knowledge such as purchasing

or licensing of patents and non-patented inventions, know-how or other types of knowledge from international firms or organizations in the last three years; the variable takes value 0 otherwise.

**Moderating variable.** We use *Governance imperfections* as a moderating variable that measures the level of institutional development of the country of origin. This variable is constructed using the indicators from the World Bank's Governance Matters database. Specifically, this database includes six indicators that capture how governments are chosen, controlled and replaced; their capacity to formulate and implement policies; and the level of respect of the citizens and the state for the institutions that govern economic and social interactions.

In our analysis, we use these six indicators to construct *Governance imperfections* as a continuous variable that measures the degree of 'imperfection' of each country of origin. In line with the previous literature (Fuentelsaz et al., 2019), we perform a factorial analysis of the six indicators and identify a single factor that defines the degree of regulatory development of the country of origin. The factor loadings are between 0.74 and 0.98 and the Cronbach's alpha has a value of 0.95, thus confirming the validity and reliability of the variable created. We then reverse the scores so that the higher values indicate greater levels of governance imperfections (Slangen and Beugelsdijk, 2010).

**Control variables.** We include controls for innovation activities, firm specific characteristics (that may be related to innovation performance), and industrial activity in all the models. First, we control for R&D activities via the variable *R&D intensity*. This is a continuous variable measured via the logarithm of the firm's expenditures on R&D activities (Chatterji and Fabrizio, 2014; Santamaría et al., 2012). Second, we control for the age of the firm, given that this is a factor that can affect innovation performance (Balasubramanian and Lee, 2008; Kafourous et al., 2015; Withers et al., 2011). *Firm age* is measured as the number of years since the business was founded (McKelvie et al., 2007). Specifically, we use the logarithm of the number of years (Oxelheim and Randoy, 2003), as the distribution of the raw age variable is dispersed (Weinberg and Abramowitz, 2008). Third, we control for firm size, which is one of the most important determinants for innovation behavior (Becheikh et al., 2006). In line with previous studies, we use firm sales as a proxy of firm size (Lu and Beamish, 2004; Huang and Chen, 2010). More exactly, we measure *Firm size* via the logarithm of the total sales in euros in the last fiscal year (Un and Rodríguez, 2018b). Fourth, given that internationalization may stimulate innovation, we control for the international activity of the firm (Galende and De La Fuente 2003; Hsu et al., 2015). We include *International activity experience* as a continuous variable which is measured by the number of years since the firm started exporting; this variable takes value 0 if the firm does not export (Wu et al., 2016).

Scholars have also identified that ownership type may affect the resources that firms have available (Fernández and Nieto, 2006). Consequently, we control for ownership structure, with a particular focus on the potential advantage of foreignness for innovation (Un, 2011). Specifically, we include Foreign ownership, which measures the percentage of share equity ownership in the hands of foreign individuals, companies and organizations (Nieto et al., 2015).

Lastly, we include sectorial dummies to capture the effects of industry characteristics, since innovation performance is not uniform across all sectors (Choi et al., 2011; Malerba, 2005). We differentiate sectors via the following dummy variables: Manufacturing; Construction; Transport; Retail; and Other services. Retail is excluded from the models and is only used as the baseline category.

#### 3.3. Methodology

Because the dependent variable is constructed via the number of product innovations (i.e., a count variable that takes only non-negative integer values), we need to use count models that assume a Poisson or a negative binomial distribution (Hausman et al., 1984; Krammer, 2009). Poisson models have been commonly used in studies of innovation via

analyses of results such as the number of patents or innovations achieved (Baptista and Swann, 1998; Ahuja and Katila, 2001). Poisson regression, however, is not suitable when an overdispersion in the dependent variable exists; this unsuitability is due to the Poisson restrictive condition, which states that the mean must equal the variance. Our data are overdispersed; they exhibit a large number of zeroes and violate a basic assumption of Poisson estimation. In these cases, the dependent variable is distributed as a negative binomial (Soda, 2011; Salomon and Jin, 2010). Thus, following previous literature analyzing product innovation performance with count measures, we employ a negative binomial model to study the relations (Ardito et al., 2018; Jong and Slavova, 2014; Un and Rodriguez, 2018b). The standard formulation for the negative binomial mass function of a variable Y is given in the following form:

$$f(y; k, \mu) = \frac{\Gamma(y + k)}{\Gamma(y + 1)\Gamma(k)} + \left(\frac{k}{k + \mu}\right)^k \left(1 - \frac{k}{k + \mu}\right)^y$$

where  $E(Y) = \mu$ , and  $Var(Y) = \mu + \mu^2/k$ , and  $1/k$  is defined as the dispersion parameter,  $k$  is the gamma scale parameter.

The specification we use to test our hypotheses is:

$$\text{Number of new products} = \beta_0 + \beta_1 (\text{Domestic External knowledge})_i + \beta_2 (\text{International External knowledge})_i + \beta_3 (\text{Governance imperfections})_i + \beta_4 (\text{Domestic External knowledge X Governance imperfections})_i + \beta_5 (\text{Domestic External knowledge X Governance imperfections})_i + \beta_i (\text{Control variables})_i + e$$

Specifically, to test hypotheses 1 and 2, we check the signs of  $\beta_1$  and  $\beta_2$ , respectively. Hypotheses 1 and 2 are supported if  $\beta_1$  and  $\beta_2$  are positive and statistically significant. To test hypotheses 3 and 4, we check the signs of  $\beta_4$  and  $\beta_5$ , respectively. Hypotheses 3 and 4 are supported if  $\beta_4$  and  $\beta_5$  are statistically significant, with  $\beta_4$  being negative and  $\beta_5$  positive.

#### 4. Analysis and results

##### 4.1. Descriptive statistics and a preliminary descriptive analysis

Table 1 displays the descriptive statistics included in the models; Table 2 contains the correlations and collinearity diagnostics of the variables used in the study. We performed an analysis of the variance inflation factor (VIF) to identify potential problems of multicollinearity. Individual VIF values greater than 10.0, combined with average VIF values greater than 6.0, indicate a problem of multicollinearity (Neter et al., 1989). The highest VIF individual value and the mean value in the model are lower than the threshold points, thus suggesting that multicollinearity is absent.

Table 3 displays the descriptive statistics for the sample, organized by product innovation propensity. In the full sample, 12.6% of firms acquire domestic external knowledge and 6.5% acquire international

**Table 1**  
Descriptive statistics.

Variable	Mean	Std. dev.	Min	Max
Number of new products	4.57	13.56	0	100
Domestic external knowledge	0.12	0.33	0	1
International external knowledge	0.065	0.25	0	1
Governance imperfections	-0.28	0.85	-2.20	0.67
R&D intensity	1.81	4.32	0	17.37
Age (ln)	2.82	0.55	0.69	4.93
Size (ln)	13.71	1.90	8.43	20.25
International activity experience (ln)	1.06	1.28	0	4.17
Foreign ownership	10.37	28.73	0	100
Manufacturing	0.46	0.50	0	1
Construction	0.07	0.26	0	1
Transport	0.04	0.19	0	1
Other services	0.06	0.24	0	1

Number of observations: 645.

**Table 2**  
Correlations and collinearity diagnostics of the independent and control variables.

	1	2	3	4	5	6	7	8	10	11	12	13	14	VIF
1 Number of new products	1													1.04
2 Domestic external knowledge	0.04	1												1.06
3 International external knowledge	0.07*	-0.10**	1											1.16
4 Governance imperfections	0.03	0.07*	-0.03	1										1.09
5 R&D intensity	0.08**	0.09**	0.07*	-0.14**	1									1.11
6 Age	-0.07*	0.02	0.01	-0.16**	-0.025	1								1.32
7 Size	0.03	0.08**	0.06	-0.28**	0.21***	0.2***	1							1.31
8 International activity experience	0.03	0.03	0.08*	-0.22***	0.16***	0.22***	0.3***	1						1.13
10 Foreign ownership	0.03	0.004	0.06	-0.09**	0.02	-0.05	0.28***	0.15***	1					1.33
11 Manufacturing	-0.01	-0.08**	-0.06	0.03	0.001	0.05	0.03	0.27***	0.01	1				1.14
12 Construction	-0.06	-0.01	0.02	-0.05	-0.03	0.04	0.04	-0.15***	-0.09**	-0.26***	1			1.09
13 Transport	-0.05	0.05	-0.02	-0.04	-0.006	0.015	0.05	0.09**	-0.01	-0.18***	1	1		1.11
14 Other services	-0.02	0.08**	0.04	-0.04	0.02	-0.02	-0.07*	-0.06	-0.00	-0.23***	-0.07*	-0.05	1	1.16
														Mean VIF

\* $p < 0.1$ .

\*\* $p < 0.05$ .

\*\*\* $p < 0.01$ .

**Table 3**  
Domestic and international external knowledge and product innovations.

Percentage of firms	Full sample	Product&Innovations <sup>(1)</sup>
Domestic External knowledge	12.6%	61.7%
International External knowledge	6.5%	71.4%
Full sample		50.5%

We use a dichotomous variable that takes value 1 when firms declare product innovations.

**Table 4**  
External knowledge and number of new products.

	Domestic external knowledge	International external knowledge	No external knowledge	Difference
Number of new products	6.01	8.02	4.08	1.93
			4.08	3.94**

T-tests on the difference between means (p-values from Student's distribution).

\* $p < 0.1$ ;

\*\*\*  $p < 0.01$ ;

\*\*  $p < 0.05$ ;

external knowledge; 50.5% of firms in the full sample declare product innovations. This percentage increases to 61.7% among firms that acquire domestic external knowledge and to 71.4% among firms that acquire international external knowledge. Interesting differences, then, emerge between the product innovation propensity of firms tapping into domestic and international external knowledge.

Additionally, we conducted a preliminary analysis of the innovation results among firms that acquire domestic or international external knowledge and those that do not acquire any type of external knowledge. Table 4 summarizes the mean differences using t-tests. These tests show that significant differences exist in the mean number of product innovations between firms that make use of international external knowledge and those that do not make use of external knowledge (difference = 3.94,  $p < 0.1$ ).

Lastly, it is important to consider the role of governance imperfections in these differences. We also conducted a t-test to compare the mean number of product innovations between the subsamples, considering firms from countries where *Governance imperfections* are above the mean value (see table 5). Our preliminary findings support our expectation that firms acquiring any kind of external knowledge—domestic or international—in countries with above average levels of governance imperfections are more likely to achieve a greater number of innovation outputs than those that do not undertake external knowledge activities (differences = 2.82,  $p < 0.1$  and 6.73,  $p < 0.01$ , respectively).

#### 4.2. Empirical results

Table 6 displays the results for the different econometric models used to test our hypotheses. Model 1 includes the control variables only. Model 2 includes the independent variables *Domestic external knowledge* and *International external knowledge*, as well as the variable *Governance imperfections*. Models 3 and 4 include the interactions between *Domestic external knowledge* and *International external knowledge* with *Governance*

**Table 5**  
External knowledge, number of new products, and governance imperfections.

	Governance imperfections > -0.28			
	Domestic external knowledge	International external knowledge	No external knowledge	Difference
Number of new products	6.87		4.05	2.82*
		10.78	4.05	6.73***

T-tests on the difference between means (p-values from Student's distribution).

\*\* $p < 0.05$ .

\* $p < 0.1$ .

\*\*\* $p < .01$ .

*imperfections*, respectively. Lastly, model 5 is the full model, which includes all the independent variables and interaction terms in which we can examine direct and moderating effects.

In hypotheses 1 and 2, we test the direct effect of domestic and international external knowledge on the number of product innovations by examining the coefficients estimated for *Domestic external knowledge* and *International external knowledge*. Specifically, for hypothesis 1, all the coefficients for *Domestic external knowledge* are positive and significant in models 2, 3, 4 and 5. This result indicates the existence of a positive relation between domestic external knowledge and the number of new products, thereby providing support for hypothesis 1. For hypothesis 2, all the coefficients for *International external knowledge* are positive and significant in models 2, 3, 4 and 5. This result indicates the existence of a positive relation between international external knowledge and the number of product innovations, thereby providing empirical support for hypothesis 2.

To test hypothesis 3 (which posits that governance imperfections negatively moderate the domestic external knowledge-innovation relation) and hypothesis 4 (which posits that governance imperfections positively moderate the international external knowledge-innovation relation), we examine the interaction terms between *Governance imperfections* and *Domestic external knowledge* and *International external knowledge* in models 3, 4 and 5. For hypothesis 3, the coefficient for the interactions between *Governance imperfections* and *Domestic external knowledge* is not significant in model 3 and positive and significant in model 5. These findings do not provide empirical support for hypothesis 3. For hypothesis 4, the coefficient for the interaction between *Governance imperfections* and *International external knowledge* is positive and significant in models 4 and 5. These findings provide support for hypothesis 4, as governance imperfections positively moderate the relations between both types of external knowledge and innovation performance.

Since the interpretation of nonlinear models is not straightforward,



**Table 6**  
Results of the negative binomial analysis of the impact of external knowledge on the number of new products.

	Model 1	Model 2	Model 3	Model 4	Model 5
Domestic external knowledge		0.450** (0.221)	0.472** (0.191)	0.473** (0.221)	0.492*** (0.190)
International external knowledge		0.702* (0.409)	0.734* (0.417)	0.813*** (0.271)	0.844*** (0.276)
Governance imperfections		0.0178 (0.106)	-0.0280 (0.105)	-0.034 (0.107)	-0.091 (0.108)
Domestic ext. know*Gov. imperfections			0.383 (0.238)		0.461* (0.255)
International ext. know*Gov.imperfections				0.898*** (0.183)	0.961*** (0.200)
R & D intensity	0.054** (0.022)	0.061*** (0.02)	0.064*** (0.02)	0.064*** (0.021)	0.068*** (0.022)
Age	-0.383*** (0.121)	-0.346*** (0.129)	-0.357*** (0.131)	-0.347*** (0.128)	-0.360*** (0.129)
Size	-0.109** (0.052)	-0.124** (0.056)	-0.127** (0.057)	-0.124** (0.055)	-0.127** (0.055)
International activity experience	0.166** (0.076)	0.138 (0.085)	0.125 (0.09)	0.132 (0.086)	0.117 (0.091)
Foreign ownership	0.0024 (0.005)	0.0037 (0.005)	0.004 (0.005)	0.004 (0.005)	0.004 (0.005)
Manufacturing	-0.394 (0.257)	-0.402 (0.278)	-0.390 (0.282)	-0.433 (0.269)	-0.421 (0.272)
Construction	-1.092*** (0.255)	-1.060*** (0.281)	-1.016*** (0.272)	-1.061*** (0.269)	-1.010*** (0.257)
Transport	-1.686*** (0.504)	-1.619*** (0.457)	-1.534*** (0.492)	-1.647*** (0.445)	-1.547*** (0.484)
Other services	-0.564 (0.354)	-0.584 (0.382)	-0.553 (0.380)	-0.517 (0.359)	-0.481 (0.355)
_cons	4.020*** (0.762)	4.006*** (0.864)	4.056*** (0.873)	3.995*** (0.853)	4.059*** (0.862)
lnalpha					
_cons	1.502*** (0.129)	1.485*** (0.123)	1.481*** (0.122)	1.474*** (0.124)	1.469*** (0.124)
N	645	645	645	645	645
χ <sup>2</sup>	98.11	172.4	167.6	121.5	124.4
Log likelihood	-1358.3	-1354.8	-1354.1	-1352.6	-1351.7

Number of observations: 645. Standard errors in parentheses.

\**p* < 0.10.

\*\**p* < .05.

\*\*\**p* < 0.01.

we have represented the values of the marginal effects graphically in Fig. 1 to clarify matters (Wiersema and Bowen, 2009). Specifically, we find that for *International external knowledge* changes of 0.5 points in the levels of governance imperfections result in positive and significant differences among the various marginal effects. These results indicate the existence of a positive relation between international external knowledge and the number of product innovations when governance imperfections increase—and that this positive impact grows with higher levels of imperfections. In other words, the relation between international external knowledge and the number of product innovations is stronger in contexts with higher levels of governance imperfections than it is in contexts with stronger institutional frameworks.

In a similar way, we calculate the differences in the marginal effects for *Domestic external knowledge* when governance imperfections increase. In this instance, we find that increases of 0.5 points in levels of governance imperfections result in positive but not significant differences in the number of product innovations. These results reveal that governance imperfections positively moderate the relation between domestic external knowledge and the number of new products; the impact of this moderating effect, however, does not change significantly for different levels of governance imperfections.

As Fig. 1 shows, the steepening in the slope of the line for *International external knowledge* indicates that the relation with the number of product innovations grows stronger as governance imperfections increase—something that does not occur in the case of domestic external knowledge. Differences, therefore, exist in the impact of domestic and

international external knowledge on innovation performance for different levels of governance imperfections.

Concerning the control variables, the estimated coefficient for *R&D intensity* is positive and significant, indicating a positive relation between firms' R&D expenditures and the number of product innovations. In contrast, the estimated coefficient for *Firm age* and *Firm size* are both negative and significant. Thus, both age and size have a negative relation with the number of product innovations, as younger firms and smaller ones are associated with the development of higher number of new products. With respect to industrial sector, the coefficients for *Construction*, *Transport* and *Other services* are negative and significant, suggesting that firms in these sectors innovate less than firms in the *Retail* category.

Lastly, to test the robustness of the results we have estimated alternative models: (i) using ordered probit models with a categorical variable for the dependent variable *Number of new products*; and (ii) using negative binomial regression models with a different measure of the variable *Governance Imperfections* based on data from Transparency International's Corruption Perception Index.<sup>2</sup> The results of these alternative analyses are consistent with those obtained from the models presented in this paper; these additional analyses are available upon request.

<sup>2</sup> Available on <https://www.transparency.org/>



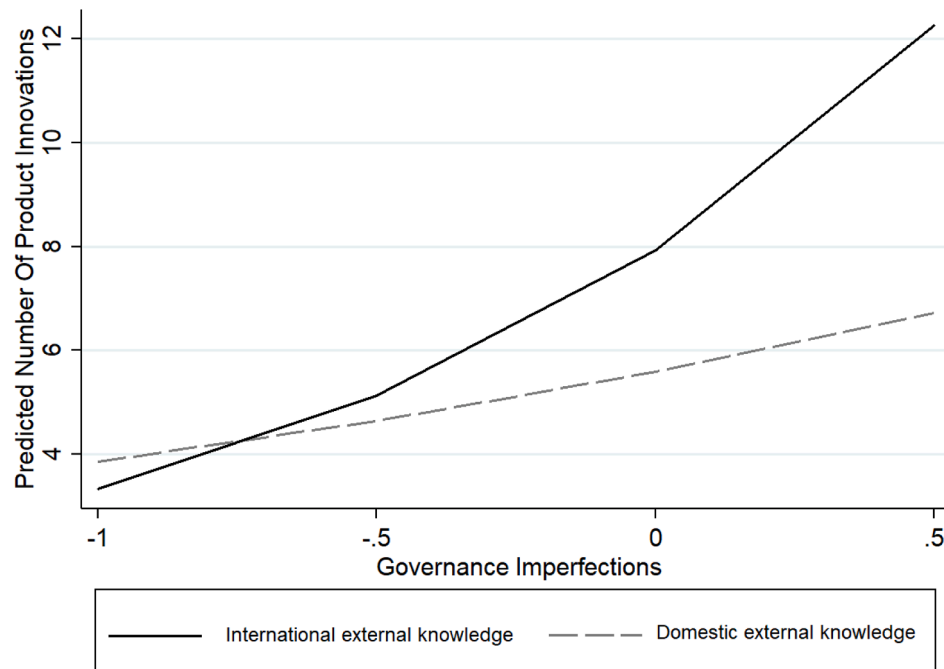


Fig. 1. Predicted number of product innovations for domestic and international external knowledge (depending on level of governance imperfections).

5. Discussion and conclusions

Transition countries display different characteristics and external factors that affect the innovation climate and results that firms can achieve (Crowley and McCann, 2018; Dixon et al., 2010; Ramadani et al., 2017). Debate continues over how to explain innovation performance in these contexts (Krammer and Jiménez, 2020; Maksimov et al., 2017; Ramadani et al., 2019; Wadhwa et al., 2017). In this study we advance our knowledge of the role of external knowledge—a determinant of innovation—in these contexts by distinguishing if the origin of this knowledge is domestic or international. These countries provide an ideal setting to test how firms may acquire resources and capabilities from external sources, given the innovation limitations present in their institutional frameworks (Krammer and Jiménez, 2020; Ramadani et al., 2019).

Using a large-scale, cross-national dataset of firms from CEE countries, we analyze the relation between domestic and international external knowledge and the product innovations of firms from transition

countries, as well as how these relations vary depending on levels of governance imperfections.

Firstly, our findings show that both domestic and international external knowledge sources are positively related with the number of new products. This result provides support for the idea that firms from transition economies obtain benefits to achieve innovation from both external knowledge sources. The reasons for this may be linked to these firms' tradition of relying on networks (Krasniqi and Desai, 2016; Maksimov et al., 2017; Musteen et al., 2014), their high levels of human capital and work experience, and their consequent absorptive capacity (Apanasovich et al., 2016). Although previous studies highlight the importance of acquiring external international knowledge for firm competitiveness (Danis and Shipilov, 2012), our work identifies the origin of the knowledge and reveals that both domestic and international sources are beneficial for innovation in transition countries. Domestic external knowledge has more limited novelty, but is less challenging to integrate and offers lower transaction costs due to possible linkages between actors and/or greater geographical, organizational and institutional proximity between them. For this reason, firms find advantages in exploiting this knowledge for innovation. For its part, international external knowledge can be problematic due to the difficulties associated with integrating it and searching for partners, but its more heterogeneous nature boosts the chances of developing novel ideas and new products.

Additionally, we postulate that the relations between both external sources of knowledge—domestic and international—and the number of new products depend on the institutional conditions of each country. Specifically, we expect that at higher levels of governance imperfections the positive external domestic knowledge-innovation relation will be weakened, while the international external knowledge-innovation relation will be strengthened. Contrary to what we posit, our findings show that governance imperfections positively moderate the relation between domestic external sources of knowledge and the number of new products. Thus, the domestic external knowledge-innovation relation is strengthened as governance imperfections increase. This result may be explained by the impact of a common innovation system. The particular and similar innovation capabilities and outputs of a specific innovation system may compensate for the increased transaction costs that occur in

Table A  
Origin countries included in the sample (grouped by income level).

Income level	Country
Lower middle income	Armenia
	Moldova
Upper middle income	Albania
	Bosnia Herzegovina
	Bulgaria
	Macedonia
	Montenegro
	Romania
	Serbia
High income	Croatia
	Czech Rep
	Estonia
	Hungary
	Latvia
	Lithuania
	Poland
	Slovakia
	Slovenia

lower quality institutional contexts. In the case of international external knowledge, our findings indicate a positive moderation of the relation with innovation performance, as postulated.

In addition, the introduction of the moderating effect of governance imperfections in these relations reveals some interesting differences between the effects of these two knowledge inputs. The benefits of domestic external knowledge for product innovation do not vary substantially between scenarios with stronger institutional conditions and those with weaker ones. In contrast, the benefits of international external knowledge for product innovation by firms do vary significantly. Specifically, we find that these benefits grow to a greater extent in contexts with weaker institutional conditions than in environments with stronger institutional conditions. In other words, international knowledge sources are more valuable when levels of institutional development are lower (i.e., the positive relation with product innovation strengthens as the level of institutional development weakens). Thus, the hoped-for benefits of international external knowledge outweigh the potential difficulties that firms in transition countries (with weaker institutions) face in incorporating it.

This study contributes to two current debates of great importance for scholars, practitioners and politicians: (i) innovation management in transition countries; and (ii) the role of institutional quality in innovation strategies. Regarding innovation management in transition countries, our findings shed light on innovation strategies in contexts with different characteristics that may influence innovation activities and performance (Crowley and McCann, 2018; Dixon et al., 2010; Ramadani et al., 2017). Specifically, we advance on previous studies of innovation performance (Maksimov et al., 2017; Wadhwa et al., 2017) by clarifying the role of external sources of knowledge—domestic and international—as determinants of innovation performance in transition economies.

Concerning the literature on institutional quality, our work advances our knowledge by considering different institutional conditions in transition countries. Specifically, we add to the research stream that examines how institutional conditions influence business decisions and results (Krammer, 2019; Krammer et al., 2018; Shinkle and Kriauciunas, 2012; Xiao and Park, 2018). We go beyond previous work that analyzes how transition economies act as contingent factors for firm innovation by studying how varying levels of governance imperfections affect the external knowledge-innovation relation. Consequently, our work leads to the conclusion that the distinct levels of institutional development present in these contexts alter the impact of different types of external knowledge on innovation strategies and performance. In short, institutional conditions play a key role in the input-output innovation relation.

Our study provides useful managerial, political and economic lessons for countries in transition. Our results show that external knowledge sources allow firms in transition economies to achieve positive innovation results. In countries with high governance imperfections, international external knowledge exerts an impact that grows in step with falls in the levels of institutional development. In these environments, managers should adopt strategies that promote access to international knowledge to boost innovation performance. Policy makers in transition countries with higher levels of governance imperfections must design and implement policies that lead to an open economic system. On the long road towards transition, governments should aid firms that are in search of foreign innovation sources.

This study is not free of limitations, many of which may suggest interesting research questions and directions for future papers to follow. First, the data used in this study do not have a longitudinal structure. Consequently, we are not able to analyze results for firms' mid- to long-term innovation strategies or for the evolution of the countries through the various stages of transition. Indeed, an analysis of the different regional innovation systems could be useful as differences exist across CEE countries; more detailed information on these systems could enhance future analyses. Second, access to external sources of information is measured via a dichotomous variable. The inclusion of more

fine-grained details about external sources and exchange information mechanisms would greatly enrich the analysis. Technological alliances are important vehicles for knowledge acquisition. The hoped-for benefits of technological collaboration will depend on the objectives and activities of the alliance (Elia et al., 2019) and/or the characteristics of the partners (Capaldo and Messeni Petruzzelli, 2015; Nieto and Santamaría, 2007). Patent acquisition is another way of acquiring external knowledge, one whose impact on innovation varies depending on the geographical location of the allied firms (Ardito et al., 2018). Future studies could advance in this direction by analyzing the impact of strategic alliances or other modes of acquiring external knowledge—domestic and international—in transition economies. Third, including other firm-specific characteristics would make it possible to refine and extend the analysis undertaken in this paper. Given that we study the impact of external knowledge, absorptive capacity would be an important dimension to examine. Other interesting dimensions to analyze in more depth are firm ownership characteristics and the influence of different stakeholders on corporate governance and decisions in transition economies, as shown in the work of Choi et al. (2011) on Chinese firms. In this study, we control for ownership type as another important factor for innovation, but future studies could advance this line of research by examining other aspects of ownership structure in more detail. Lastly, future studies could analyze other measures of innovation performance that focus on different types of innovation or their radicalness.

#### Author statement

Declarations of interest: none

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#### Supplementary materials

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