SUBNATIONAL INSTITUTIONAL DIFFERENCES, R&D-PERFORMANCE RELATIONSHIP, AND FDI SPILLOVERS IN RUSSIA

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[Abstract]

This study explores how subnational institutional differences in a large emerging economy influence the relationship between research and development (R&D), foreign direct investment (FDI) spillovers, and firm performance. Using a sample of Russian firms, we find that subnational institutional development significantly alters the link between R&D and firm performance. Specifically, we find that this relationship is positively moderated by better market-supporting institutions in a region and negatively moderated by higher levels of corruption in a region. Furthermore, we find that FDI will more positively moderate the relationship between R&D and firm performance if subnational institutional development is also higher, thus showing that subnational institutional development may foster the positive spillover effect of FDI on local firms.

Key words: institutions, intra-country, subnational, FDI spillover, R&D, Russian regions

Do firms benefit from research and development (R&D) investment? In developed economies, there are clear benefits to R&D in the form of increased productivity, lower costs, or improved product quality, all of which are likely to improve firm performance. However, the presence of institutional voids in emerging economies makes it more difficult to reap the benefits from R&D and innovation in general (Chen et al., 2014; Choi, Lee, & Williams, 2011; Li & Vermeulen, 2020; Zhou, Gao, & Zhao, 2017). Yet, many firms operating in emerging economies—both foreign multinational enterprises (MNE) and local firms—are actively investing in R&D (Awate, Larsen, & Mudambi, 2015; Zhao, 2006). Furthermore, another important aspect of benefiting from innovation is the presence of foreign firms that enter the country via foreign direct investment (FDI). One the one hand, FDI spillovers (such as transfer of valuable knowledge from foreign entrants to local firms) can increase returns on R&D and innovation in general. On the other hand, competition from foreign firms may also crowd out local firms through more intense competition, potentially reducing returns on innovation (Spencer, 2008).

Why would firms invest in R&D in institutional environments where it is much more difficult to benefit from innovation? What role does FDI play in how likely local firms to benefit from R&D? We argue that apart from the firm-level factors, it is important to look at aspects of institutions themselves to gain a more complete understanding of the R&D-performance link in emerging economies—in particular, the spatial dimension of institutions reflected through *subnational* (intra-country) institutional variation. Economic geography research has shown the importance of such spatial characteristics for innovation—for example, regional clusters of innovation or agglomeration in specific locations within a country (Lamin & Livanis, 2013). We focus on subnational variation in institutional development, which is especially prevalent in

emerging economies, as compared to developed economies (Chabowski et al., 2009; Chan, Makino, & Isobe, 2010; Peng & Lebedev, 2017; Shi Sun, & Peng, 2012).

Drawing on research on innovation and institutions, this study addresses two crucial but underexplored questions: (1) How do intra-country (subnational) institutional differences within a large emerging economy affect the relationship between R&D and firm performance? (2) How do subnational institutional development and FDI jointly influence the R&D-performance relationship? Specifically, we first examine how the relationship between R&D and performance can be altered by subnational institutional development. We collected data on Russian firms from the OSIRIS database. Using two main measures of subnational institutional development, we hypothesize and find that the relationship between R&D intensity and firm performance is positively moderated in more institutionally developed Russian regions. Second, we also hypothesize and find that FDI will more positively moderate the relationship between R&D and firm performance if subnational institutional development is also high, suggesting that higher quality institutions in a region may facilitate positive FDI spillover effect, as opposed to crowding-out effect.

We aim to make two contributions. First, we show that subnational differences in institutional development can make a significant difference in how firms benefit from R&D and innovation in general, despite institutional voids present in emerging economies. Furthermore, our focus is on Russia, which, unlike China (as an emerging economy with the largest GDP receiving the most attention from researchers), is a novel country context. Russia is the largest country in the world by area, and, as we describe below, subnational differences are significant in Russia. We thus also contribute to the literature on business and management in Russia (McCarthy, Puffer, & Satinsky, 2019; Puffer & McCarthy, 2011).

Second, we show that R&D-performance relationship is also jointly influenced by subnational institutional development and FDI in a region. Our findings suggest that subnational institutional development may play an important role in whether FDI has a beneficial spillover effect or a negative crowding-out effect on local firms.

R&D AND FIRM PERFORMANCE

Studies looking at the relationship between R&D and firm performance generally find that R&D positively influences performance by providing cost advantages and increased productivity (Chan, Martin, & Kensinger, 1990; Eberhart et al., 2004; Franko, 1989; Golovko & Valentini, 2011; Pindado, De Queiroz, & De La Torre, 2010). However, a few studies report mixed findings, with zero or even negative returns on R&D (Artz et al., 2010; Erickson & Jacobson, 1992; Graves & Langowitz, 1993; Kandybin, 2009).

While the positive relationship has also been shown by some scholars in emerging economies such as China (Hu & Jefferson, 2004; Zhang, Zhang, & Zhao, 2003) and India (Sharma, 2012), the positive returns on R&D may be contingent on a variety of factors. Thus, it is also important to consider various contingencies affecting R&D and the R&D-performance link, which have been proposed by some scholars (Égert, 2016; Higón & Antolín, 2012; Pindalo et al., 2010; Zhang et al., 2007; Zhao, 2006). In particular, the importance of institutions as such a contingency has been pointed out. For example, Qian et al. (2017) show that rent appropriation of returns from R&D by insiders is weakened in Chinese provinces with more developed institutions. Higón & Antolín (2012) find that R&D-related returns on productivity are negatively affected by institutional distance.

Further, in the context of emerging economies, scholars have looked at factors mitigating weak institutions, such as leveraging ownership structure (Zhang et al., 2007; Zhou et al., 2017), combining different types of R&D (Damanpour, Walker, Avellaneda, 2009; Mudambi & Swift, 2014), and acquiring external knowledge (Kafouros & Forsans, 2012). Zhao (2006) suggests that firms may benefit from R&D in emerging economies by using the outcomes of the R&D activities internally to avoid imitation and circumvent weak intellectual property rights (IPR) protection.

To our knowledge, while scholars have looked at factors influencing innovation at the regional level in Russia (Ivanov, 2016), no studies specifically address the relationship between R&D and firm performance in Russia. We suggest that an important yet overlooked factor—subnational institutional differences—can help explain how firms are able to benefit from R&D despite the detrimental institutional environment. Such subnational differences are especially relevant for Russia, for two reasons. First, Russia's sheer geographic size (as the largest country in the world by area) results in substantial subnational differences. Second, innovation in Russia has been historically unevenly distributed among different regions (Crescenzi & Jaax, 2017; Ivanov, 2016), and institutional factors—such as local governments (Tsatsulin, 2018) or the level of risks in a region (Ermasova, 2016)—may significantly influence innovation in Russia. In the next section, we discuss subnational differences in general and for Russia specifically.

INTRA-COUNTRY DIFFERENCES

In the literature on emerging economies, there is evidence that intra-country differences affect firm behavior and performance outcomes (Jia, 2016; Lu, Song, & Shan, 2018; Ma, Tong, &

Fitza, 2013; Peng & Lebedev, 2017).[1] Chan et al. (2010) find that subnational differences affect performance of multinational enterprises (MNE) foreign subsidiaries in the United States and China. They also show that intra-country effects are much stronger in China (an emerging economy) than in the United States (a developed economy). Studies have also shown the importance of subnational institutional differences for joint venture partner selection (Shi et al., 2012), the likelihood of an acquisition linked to principal-principal conflicts (Li and Qian, 2013), firm internationalization (Li et al., 2018; Ma, Ding, & Yuan, 2016; Sun et al., 2015), and inward foreign direct investment (FDI) location and entry mode choices (Meyer and Nguyen, 2005; Nunnenkamp, Liu, and Bickenbach, 2014). In addition to China, scholars have explored subnational institutional differences in other emerging economies, such as India (Nunnenkamp et l., 2014), Vietnam (Meyer and Nguyen, 2005), and Mexico (Montiel et al., 2012).

While the number of studies on subnational institutional differences in emerging economies is still limited to identify any consistent patterns, it can be inferred that firms located in subnational regions with more developed market-supporting institutions may benefit more from undertaking market-based strategies. These strategies—such as R&D, FDI, or acquisitions—are based on "rule-based, impersonal exchange" that rely on "third-party enforcement" (Peng, 2003). For example, Li and Qian (2013) report that in more institutionally developed Chinese provinces, the largest shareholder's share of a firm's equity has a less negative effect on the probability of an acquisition of the firm. Their findings suggest that there

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[1] While we focus on emerging economies, in developed economies such as Ireland (Monaghan, Gunnigle, and Lavelle, 2014), Italy (Laursen, Masciarelli, and Prencipe, 2012), Spain (Greenwood et al., 2010), and the United States (Chan et al., 2010), intra-country differences have also been found to affect firm behavior and performance.

is a significant discrepancy in institutional development between different Chinese regions, which results in better protection of minority shareholders in certain provinces with more market-oriented institutions, mitigating principal-principal conflicts. Thus, better subnational institutional development may lead to more active market of corporate control, facilitating market-based strategies. In India, Nunnenkamp et al. (2014) find that the better developed market-supporting institutions in a region may contribute to the increasing concentration of FDI in certain regions, such as Bangalore, Delhi, and Mumbai, compared to the rest of the country.

In this stream of the management literature, Russia remains an underexplored setting despite the fact that Russian regions exhibit significant diversity in terms of gross regional product (GRP) per capita, FDI, natural resources, and institutions, among others (Dininio & Orttung, 2005; Kuzmina, Volchkova, & Zueva, 2014; Yakovlev & Zhuravskaya, 2013). Regional inequality has increased rapidly after the collapse of the Soviet Union (Fedorov, 2002). For instance, FDI per capita can vary from just a few cents in some regions (for example, in the Republic of Karachaevo-Cherkessia) to thousands of dollars in others (for example, in Lipetsk region) (Kuzmina et al., 2014). GRP per capita varies substantially as well, ranging from 1,555,586 rubles (about $21,900) in Moscow to 145,723 rubles (about $2,050) in Ingushetia as of 2019 (Goskomstat, 2021). Despite the clear policy of re-centralization conducted by the federal government since 2000 (manifested through, for example, abolishing elections of regional governors in 2005), regional inequality has persisted, and local governors still matter a lot for businesses (Leonard, Nazarov, & Vakulenko, 2016; Sharafutdinova & Steinbuks, 2017). In particular, while regional formal laws and regulations generally align with federal laws, the *enforcement* and *application* of the laws significantly depends on local authorities in a region,

and violation of federal rules is not uncommon (Chebankova, 2005; Yakovlev & Zhuravskaya, 2013).

Studies have also shown significant variation in terms of institutions among Russian regions. Yakovlev and Zhuravskaya (2013) report a significant difference in enforcement of liberalization reforms 2001-2004 among Russian regions due to institutional factors such as government transparency. Leonard et al. (2016) show that subnational institutional development significantly affects economic growth in a region despite the ongoing recentralization policy. The findings of Lambert-Mogiliansky, Sonin, and Zhuravskaya (2007) suggest that bankruptcy and reorganization laws application varied significantly in different Russian regions depending on the judicial quality in a region, resulting in firms located in regions with higher judicial quality performing better after reorganization. Finally, Bertrand, Betschinger, and Laamanen (2019) find that the level of corruption in different regions affects firms' acquisition strategies. Thus, it is reasonable to expect that subnational institutional differences may have a significant influence on Russian firms' strategies (and their performance implications). How do these subnational institutional differences impact the link between R&D and firm performance?

SUBNATIONAL INSTITUTIONAL DEVELOPMENT AND
THE R&D-PERFORMANCE LINK

Given that Russian regions are quite diverse (as discussed above) and that institutional development in general has been shown to affect the choice of strategies and their performance consequences (Lin et al., 2009; Peng, 2003; Shinkle & Kriauciunas, 2010; Shinkle, Kriauciunas, & Hundley, 2013), we propose that subnational institutional development in Russia is likely to

influence performance benefits of R&D. Specifically, we argue that firms will benefit more from R&D in more institutionally developed Russian regions.

The institution-based view suggests that firms' strategic choices and their performance consequences are significantly influenced by institutional environments (Dau, 2012; Kathuria, Majumdar, & Peng, 2022; Meyer & Peng, 2005; North, 1990; Oliver, 1991, 1997; Peng et al., 2009; Scott, 2008). Research has also shown that certain institutional factors—such as enforcement of IPR—may influence performance consequences of firm innovation (Hemmert, 2004; James et al., 2013; Li & Vermeulen, 2020). The literature on emerging economies suggests that the influence of institutional factors on innovation may be especially strong in these economies (Khoury & Peng, 2011; Meyer et al., 2009; Wright et al., 2005).

In addition, prior research suggests that subnational differences play an important role in innovation (Autant-Bernard, Fadairo, & Massard, 2013). Studies have shown the influence of "spatial patterns of innovation," referring to subnational clusters of innovation within a country, as well as the importance of agglomeration for domestic firms in emerging economies (Lamin & Livanis, 2013). For example, Cabrer-Borrás and Serrano-Domingo (2007) find that there are knowledge spillovers between different subnational regions in Spain that may benefit regional innovation output. Moreover, their results suggest that a certain level of economic and institutional development in a region is necessary for innovation efforts to translate into innovation output. Another study analyzing innovation in Spanish regions by Acosta and Coronado (2003: 1786) also points out the "importance of the environmental and institutional factors that… constitute a favorable climate for increased activity aimed at innovation." In emerging economies such as China or Russia, these factors are likely to be even more pertinent (Li, 2009; Peng & Lebedev, 2017; Smith & Thomas, 2016). In Russia specifically, subnational

heterogeneity may significantly contribute to the innovation output of a region as a whole (Crescenzi & Jaax, 2017; Ivanov, 2016). However, the role of subnational institutional development in relation to firm-level R&D in Russia is yet to be explored.

Leveraging the institution-based view, we propose that subnational institutional development will positively moderate the relationship between R&D and firm performance in Russia, so that relationship between R&D and firm performance will become more positive in more institutionally developed regions, for two main reasons. First, better enforcement of property rights in general and IPR in particular in more institutionally developed regions are likely to facilitate more value appropriation from firms' R&D efforts. Research has noted substantial appropriability hazards in emerging economies (Keupp, Friesike, and von Zedtwitz, 2012; Peng et al., 2017; Zhao, 2006). Appropriability refers to a firm's ability to capture the value created by innovation activities such as R&D, and institutional factors (e.g., property rights protection) have been found to play a crucial role for appropriability (Ceccagnoli, 2009; James et al., 2013; Teece, 1986). Emerging economies are typically characterized by a loose appropriability regime (with substantial appropriablity hazards) and weak IPR protection (Liu et al., 2010; Peng et al., 2017; Zhang et al., 2007; Zhao, 2006).

In such an environment, barriers to spillover and imitation of R&D outcomes are weak, and it becomes much more difficult for a firm to capture value from its R&D activities. While IPR laws in Russia are comprehensive and generally comparable to such legislation in developed economies, their enforcement so far has been ineffective and subject to local institutional conditions (Aleksashenko, 2012; Crescenzi & Jaax, 2017; O'Connor, 2011; Yegorov, 2009).[2]

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[2] More recently, for example, in the aftermath of Russia's invasion in Ukraine and massive exit of foreign firms supplying crucial imports to Russia, the government allowed domestic firms to engage in so-called

However, we suggest that in more institutionally developed regions IPR and property rights in general may be better enforced, and firms in these regions will thus be able to appropriate more value from R&D, increasing performance.

Second, while the prior literature has mostly emphasized the influence of institutions on value appropriation (James et al., 2013), firms in Russia face not only appropriability hazards stemming from low barriers to imitation and weak IPR protection, but also additional impediments that may hinder value *creation*. These barriers stem from institutional voids (Puffer, McCarthy, & Boisot, 2010), such as a lack of financial intermediaries (making access to capital difficult), insufficient collaboration between research centers (e.g., technology parks) and businesses, as well as historical emphasis on military innovation over civilian causes (Klochikhin, 2012; Michailova & Hutchings, 2006; Podmetina et al., 2009; Vercueil, 2014). In addition, firms in Russia have to deal with complex and cumbersome legal norms, including those that regulate innovation (e.g., patent and trademark registration), as well as with a high level of corruption (Aidis, Estrin, Mickiewicz, 2008; Ahlstrom & Bruton, 2010; Karhunen et al., 2018; Karhunen & Ledyaeva, 2012; Spicer, 2009).

We propose that better institutional development in a region may alleviate such barriers to value creation, increasing performance benefits of R&D. Research suggests that innovation is likely to generate value and increase firm performance only if it is complemented by commercialization activities such as changes in a product line, distribution, and marketing (Liao & Rice, 2010; Teece, 1986). In more institutionally developed regions, these activities may be

"parallel imports" in violation of IPR (https://www.reuters.com/business/russia-publishes-list-parallel-imports-goods-2022-05-06/).

implemented with less costs due to, for example, more developed financial markets leading to better access to capital, more efficient collaboration with local research centers, or less severe red tape and corruption allowing firms to more easily establish distribution channels for a new product or register patents. Overall, we suggest that being able to implement the commercialization activities more easily will likely facilitate value creation from R&D and thus its performance benefits.

In sum, while institutional voids create obstacles for both value appropriation and value creation from R&D in Russia, these obstacles may be less detrimental to benefiting from R&D in more institutionally developed Russia regions. Overall, we expect that the relationship between R&D and firm performance will be positively moderated by subnational institutional development in Russia. Thus:

Hypothesis 1: Subnational institutional development positively moderates the relationship between R&D intensity and firm performance.

SUBNATIONAL INSTITUTIONAL DEVELOPMENT AND FDI SPILLOVER EFFECT

We suggest that in addition to positively moderating the relationship between R&D and firm performance, subnational institutional development may also affect the balance between positive foreign direct investment (FDI) spillover effect and negative crowding-out effect on local firms. Specifically, we propose that in more institutionally developed regions, FDI will more positively moderate the relationship between R&D and firm performance. In other words, firms located in Russian regions with high levels of FDI will benefit more from R&D if these regions also have higher levels of institutional development. Thus, we propose that FDI and subnational institutions jointly influence the R&D-performance relationship.

FDI spillovers are defined as externalities created by FDI presence (Eden, 2009). These externalities are often beneficial for local firms' innovation, as foreign entrants provide access to knowledge and learning opportunities to local firms through direct observation and imitation, backward and forward linkages to suppliers and distributors, among others (Gorodnichenko, Svejnar, & Terrell, 2010; Li et al., 2013; Spencer, 2008; Zhang, Li, & Li, 2014). However, FDI can also have a crowding-out effect on local firms by intensifying competition (Chang & Xu, 2008) and limiting access to resources (such as suppliers or skilled labor), thus hindering local firms' innovation (Smith & Thomas, 2017). Institutions have been shown to be an important contingency of FDI spillovers in recent research. For example, Slesman, Abubakar, and Mitra (2021) find that a certain threshold level of institutional development in a country is needed in order for FDI to have a positive spillover effect on domestic entrepreneurship, below which a negative crowding-out effect prevails. Christopoulou et al., 2021 find that IPR enforcement strength has a direct positive effect on FDI spillovers.

Since knowledge is localized, factors affecting the influence of the positive spillover effect versus the negative crowding-out effect are important to explore at the subnational level (Huang, Liu, & Xu, 2012; Wang & Kafouros, 2020). We argue that subnational institutional development may moderate the influence of FDI on R&D-performance link in such a way that local firms will benefit more from R&D in the presence of FDI in a region if this region also has a higher level of institutional development—that is, in more institutionally developed Russian regions, FDI will more strongly facilitate performance benefits from R&D.

While recent research has explored the influence of national-level institutions in relation to FDI spillovers (as discussed above), only a few studies explore the relationship between subnational institutional development and FDI spillovers. Overall, the results so far have been

mixed. For example, Yi et al. (2015) find that more developed subnational institutions positively moderate the relationship between FDI and firm productivity in China. Xiao and Park (2018) find that better subnational institutions may negatively moderate the relationship between FDI inflows and productivity of local firms because better institutions may make the knowledge transfer from foreign entrants less valuable, as well as make it easier for foreign entrants to compete, thus crowding out local firms. These effects may also differ in a different country context. Smith and Thomas (2017) find that in Russian regions with a higher level of human capital benefited less from FDI-related technological spillovers.

The findings thus appear to be mixed, and it is worth exploring the interaction between subnational institutions, innovation outcomes, and FDI spillovers further. Departing from this prior research, we suggest that subnational institutional development and FDI may have a *joint* positive influence facilitating local firms' benefits from R&D.

First, subnational institutional development may foster more market-based competition, rather than rent-seeking activities such as bribery (by both foreign and local firms). Furthermore, entry barriers (such as red tape) are also likely lower in more institutionally developed regions (Li et al., 2013). Consequently, local firms will have more incentive to engage in productive R&D due to competition threat from foreign firms. In comparison, when subnational institutional development is lacking, the competition threat from FDI is decreased due to higher entry barriers, while at the same time incentives for rent-seeking behavior increase. Thus, local firms may benefit less from R&D in the presence of FDI in less institutionally developed regions.

Second, subnational institutional development may facilitate knowledge transfer to local firms through linkages with local suppliers and distributors connected to foreign entrants. As discussed above, a higher level of institutional development may facilitate commercialization

activities, increasing returns from R&D. In a similar vein, easier implementation of the necessary commercialization activities—for example, marketing and distribution—may help create more linkages between local and foreign firms, as compared to less institutionally developed regions. Furthermore, overall better protection of property rights (including IPR) facilitates trust between firms, which has been shown to be a crucial factor for knowledge transfer (Christopoulou et al., 2021; Li et al., 2013; Spencer, 2008; Yi et al., 2015). More active knowledge transfer between local firms and foreign entrants can also lead to better performance benefits from R&D, as local firms can leverage this knowledge to get higher returns on their R&D investments.

Summing up, subnational institutional development may have a joint influence with FDI in relation to R&D-performance link, facilitating positive (rather than negative) spillover effects from FDI. Accordingly, we propose that FDI will more positively moderate the relationship between R&D and firm performance if subnational institutional development is also higher. Thus:

Hypothesis 2: FDI will more positively moderate the relationship between R&D intensity and firm performance when subnational institutional development is high rather than low.

METHODS

Data

We use multiple data sources for the study. For regional market institutions development, we use the index developed by a Russian non-profit organization Opora Russia, which was established with the purpose to support small and medium-sized enterprises (SMEs). The index includes 39 regions and ranks them in terms of regulation quality, rule of law, administrative barriers, financial institutions development, infrastructure, human resources, and access to suppliers.

Overall, the combined index estimates how friendly to SMEs a region's institutional environment is—in other words, regional business (or entrepreneurial) climate. The index is based on a phone survey of more than 6,000 business-owners and top-managers in 39 Russian regions (Opora, 2013). Higher values indicate higher levels of subnational institutional development.

As an alternative measure of subnational institutional development, we use data on regional corruption levels. These data are obtained from a survey conducted by Transparency International (TI) and the Information for Democracy Foundation (INDEM) in 40 Russian regions in 2002 (which remains the only study of corruption in Russia at the subnational level) (Transparency International and INDEM Foundation, 2002). TI/INDEM surveyed 5,666 citizens and 1,838 business representatives. The key advantage of the TI/INDEM survey is that it includes respondents' answers about the actual experience of dealing with corruption (which is likely a less biased measure compared to perceptions of corruption) (Dininio & Orttung, 2005). This measure of subnational corruption has also been used in recent research (Bertrand et al., 2019).

For firm-level data, we use the OSIRIS international database by Bureau van Dijk. This database provides detailed financial information on both listed and unlisted firms, thus reducing potential sample selection bias (both public and private firms are included in the sample). The initial sample consists of all (domestic) Russian firms included in the database from 2009 to 2012 (inclusive). We choose this time frame to minimize potential confounding effects of external shocks, such as political changes (e.g., abolishing elections of regional governors in 2005) or 2008 financial crisis (Libman, 2012). In addition, since data on the index of institutional development (from Opora Russia described above) were collected in 2012, and this measure is

assumed to be time-invariant within the sample period, it is more plausible to make such an assumption within the 2009-2012 time frame. Data on regions' overall economic development are provided by Russian Federation Federal State Statistics Service (Goskomstat). We also use Goskomstat data to obtain FDI per capita for each region, which is our second moderating variable. After excluding incomplete observations and combining the sample with the regional data, the final sample consists of 902 observations of 317 firms in 32 regions (the number of observations is smaller in the models with the corruption measure due to data availability). Five regions had only one firm from our sample and were excluded from the analysis. Table 1 shows the distribution of firms' headquarters by region.

[Insert Table 1 about here]

Variables

Dependent variable. Our depended variable is *firm performance* measured by return on assets (ROA, %) (Zhang et al., 2007).

Independent variable. The independent variable is *R&D intensity*—a ratio of R&D expenses to (gross) sales.[3]

Moderating variables. We use the index of regional entrepreneurial climate as a first proxy for subnational institutional development. The index (*institutional development index*) takes only positive values. Essentially, it reflects the quality of the institutional environment for the development of SMEs. While our sample contains firms of different sizes (with most firms being relatively large), the factors included in the index—such as rule of law or access to

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[3] If R&D expenses are not reported (missing), they are assumed to be zero (Chintrakarn et al., 2016; Ciftci & Cready, 2011; Fabrizio & Tsolmon 2014; Singh, 2008). The ratio is rescaled to avoid coefficients being too large.

finance—are likely to influence SMEs as well as large firms. In addition, SMEs are particularly

vulnerable to imperfections in the institutional environment (Lee et al., 2011; Spicer,

McDermott, & Kogut, 2000; Stenholm, Acs, & Wuebker, 2013), specifically because they often

seek legitimacy and are susceptible to the liability of newness (Delmar & Shane, 2004;

Stinchcombe, 1965). Thus, better conditions for SMEs in a region indicate a higher overall

development of market institutions, which ultimately affects all firms.[4] This index has also been

used in prior research (Kuzmina et al., 2014). Our second proxy for the development of

subnational market institutions is the regional level of corruption. Research has shown that

corruption is associated with underdeveloped market institutions and, at the same time, exhibits

relatively low variability over the years (Lee & Weng, 2013; Lee & Hong, 2012; Mauro, 2004;

Mishra, 2006; Tirole, 1996; Uhlenbruck et al., 2006; Zhou & Peng, 2012). The *corruption*

variable ranges from 0 (least corrupted) to 1 (most corrupted) and reflects the respondents'

experience of both petty and business corruption in a region. Because these two measures depict

the same underlying concept, we do not include both of them in the same model.

 Our second moderating variable is FDI inflows per capita (*FDI per capita*) (Li, Chen, &

Shapiro, 2013), measured as total FDI inflows in a region (in local currency) divided by the

region's population.

 Control variables. We control for *firm size* (total assets) and *firm age* (calculated as a

difference between a current year and a firm's year of incorporation). We also control for debt-

to-assets ratio (*debt-to-assets*), as heavily indebted firms may experience a decrease in

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[4] It is important to note that there is no clear correlation between this index and gross regional product

(GRP) per capita. Some relatively wealthy Russian regions (such as Saint Petersburg) may still rank

poorly in terms of institutional development.

performance. The overall economic profile of a region is controlled for by including GRP per capita (in local currency) (*GRP per capita*), *population* (in millions) (Li et al., 2013). We also include region dummies for Moscow and Saint Petersburg, since many corporate headquarters are located in these cities (Libman, 2012). Finally, we include year and industry dummies.[5]

Analysis

While fixed-effects models are generally preferable to analyze panel data, they are not suitable to estimate effects of time-invariant or very slowly changing variables, such as institutional characteristics (Plümper & Troeger, 2007). While random-effects models are able to estimate effects of such variables, they may be biased if the unobserved heterogeneity is correlated with an error term. To account for these factors, we run generalized estimating equations (GEE) models with robust Huber/White/sandwich standard errors. These models do not make the assumption about unobserved heterogeneity independence and can account for autocorrelation among repeated observations across years and heteroskedasticity, while controlling for unobservable firm differences (the downside of the GEE regression is that the estimates may be less efficient than fixed- or random-effects estimates) (Liang & Zeger, 1986; Petersen, 2009). To establish a temporal order, we lag all independent and control variables by one year.

RESULTS

Table 2 presents descriptive statistics. Overall, the mean and highest variance inflation factor values (VIF) of, respectively 2.11 and 4.49 indicate that multicollinearity is not a major concern.

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[5] While it could also be fruitful to test our hypotheses in a single-industry setting, our sample does not provide a sufficient number of observations for a single-industry study.

[Insert Table 2 about here]

Table 3 presents the results of the GEE analysis. Model 1 includes only control variables. Models 2, 3, and 4 include the independent variable (*R&D intensity*) and two measures of the moderating variable separately (*institutional development index* and *corruption*). Models 3 and 4 test Hypothesis 1 by adding interactions of the two measures of the moderating variable— *institutional development index* and *corruption*—with *R&D intensity*. The coefficient of the interaction with *institutional development index* is positive and highly significant ($p < 0.001$), supporting Hypothesis 1 (the relationship is positively moderated in more institutionally developed regions). Model 4 adds the interaction between *R&D intensity* and *corruption*. The coefficient of this moderating variable is negative and highly significant ($p < 0.01$), providing additional support for Hypothesis 1 (the relationship is negatively moderated in more corrupt regions). This is further illustrated by interaction plots (see Figure 1).

In regions with low institutional development (one standard deviation below the mean), an increase in R&D intensity from zero to 0.24% of sales leads, on average, to a decrease in ROA by 0.8%. In regions with high institutional development (one standard deviation above the mean), the same increase in R&D intensity leads to an increase in ROA by 0.7%. In regions with low corruption (one standard deviation below the mean), an increase in R&D intensity from zero to 0.24% of sales leads, on average, to an increase in ROA by 1.2%. In regions with high corruption (one standard deviation above the mean), the same increase in R&D intensity leads to a decrease in ROA by 0.8%.

Models 5, 6, and 7 add our second moderating variable—FDI per capita. To test Hypothesis 2, we add a three-way interaction between subnational institutional development, FDI per capita, and R&D intensity. The coefficient for this moderating effect is positive and

highly significant ($p < 0.01$) in Model 7, supporting Hypothesis 2. However, if we use corruption as a measure of subnational institutional development in Model 8, the moderating effect is only marginally significant ($p < 0.1$). The three-way interaction is further illustrated by interaction plots (see Figure 2). In regions with low institutional development (one standard deviation below the mean), an increase in R&D intensity from zero to 0.24% of sales leads, on average, to a decrease in ROA by 2.4% when FDI per capita is zero and to a decrease in ROA by 3.6% when FDI per capita is increased to a half of its standard deviation. In regions with high institutional development (one standard deviation above the mean), the same increase in R&D intensity leads, on average, to a smaller decrease in ROA by 1.2% when FDI per capita is zero and to an *increase* in ROA by 14% when FDI per capita is increased to a half of its standard deviation. Thus, subnational institutional development substantially alters the moderating effect FDI per capita has on the R&D-performance relationship, as firms in more institutionally developed regions benefit more from R&D in the presence of higher FDI inflows.

[Insert Table 3 and Figures 1 and 2 about here]

Additional analysis and robustness checks

We conduct additional analysis and robustness checks to test reliability of our results. First, R&D intensity may be potentially endogenous to performance because firms may make a decision regarding R&D spending based on performance indicators they observe (Bolton, 1993). In addition, an unobservable firm's capability to innovate may be correlated with both R&D intensity and firm performance. To address the possible endogeneity issue, we run two-stage least squares (2SLS) analysis. We choose a firm's intangible assets as an instrument for R&D intensity. Intangible assets are unlikely to be correlated with the unobserved innovation capability, since larger amount of intangible assets on the balance sheet does not necessarily

indicate the ability to extract value from them. Intangible assets are also reasonably highly correlated with R&D intensity ($r = 0.16$, $p < 0.001$), but not with firm performance ($r = 0.03$, n.s.), making this variable an appropriate instrument (Greene, 2008). The results of 2SLS regression remain consistent with our hypotheses.

To further explore the possible influence of ROA on R&D intensity, we run a fixed effects regression with R&D intensity as a dependent variable and ROA lagged by one year as an independent variable, with the same control variables as in the main analysis (except for time-invariant variables due to employing fixed effects) also lagged by one year. The regression does not indicate a significant effect of ROA on R&D intensity ($p = 0.19$), and the regression as a whole is not significant ($F = 1.59$, ns), further suggesting that reverse causality is not a significant concern in our analysis. These results hold with a 2-year lag as well.

Second, we address how R&D may be potentially affected by the institutional environment in which the firm operates. We further explore the effects of the regional institutional environment by using a multilevel regression (*mixed* command in STATA) with firms nested within regions. The results are very similar to the results of our main analysis.

Third, we collect additional data on regional level of investment risk as an alternative measure for subnational institutional development, following prior research (Ermasova, 2016; Granville & Leonard, 2010; Leonard et al., 2016; Popov, 2001). This measure is a ranking of investment climate in a region assessed each year, a continuous measure based on a series of surveys. The investment risk level includes key components of institutional development: (1) the legal protection of property rights, (2) the enforcement of laws, (3) the strength of creditor and shareholder rights, (4) the implementation of market-supporting reforms, thus making it an appropriate measure for our purposes. The data were collected from the Russian consulting

agency Expert RA (Expert RA, 2018). Results using this measure of institutional development are very similar to the results of our main analysis.

Fourth, we split the sample between regions with high institutional development (regions with the values of *institutional development index* higher than the mean) and low institutional development (regions with the values of *institutional development index* lower than the mean). Providing further support to our findings, the analysis shows a positive and significant relationship between R&D intensity and firm performance for the subsample of regions with high institutional development ($b = 0.93$, $p < 0.05$) and a non-significant relationship for the subsample of regions with low institutional development ($b = –0.2$, $p = 0.253$).

Finally, we run additional regressions with changes made to our sample and variables to further test robustness of our results. The additional analysis expands the sample to include years from 2000 to 2008 (to test if our findings hold over the longer time frame). In this model we also exclude all regions with fewer than 10 firms (to test whether the results are confounded by regions that include only a small number of firms) and lag all the independent and control variables by two years (to test a different lag structure). The results remain consistent with our original analysis. Results are also similar if we use the one-year lag and exclude regions with only one firm, as in the original analysis. Finally, given that a large proportion of firms in our sample are located in Moscow and that Moscow has a unique economic status in Russia (Kolenikov & Shorrocks, 2005), we run the additional (extended sample) analysis excluding firms located in Moscow (to verify that the results of the original analysis were not driven mostly by these firms). Overall, when Moscow firms are excluded, the results remain consistent with the original analysis—however, the results are stronger with a two-year lag. Results of the additional analyses are available on request.

DISCUSSION

Contributions

Aiming to contribute to the broader question of how firms can benefit from innovation in the presence of institutional voids in emerging economies, this paper analyzes intra-country institutional differences within Russia and their effects on the relationship between R&D, FDI inflows, and firm performance. We find that the relationship between R&D intensity and firm performance is more positive in more institutionally developed Russian regions (as evidenced by a more favorable entrepreneurial climate, less corruption, or lower investment risk). We also find that subnational institutional development may foster the positive spillover effect of FDI on local firms.

At least two contributions emerge. First, we extend the institution-based view (Dau, 2012; Peng et al., 2009) in relation to the influence of institutions on firm innovation by highlighting the importance of subnational institutional development for the R&D-performance relationship. To the best of our knowledge, this study is one of the first to explore the influence of such subnational institutional variation on firm-level performance consequences of R&D. Our findings thus suggest an additional factor that affects returns on innovation and that accounting only for institutions at the country level may omit the important influence of intra-country differences. Research that does look at subnational differences mostly focuses on macro-level policy implications rather than on firm-level outcomes. Our findings suggest that the management literature may be enhanced by exploring implications of subnational institutional differences for firms' benefits from R&D (and innovation efforts in general), especially in emerging economies.

Moreover, considering characteristics of institutional development other than IPR protection may be potentially important for a more complete picture of the R&D-performance relationship in particular and the drivers of firm innovation in general. We use three measures to depict institutional development on the broader level—regional entrepreneurial climate, regional corruption level, and regional investment risk in additional analysis. Our measures of institutional development reflect both market-supporting institutions that facilitate exploitation of new business opportunities, as well as barriers and impediments in the form of corruption. This study thus takes a step towards exploring "the influence of the broader formal and informal institutional context" on firm innovation (Phelps, Heidl, & Wadhwa, 2012: 1151).

Second, we extend the literature on FDI spillover effects. Prior research findings regarding the effect of institutional development on FDI spillover effect have been mixed, and only a few studies look at subnational institutions in this context. Some studies report that subnational institutional development facilitates positive FDI spillovers, while others show that it may, conversely, increase the crowding-out effect of FDI inflows (Xiao & Park, 2018). Specifically, in contrast to previous studies that looked at the direct effect—both positive and negative—of FDI on outcomes such as firm productivity as contingent on subnational institutional development (Yi et al., 2015), we show that FDI and subnational institutions have a joint positive influence on the R&D-performance *relationship* for local firms. Extending previous research findings, we suggest that subnational institutional development jointly with FDI inflows have a positive effect on R&D-performance relationship for local firms, making investing in R&D more productive when higher FDI inflows are *combined* with better subnational institutional development. We thus uncover an additional facet of the interaction between subnational institutions and inward FDI.

In addition, we contribute to the burgeoning research on subnational differences in emerging economies (which thus far mostly focuses on China), by analyzing the influence of subnational variation in institutional development in a novel country context of Russia. Russia's enormous geographic size and related subnational differences have surprisingly been mostly overlooked by management researchers, and, to our knowledge, have not yet been explored in relation to firm-level innovation. We also focus on domestic firms, which are likely to the greatest extent affected by the local institutional imperfections and have also been often overlooked by the previous research on emerging economies, as compared to foreign MNEs (Lebedev et al., 2015). As a result, this study contributes to the literature on business and management in Russia, as well as to the broader literature on emerging economies (Fey & Denison, 2003; Gelbuda, Meyer, & Delios, 2008; Hoskisson et al., 2013; Inkpen & Ramaswamy, 2007; Koveshnikov et al., 2012; McCarthy, Puffer, & Naumov, 2000; McCarthy et al., 2019; Okhmatovskiy & David, 2012; Puffer & McCarthy, 2007, 2011). Specifically, our findings indicate that institutional differences between Russian regions are substantial enough to have a significant effect on (1) how much firms will benefit from innovation and (2) how FDI inflows influence benefits from innovation. We also explore different aspects of institutional development in Russia—namely, entrepreneurial climate, corruption, and investment risk. Our findings remain consistent for each of these measures of institutional development.

Limitations and future research directions

This study has certain limitations. First, the time frame we analyze is relatively short due to data availability. While we expand the time period in the additional analysis, a longer time frame may still be needed for future research—for example, to account for a possible change in institutional variables over time. Second, we only look at one type of innovation activity (R&D) in relation to

subnational institutional development. However, other types of innovation may exhibit different patterns in response to varying subnational institutional development.

This study suggests some other promising directions for future research. For example, future studies may consider subnational institutions in more detail and explore how different aspects of intra-country institutional development relate to different types of innovation. Future studies may also explore subnational differences in other large and diverse emerging economies, such as Brazil, India, and South Africa (Peng & Lebedev, 2017). In light of recent events, sanctions imposed on Russia in response to its invasion in Ukraine and how they affect the interplay between innovation, FDI, and local institutions may be worthwhile to explore in future research (Meyer et al., 2022). Finally, in addition to analyzing the performance implications of firms' strategic choices (such as R&D spending), it is important to explore how subnational institutional factors influence the strategic choices themselves—for example, how firms respond to multiple (and often conflicting) institutional logics within a region (Greenwood et al., 2010).

CONCLUSION

Institutions have long been shown to significantly influence firm strategies, such as innovation, and their performance consequences. Institutional development may affect both value creation and value appropriation from innovation activities. However, the influence of subnational institutional development on performance consequences of innovation—specifically, in large emerging economies—has been largely overlooked by previous research. Beginning to fill this gap, this study examines the effect of subnational differences in Russia on the link between R&D, FDI spillovers, and firm performance. Our findings indicate that, first, in more institutionally developed regions R&D is indeed more beneficial for firm performance,

suggesting how firms are able to benefit from R&D in a detrimental institutional environment.

Second, we find that subnational institutional development may foster the positive spillover

effect of FDI on local firms when it comes to R&D-performance relationship. Extending the

institution-based view, these results suggest an important direction to the burgeoning research on

subnational institutional differences, especially in large emerging economies. We hope that our

study will spur further investigation of the relationships between subnational institutions,

innovation, and performance.

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Table 1. Number of firms by region

Region	Number of firms
Arkhangelsk Oblast (Архангельская область)	2
Buryatia (Республика Бурятия)	3
Chelyabinsk Oblast (Челябинская область)	11
Irkutsk Oblast (Иркутская область)	2
Kaluga Oblast (Калужская область)	2
Khabarovsk Krai (Хабаровский край)	5
Krasnodar Krai (Краснодарский край)	6
Krasnoyarsk Krai (Красноярский край)	12
Lipetsk Oblast (Липецкая область)	3
Moscow (Москва)	99
Moscow Oblast (Московская область)	11
Murmansk Oblast (Мурманская область)	4
Nizhny Novgorod Oblast (Нижегородская область)	9
Novgorod Oblast (Новгородская область)	2
Novosibirsk Oblast (Новосибирская область)	7
Omsk Oblast (Омская область)	3
Orenburg Oblast (Оренбургская область)	2
Perm Krai (Пермский край)	19
Primorsky Krai (Приморский край)	5
Republic of Bashkortostan (Республика Башкортостан)	17
Republic of Tatarstan (Республика Татарстан)	7
Rostov Oblast (Ростовская область)	6
Saint Petersburg (Санкт-Петербург)	21
Samara Oblast (Самарская область)	5
Sverdlovsk Oblast (Свердловская область)	12
The Chuvash Republic (Чувашская республика)	9
Tula Oblast (Тульская область)	4
Tyumen Oblast (Тюменская область)	10
Ulyanovsk Oblast (Ульяновская область)	2
Vladimir Oblast (Владимирская область)	5
Voronezh Oblast (Воронежская область)	2
Yaroslavl Oblast (Ярославская область)	10
Total	**317**

Table 2. Descriptive statistics and correlation matrix

	Variables	Mean	SD	1	2	3	4	5	6	7	8	9
1	ROA	3.10	15.30									
2	Firm size [a]	15.95	2.08	**0.14**								
3	Firm age [a]	2.97	0.95	0.00	**-0.08**							
4	Leverage	0.15	0.38	**-0.18**	0.02	**0.20**						
5	GRP per capita [a]	12.79	0.63	0.01	**0.16**	**-0.11**	**-0.08**					
6	Population [a]	8.48	0.72	-0.01	**0.17**	-0.05	0.00	**0.77**				
7	R&D intensity [b]	0.37	1.99	-0.03	**0.13**	-0.04	0.05	**0.11**	**0.14**			
8	FDI per capita [a]	5.47	0.66	-0.03	0.06	**-0.14**	-0.04	**0.73**	**0.69**	**0.12**		
9	Institutional development index	0.99	0.06	0.00	-0.03	**0.13**	-0.03	**-0.44**	**-0.34**	**-0.11**	**-0.43**	
10	Corruption	-0.93	1.16	-0.01	**0.08**	-0.01	0.06	**0.29**	**0.64**	**0.09**	**0.55**	**-0.29**

[a] Log-transformed. [a] Rescaled. Values highlighted in **bold** are significant at $p < 0.05$

Table 3. Results of GEE model estimation for firm performance

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	14.71	18.86	18.90	8.55	7.69	-118.57	19.25
	(15.55)	(15.62)	(18.50)	(18.00)	(19.47)	(85.83)	(17.14)
Firm size	0.61	0.63	0.39	$0.62^{\dagger}$	$0.73^{\dagger}$	0.54	$0.72^{\dagger}$
	(0.38)	(0.39)	(0.62)	(0.39)	(0.41)	(0.40)	(0.41)
Firm age	0.36	0.15	0.14	-0.01	-0.11	0.09	-0.11
	(0.74)	(0.76)	(0.77)	(0.82)	(0.85)	(0.77)	(0.82)
Leverage	-0.13	0.37	0.38	1.35	1.38	0.38	1.36
	(4.31)	(4.51)	(4.59)	(4.79)	(4.93)	(4.56)	(4.79)
GRP per capita	-1.43	-1.65	-1.65	-1.76	-0.08	-1.14	-0.98
	(1.12)	(1.13)	(1.13)	(1.47)	(1.73)	(1.15)	(1.52)
Population	0.23	0.08	0.06	1.06	0.51	0.30	1.84
	(1.11)	(1.12)	(1.09)	(1.34)	(1.68)	(1.08)	(1.40)
Moscow	0.11	0.86	1.01	0.73	2.79	0.32	3.92
	(2.14)	(2.20)	(2.52)	(2.61)	(3.34)	(3.56)	(2.98)
Saint Petersburg	0.29	0.40	0.53	0.97	2.04	0.30	2.77
	(2.09)	(2.12)	(2.34)	(2.27)	(2.60)	(2.62)	(2.45)
R&D intensity		-0.17	-4.70^{*}	-0.34	$1.44^{\dagger}$	530.82^{**}	2.75
		(0.20)	(1.83)	(0.24)	(0.84)	(182.62)	(3.02)
Institutional development index			0.21		1.90	$137.01^{\dagger}$	
			(10.99)		(12.71)	(81.31)	
Corruption				-0.56	0.00		9.74^{*}
				(0.61)	(0.70)		(4.23)
FDI per capita					-3.21^{*}	24.48	-5.06^{**}
					(1.39)	(16.52)	(1.91)
Institutional development index × R&D intensity			4.74^{**}			-569.11^{**}	
			(1.78)			(195.42)	
Corruption × R&D intensity				-0.40^{*}			$19.02^{\dagger}$
				(0.19)			(10.95)
FDI per capita × R&D intensity					$0.27^{\dagger}$	-112.90^{**}	-0.63
					(0.14)	(38.61)	(0.51)
FDI per capita × Institutional development index						-25.80	
						(16.13)	
FDI per capita × Corruption							-2.00^{*}
							(0.82)
FDI per capita × Institutional development index × R&D intensity (H2+)						120.89^{**}	
						(41.29)	
FDI per capita × Corruption × R&D intensity (H2-)							$-4.03^{\dagger}$
							(2.32)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	914	902	902	819	819	902	819
Chi-squared	38.95^{*}	36.77^{*}	104.76^{***}	58.58^{***}	61.37^{***}	66.54^{***}	62.98^{***}

Robust standard errors are in parentheses. $\dagger$ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed tests).
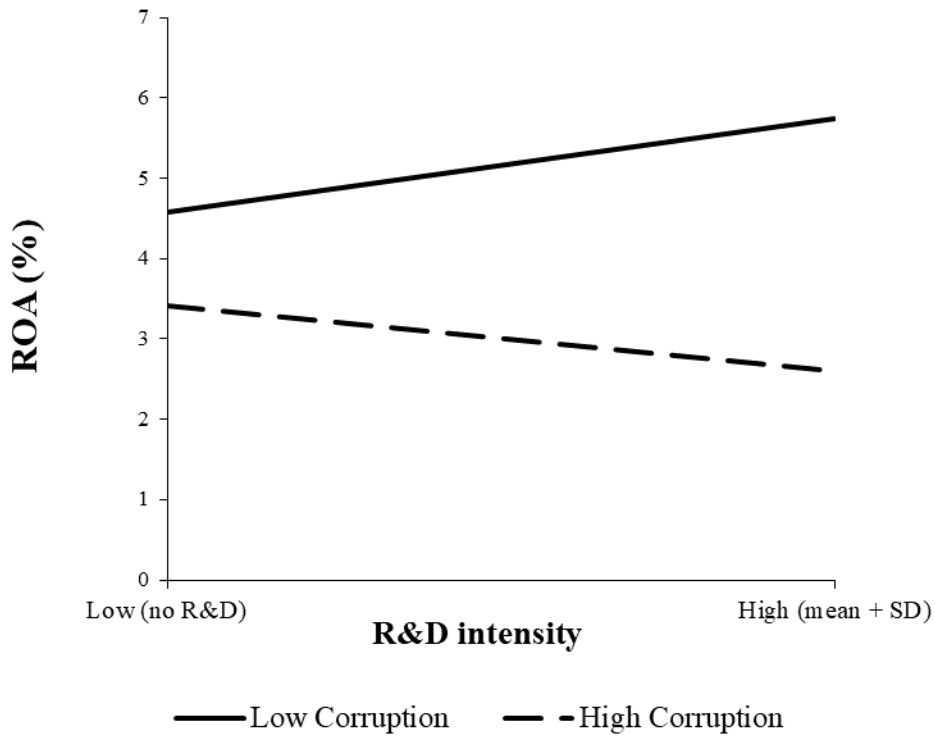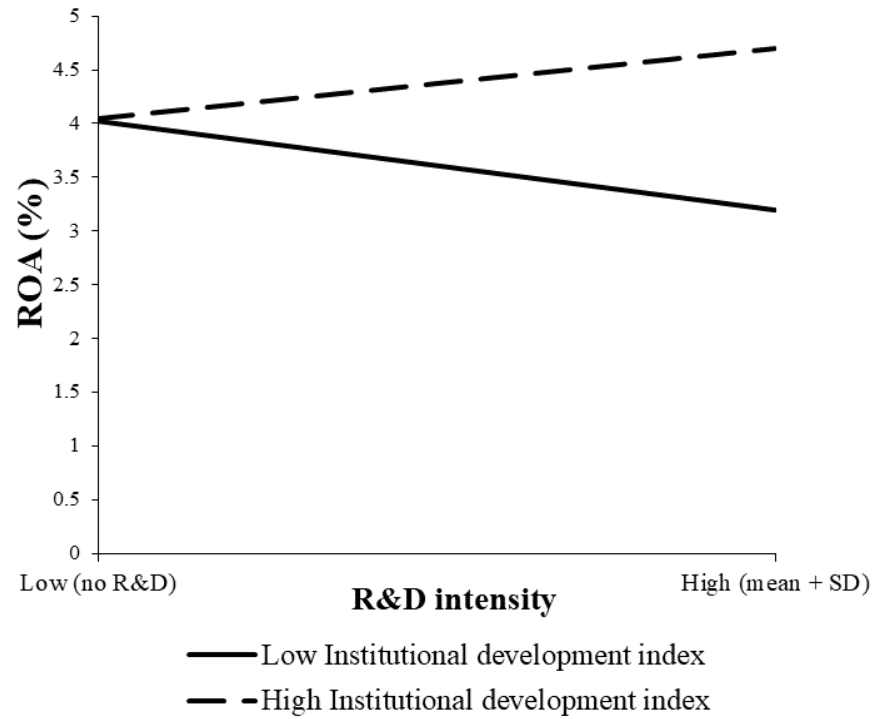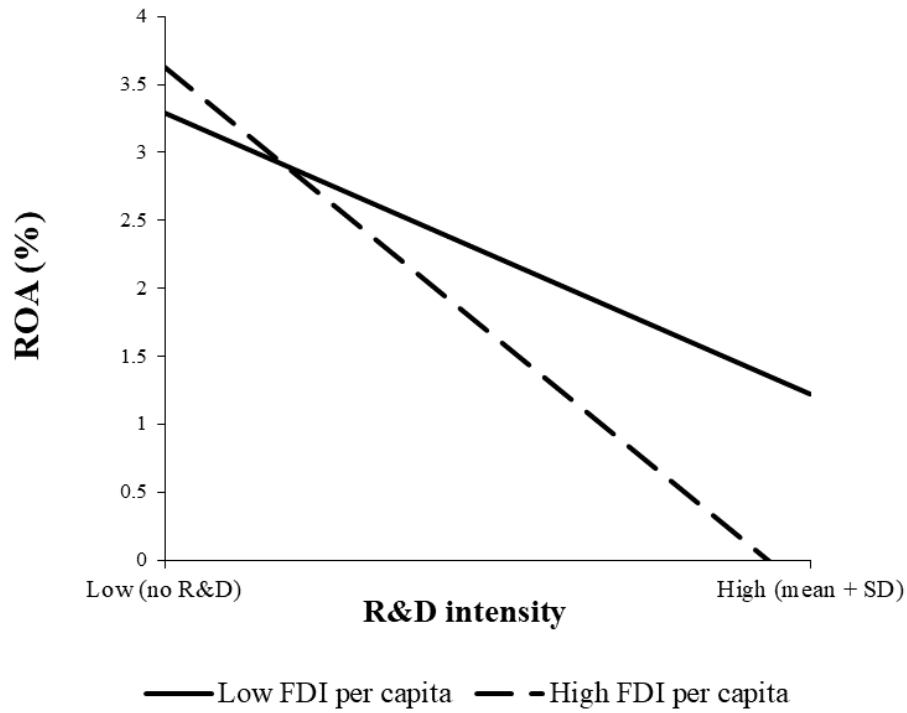
Figure 1. Interactions between R&D intensity, institutional development index, and corruption in predicting firm performance

Low institutional development (mean – SD):

Low FDI per capita — High FDI per capita

High institutional development (mean + SD):

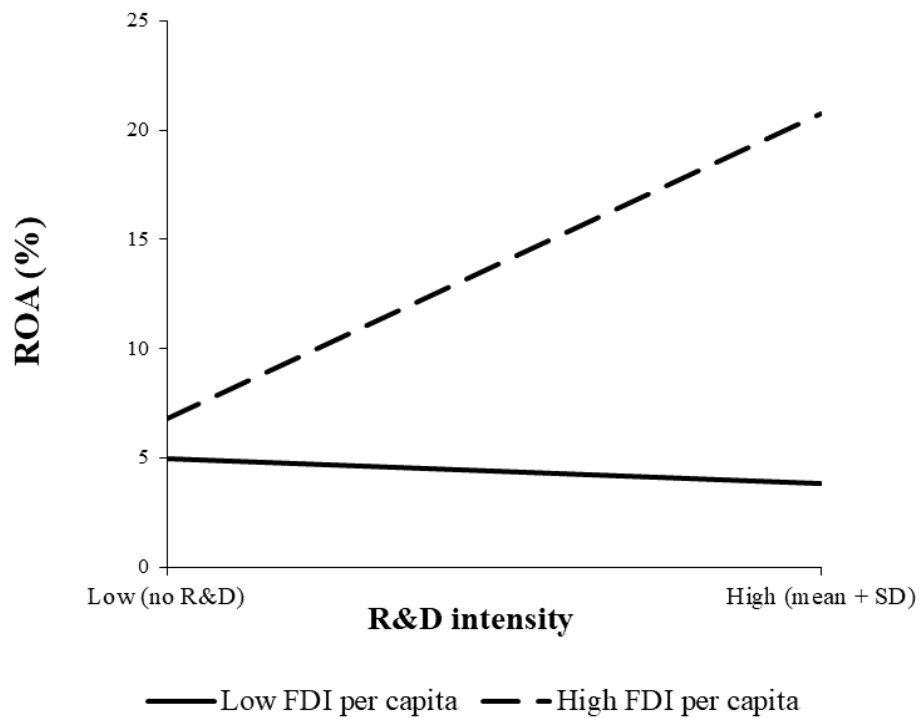

Low FDI per capita — High FDI per capita

Figure 2. Three-way interaction between R&D intensity, FDI per capita, and institutional development index in predicting firm performance