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The impact of FDI on R&D investment of small and medium-sized enterprises in Vietnam: The role of institutions

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ABSTRACT

This paper investigates how the quality of the local institutional environment affects the impact of foreign direct investment (FDI) on R&D investment of domestic small and medium-sized enterprises (SMEs) in Vietnam. By analysing data of 2690 manufacturing SMEs in 2011, 2013 and 2015, we find that FDI presence hinders R&D activities of domestic SMEs, probably due to SMEs' low absorptive capacity, large technological gap, lack of economies of scale and low market power. However, institutions positively moderate the relationship, that is better institutions mitigate the negative impacts of FDI on R&D investment of domestic SMEs. When the quality of local institutions improves beyond a certain minimum level, FDI exerts positive spillovers that encourage R&D activities of domestic SMEs. Our hypothesis suggests that institutions can moderate FDI spillovers to SMEs' R&D by promoting the foreign investors' incentive and ability to create technological spillovers, mitigating FDI crowding-out effects, enhancing domestic SMEs' absorptive capacity, and facilitating interaction and knowledge sharing in the local business environment. We also find that the institutional moderating effect is less pronounced for FDI originating from countries with lower institutional quality compared to that from countries with higher institutional quality. This suggests that multinational enterprises (MNEs) in the former group may be more susceptible to institutional impacts due to their unfamiliarity with institutional obstacles in the host economy. Our study highlights the importance of institutions to researchers who explore the relationship between FDI and domestic firms' R&D investment and to policymakers in emerging economies where FDI inflows and domestic SMEs play a pivotal role.

1. Introduction

Inward foreign direct investment (FDI) plays an important role in the host economy influencing its capital stock and technological advancement (Sun & Anwar, 2017). Theoretically, FDI can create positive spillovers to domestic firms through demonstration effect, labour mobility, competition effect, and backward and forward linkages (Blomström & Kokko, 1998). However, these can be offset by

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the negative crowding-out effects that occur when foreign firms compete with the incumbents for market share, skilled labour, finance and other resources (Qu & Wei, 2017; Spencer, 2008). Not surprisingly, researchers have examined the impacts of FDI on different behavioural aspects of domestic firms,[1] one of which is R&D investment[2] (see, e.g., Anwar & Sun, 2014; Ha, Holmes, & Hassan, 2023; Huang & Zhang, 2020; Khachoo et al., 2018; Stiebale & Reize, 2011). The mixed results of this body of literature are generally attributed to the competitive pressure enhancing effect of FDI in the domestic market. Competitive pressure may encourage domestic firms to enhance their competitive advantage by investing in R&D, or, due to a lack of resources and economies of scale, crowd out domestic firms who therefore fail to engage in R&D investment.

So far, a large number of attempts have been made to reconcile the mixed effects of FDI presence on innovation performance of domestic firms. Recent empirical studies emphasize the role of firm agglomeration or clustering in technological transfer. These studies adopt spatial econometric techniques to demonstrate that technological spillovers can decline with distance (Huang & Zhang, 2020; Wang & Wu, 2016). The justification was that geographic proximity among firms can foster knowledge sharing through skilled labour mobility, specialize the local markets for labour and intermediate goods, reduce communication cost, and enhance the trust relation, interactions and linkages in both horizontal and vertical directions.

In addition, FDI heterogeneity, including modes of entry, ownership structures, origins and purposes might lead to diverse effects on domestic innovation performance. Liu and Zou (2008) distinguish between the two modes of entry: greenfield investment or cross-border M&As. Javorcik and Spatareanu (2008) and Ito et al. (2012) take into account FDI ownership structures, that is, whether the MNEs establish a joint venture or wholly own subsidiary in the local market. Hong et al. (2019) show that FDI from developed countries is a more promising source of advanced technology compared to that from emerging countries which often comes with asset-seeking purpose rather than contributing to local technological advance. Other studies also account for the type of activity engaged by MNEs, such as R&D activities versus production activities (Cheung, 2010; Ito et al., 2012; Liu & Buck, 2007; Qu & Wei, 2017).

Finally, a large strand of literature highlights the role of firm-specific absorptive capability in determining the effectiveness of FDI technological spillovers. Absorptive capability can influence the extent to which firms are able to recognize, adopt, assimilate and apply the advanced technology and managerial practices from their foreign counterparts to create internal values (Glass & Saggi, 1998). Studies using the level of in-house R&D activities, skilled labor and financial access as indicators of firm-specific absorptive capability find a positive moderating effect of such measurements on the relationship between FDI and the innovation performance of incumbent firms (Girma et al., 2008; Liu & Buck, 2007).

This paper focuses on an alternative, less established, argument that may explain the mixed findings in the literature exploring the effect of FDI on domestic firms' R&D investment through the moderating effect of institutional settings. Institutional settings are the sets of rules governing the behaviours of individuals and organizations (North, 1990). These rules can be either formal (with codified laws, regulations and contracts) or informal (such as customs, values, social norms, ethics and ideologies that are tacit and socially embedded). Host country institutions are immobile factors contributing to the locational advantages of FDI, i.e., the ability of multinational enterprises (MNEs) to exploit local resources to their advantage (Meyer & Nguyen, 2005; Mudambi & Navarra, 2002). Research has shown that institutions are of prime concern to MNEs upon making investments, thereby influencing their locational choice (Du et al., 2008; Godinez & Liu, 2015). In addition, institutions can affect various MNEs' decisions, including entry modes, human resources, alliance formation, and export strategies (Brouthers & Brouthers, 2000; He et al., 2013; Xu & Shenkar, 2002). By shaping the strategies of foreign-invested firms in the local market, institutions can influence their incentives and abilities to generate technological spillovers (Wang et al., 2013; Yi et al., 2015). Therefore, the FDI technological spillovers on domestic firms may be contingent upon the level of institutional development. Despite this conceptual link and governments' ability to influence the institutional setting (particularly formal institutions), to the best of our knowledge, surprisingly little attention has been paid to assessing the role of institutions in moderating FDI's impacts on the R&D investment of domestic firms.

This paper fills the gap by examining institutions as a moderating factor in the relationship between FDI and R&D investment of domestic small and medium-sized enterprises (SMEs). We focus on SMEs because they are generally more vulnerable to institutional constraints than large firms, which may lead to more significant institutional effects. SMEs often lack market power, resources and political connections to deal with regulatory burdens or to exchange for public favours (LiPuma et al., 2013; Schiffer & Weder, 2001). In this way, institutions can determine the levels of resources and transaction costs of SMEs, and subsequently, influence their absorptive capacity for FDI spillovers more so than large firms.

Investigating how institutions moderate R&D spillovers from FDI is of significant relevance to emerging countries. Technological spillovers from FDI are often deemed the most important source of innovation for emerging economies that lack the capital and resources to launch new-to-the-world research (Sun & Du, 2010). Therefore, emerging economies fiercely compete to attract FDI as a focal strategy to close the innovation gap with more advanced economies (Cheung, 2010; Cheung & Ping, 2004; Sun & Du, 2010). However, policymakers are often unaware of the extent to which domestic firms benefit from FDI technological spillovers. These countries may merely import technologies while failing to build their own innovative capacity through R&D activities. In addition, institutions likely contribute to the variation in regional FDI spillovers within an emerging country. This is because institutional

[1] For example, since the work of Caves (1974), a large body of literature has examined productivity spillovers of FDI. See Rojec and Knell (2018) for a survey.

[2] R&D is broadly defined as *"creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge"* (OECD, 2015). According to the OECD manual, R&D expenditures are considered capital formation, that is, investment.

arrangements in emerging countries are different and generally of lower quality than those in more developed countries, from where FDI often originates (Peng et al., 2008). In addition, emerging countries often experience significant institutional changes over time, and have heterogeneous institutional conditions across subnational regions (Xiao & Park, 2018). Thus, the policy implications drawn from this research may assist emerging countries in adjusting their institutional arrangements to capture positive FDI technological spillovers and foster domestic innovative performance.

This paper explores the following research questions using the context of Vietnam: How do local institutions moderate FDI spillovers to R&D investment of domestic SMEs? Our analysis is based on a panel dataset of 2690 manufacturing SMEs from the biennial surveys in 2011, 2013 and 2015. We use the instrumental variable (IV) approach to address the potential endogeneity issues surrounding FDI and institutions. Our results suggest that institutions positively moderate the impacts of FDI presence on R&D investment of domestic SMEs. That is, better institutions mitigate the negative impacts of FDI on (*i*) the probability of R&D investment and (*ii*) R&D expenditure of domestic SMEs; and when the quality of institutions reaches a threshold level, FDI encourages R&D investment. These institutional effects are pronounced for FDI from countries with higher institutional quality but negligible for FDI from countries with lower institutional quality.

In doing so, this paper makes several contributions to the existing literature. First, this paper contributes to the strand of literature investigating FDI's impact on R&D investment of domestic firms. Existing literature remains scant, with some studies supporting positive spillovers (Anwar & Sun, 2014; Huang & Zhang, 2020; Khachoo et al., 2018), while others find insignificant (Chuang & Lin, 1999) or even negative effects (Kathuria, 2008; Stiebale & Reize, 2011). The mixed findings potentially hint at missing explanatory variables, hence the call for further investigations. Since inadequate accounting for the moderating effect of institutions may cause omitted variable bias, we advance the literature by incorporating an institutional variable and its interaction term with FDI in our analysis.

Second, our paper differs from prior studies by focusing on SMEs as the recipient of technological spillovers. Arguably, SMEs possess characteristics that are distinct from large firms, which in turn may affect their ability to innovate under the influence of FDI. While SMEs' flexibility, speed, and willingness to take risks are advantageous for adopting new ideas (Hossain & Kauranen, 2016), they may lack the necessary resources to efficiently absorb FDI technological spillovers. In addition, SMEs have been increasingly recognised as the engine of technological progress in emerging economies (Ndiaye et al., 2018). Hence, it is of importance, both conceptually and policy-wise, to study SMEs.

Finally, this paper adds to the literature looking at the institutional moderating effect on FDI productivity spillovers (Gorodnichenko et al., 2014; Krammer, 2015; Wang et al., 2013; Xiao & Park, 2018; Yi et al., 2015; Zhang, 2019) by expanding the analysis to innovation, that is R&D investment. This is important because although improved productivity might be the result of innovation activities, productivity measures cannot directly reflect the firm's effort to innovate (Salomon & Shaver, 2005). In addition, these studies mostly examine the context of China. Although China is the largest emerging market in the world, which receives the greatest amount of inward FDI, it has been suggested that research on other emerging markets is essential to explain the institutional mechanism of FDI spillovers (Xiao & Park, 2018). Therefore, this study focuses on Vietnam, an emerging economy that features significant variation in institutional development across provinces (Yi et al., 2015).

This paper proceeds as follows: Section 2 develops the research hypotheses. Section 3 outlines relevant background information about Vietnam. Section 4 describes the data and methodology. Section 5 reports the empirical results, while Section 6 provides conclusions and discussions.

2. Hypotheses

Researchers summarise four main channels through which FDI spillovers may occur, namely the demonstration effect, labour mobility, competition effect, and supplier-customer relations (Blomström & Kokko, 1998). Domestic firms can observe, imitate and reverse engineer the products and technologies brought in by foreign firms (Qu & Wei, 2017). In this process, they may undertake some adaptive R&D to ensure the newly devised products and technologies suit the local conditions (Kathuria, 2008). Employees in FDI firms, with technical knowledge and managerial expertise, can move to domestic firms or start their own businesses locally (Liu & Zou, 2008). Such a movement of R&D personnel then promotes innovation in domestic firms. In addition, the entry of MNEs often heightens competition in the local market, thereby creating an incentive for domestic firms to innovate and escape competition (Aghion et al., 2009). In response to foreign entry, local firms launch R&D projects, which in turn can give them competitive advantages (Rammer et al., 2009).

The last channel, supplier-customer relations, consists of forward and backward linkages.[3] Forward linkages occur when MNEs from upstream industries supply local customers with high-quality equipment and inputs, followed by further technical support and management training (Liang, 2017). In terms of backward linkages, MNEs may want to enhance the quality of input from local suppliers by providing technical assistance, training programs, information, financial support, and organizational and managerial expertise (Le & Pomfret, 2011; Liang, 2017). In both cases, domestic firms entering a customer/supplier relationship with FDI firms

[3] Forward FDI refers to the foreign firms supplying to local customers located in downstream industries while backward FDI refers to the foreign firms buying from local suppliers located in upstream industries (Newman et al., 2015).

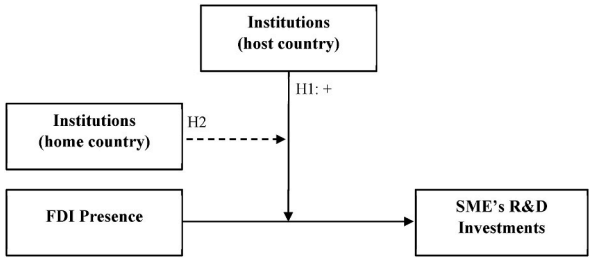


Fig. 1. Conceptual model of FDI presence, R&D investment of domestic SMEs, and host and home country institutions.

can increase their capacity to engage in R&D activity.[4]

2.1. FDI presence and R&D investment of domestic SMEs

Prior studies focus on large firms and hence offer little insight into how FDI may influence R&D investment of indigenous SMEs. Arguably, not every domestic firm can reap the same benefit from foreign technologies since the extent of FDI technological spillovers largely depends on the domestic firm's absorptive capacity (Liu & Buck, 2007). Incumbent firms need prerequisite knowledge, familiarity with technology in the field, and a pool of highly skilled workers in order to recognize, decode and assimilate the technologies from their foreign counterparts (Cohen & Levinthal, 1990; Liang, 2017). In the case of SMEs, they may face various barriers to innovation, such as a lack of financial resources, skilled labour, managerial expertise, technical experts, technological assets, and technical information (Madrid-Guijarro et al., 2009; Xie et al., 2010). These inherent demerits result in a low absorptive capacity of SMEs for foreign technologies, i.e., SMEs are less capable of improving their R&D capacity under FDI presence.

Among different innovation activities, R&D investment has the potential of generating radical innovations with high degrees of novelty (Cassiman & Veugelers, 2002), which particularly large firms prefer due to economies of scale (Shefer & Frenkel, 2005). However, the potentially excessive costs and risks inherent to R&D investment, make it a less favourable option for SMEs (Rammer et al., 2009). Herrera and Sánchez-González (2012) argue that in a highly competitive market, SMEs often make use of production flexibility and speed to benefit from incremental innovations. Therefore, under the heightened competition by foreign entry, SMEs may replace in-house R&D activities with more incremental innovations as a way to survive the competition. We refer to this as the substitution effect.

Finally, SMEs may endure negative crowding-out effects from FDI entry that reduce their resources to engage in R&D. Specifically, horizontal FDI firms compete with their less efficient domestic counterparts for market share, which puts downward pressure on prices (Liu & Buck, 2007) and reduces domestic firms' resources for R&D. Higher wages paid by FDI firms attract the highly skilled workers in the labour market, leading to a depletion of human resources for domestic firms (Spencer, 2008). Competition may also occur in the financial market when foreign investors use their strong reputation to compete for bank loans (Qu & Wei, 2017). These crowding-out effects are particularly deleterious for SMEs since their lack of economies of scale often exacerbates the financial burden associated with R&D investment (Cohen & Klepper, 1996; Rammer et al., 2009).

The negative FDI crowding-out effects may also manifest via vertical channels when FDI firms use market power to raise input prices for local buyers, or to appropriate the expected profits of local suppliers (Newman et al., 2015). This can reduce the profitability of domestic SMEs with lower market power thereby restraining their financial resource to invest in R&D. In addition, foreign firms in downstream industries can import intermediate inputs and substitute local suppliers in the host economy (Liu & Buck, 2007; Newman et al., 2015). Particularly, MNEs with technology-intensive products prefer suppliers who can meet high standards on quality, cost, and delivery (Ni et al., 2017). Therefore, FDI firms are less likely to choose domestic SMEs with low technical capacity as preferred suppliers, who consequently suffer from the crowding-out effect in the supply market.

Therefore, FDI presence can negate domestic SMEs' R&D efforts due to SMEs' low absorptive capacity, substitution and negative crowding-out effects.

In the following subsections, we derive predictions for the moderating impact of local institutions on R&D spillovers from FDI and how this relationship differs based on the level of institutional development of home countries. Fig. 1 graphically summarizes these proposed relationships.

2.2. Institutions and R&D spillovers from FDI

Institutions manifest themselves as significant immobile factors affecting FDI in an international market. This is because while firms and factors of production are transferable across countries, factors such as political systems, legal frameworks and government policies

[4] The resource-based view considers R&D decision a function of firm-internal resources, indicating that financial resources, tangible assets and intangible resources, such as human capital, managerial and organizational excellence are important factors in promoting R&D investment (Lai et al., 2015; Galende& Fuente, 2003).

are deeply embedded in a society, circumscribed by the geographical border and constitute local-specific environmental characteristics (Mudambi & Navarra, 2002). Theoretically, institutions contribute to locational advantages, one of the three pillars in the ownership-location-internationalization paradigm (OLI paradigm) proposed by Dunning (1988). Institutions influence how MNEs exploit local resources to their advantage; thus, determine the locational attractiveness to FDI (Meyer & Nguyen, 2005). MNEs entering a new market often suffer from the "*liabilities of newness*" due to a lack of local network and unfamiliarity with local legal frameworks and the ways of doing business (Krammer, 2015). This makes institutional arrangements a prior concern of MNEs upon making investments. Prior research has shown how institutional quality affects MNEs location choice (Demirbag, Tatoglu, & Glaister, 2010; Du et al., 2008), as well as their strategies regarding the establishment of ownership structure (Hennart & Park, 1993; Yiu & Makino, 2002) and entry mode choice (Brouthers & Brouthers, 2000; Luu, Nguyen, Ho, & Nam, 2019). Zhang and Kim (2022) show that although low labour costs are a major determinant of FDI inflows into emerging countries, this factor is less important when the institutional quality is improved. Furthermore, the institutional distance between the host and home countries can influence the volume of FDI inflows (Godinez & Liu, 2015; Wang & Anwar, 2022) and a variety of MNEs' decisions, including entry modes, human resources, alliance formation, and export strategies (He et al., 2013; Xu & Shenkar, 2002). The general prescription is that more developed institutions and a smaller institutional gap between the host and home countries of MNEs increase regional appeal to FDI and facilitate MNEs' operation in such an environment (Krammer, 2015).

Given the vulnerability of SMEs to the institutional environment, institutions may be an important factor affecting the relationship between FDI and SMEs' R&D investment. Institutions can moderate FDI spillovers to SMEs' R&D investment in several ways, namely through promoting the foreign investors' incentive and ability to create technological spillovers (Gorodnichenko et al., 2014; Wang et al., 2013), mitigating FDI crowding-out effects (Krammer, 2015), enhancing domestic SMEs' absorptive capacity (Yi et al., 2015), and facilitating interaction and knowledge sharing in the local business environment (Yi et al., 2015; Zhang, 2019).

First, highly developed institutions may facilitate FDI spillovers in the local market by promoting the foreign investors' incentive and ability to create technological spillovers. FDI firms often consider better institutional environments as a safeguard to efficiently exploit their ownership advantages and maximize their profits (Meyer & Nguyen, 2005). They are, therefore, encouraged to bring better technology to the host economy, incorporate more technology-intensive assets and undertake R&D investment and innovation projects locally, leading to a higher possibility of spillovers (Gorodnichenko et al., 2014). In addition, institutional development, such as strong law enforcement, transparency, low regulatory burden, adequate government support, equal access to finance, and better control of corruption, can enhance the productivity and innovation capacity of foreign entrants (Yi et al., 2015). This subsequently enables them to expand their innovative activities in the host economy by setting up R&D centres and pursuing technology-intensive projects, which ultimately generate more positive externalities (Wang et al., 2013). We expect that the more technological spillovers are generated, the higher the chance that SMEs (even though restrained by low absorptive capacity) can absorb some of these to improve their R&D performance.

Second, it has been suggested that FDI entry, with the purpose of exploiting local resources, such as the domestic market, cheap labour, and natural resources, is most likely to exert negative crowding-out effects by putting direct competition pressure on domestic firms (Anwar & Nguyen, 2011; Le & Pomfret, 2011). In fact, countries with low institutional quality can still attract a large volume of FDI inflows thanks to their large markets and significant resource endowments (Asiedu & Lien, 2011). Subsequently, well-developed institutions remove MNEs' opportunity to corrupt local elites and extract rents from exclusive resource exploitation (Krammer, 2015), thereby reducing the potential of crowding-out effects of FDI, making FDI less detrimental to domestic SMEs' R&D activities.

Third, for domestic firms as the recipients of FDI technological spillovers, strong institutions can enhance their absorptive capacity for foreign technologies and reduce transaction costs to facilitate the learning process, value creation, labour movement and the acquisition of human resources (Krammer, 2015; Yi et al., 2015). This is particularly important for SMEs since they are more vulnerable to institutional barriers compared to large firms. SMEs often lack the market power, resources and political connections to endure the cost of bureaucratic obstacles or to seek public favours (LiPuma et al., 2013; Schiffer & Weder, 2001). In addition, they have to use a larger proportion of resources to cope with administrative procedures, compared to large firms (OECD, 2019). Therefore, as the institutional quality improves, SMEs can reallocate the resources, otherwise spent on coping with institutional constraints, to develop technical ability, financial resources and human capital. These internal resources are often considered the key components of the firm's absorptive capacity (Anwar & Nguyen, 2014).

Finally, the development of institutions may enhance the effectiveness of spillovers by creating a conducive environment to facilitate coordination, interactions and knowledge sharing between foreign-invested firms and local firms (Yi et al., 2015). Better institutions reduce transaction costs and uncertainties of foreign investors in finding and negotiating with local partners (Meyer, 2001), thereby allowing them to access local networks and complementary resources (Meyer & Nguyen, 2005). This can foster the scope and depth of the foreign entrants' linkages in the local economy, which enhances the effectiveness of FDI spillovers (Krammer, 2015). In addition, high-quality institutions with effective enforcement of laws and lower corruption can mitigate the risk of opportunistic contracting behaviours whereby one party can break the contract and appropriate the expected profits of the other (Anokhin & Schulze, 2009; Zhang, 2019). This can enhance the productivity and efficiency of supplier-customer relations and subsequently foster FDI spillovers through vertical linkages (Zhang, 2019).

In this study, we are interested in how institutions may influence the relationship between FDI and R&D investment. Following the above discussion, we hypothesise that.

Hypothesis 1. Institutional development has a positive moderating effect that mitigates the negative impact of FDI on R&D investment of domestic SMEs.

2.3. The role of FDI origin

In this subsection, we argue that the moderating effect of institutions on FDI spillovers is likely to depend on the institutional quality in the origin country. Low institutional quality in the host relative to the origin economy can create additional costs and risks to FDI (Choi et al., 2016). This occurs as MNEs entering a new market may suffer from the *"liabilities of foreignness"* due to their unfamiliarity with local legal frameworks and the ways of doing business (Krammer, 2015). However, MNEs experiencing poor institutional environments at home may have developed the management skills and knowledge to cope with institutional pressures, leading to lower sensitivity to poor institutional quality (Godinez & Liu, 2015). For example, research has shown that investors who have been exposed to bribery at home may not be hindered by corruption abroad (Cuervo-Cazurra, 2006). Wang et al. (2013) posit that the moderating effect of institutions on spillovers of ethnic-linked FDI[5] is not significant as opposed to non-ethnic-linked FDI due to the familiarity of the former with the local business environment. Therefore, MNEs already encountering low institutional quality at home are more familiar with institutional obstacles in the host economy, thereby less susceptible to institutional impacts. Hence, recognizing Vietnam's poor institutional quality setting (see Section 3), we hypothesise that:

Hypothesis 2. The moderating effect of local institutions on FDI spillovers is weaker for FDI from countries with low rather than high institutional quality.

3. Background on Vietnam

Vietnam has undergone a transition from a centrally planned economy to a market economy since the major economic reform, known as *Doi Moi*, in 1986. Consequently, the institutional environment has evolved to accommodate the process of liberalization, privatization, and internationalization. This is a gradual hold-and-see process happening at different speeds throughout the country (Tran, 2019). In addition, active decentralization of fiscal, administrative and political power has endowed provincial governments with considerable discretion in implementing laws and policies. Most government-business interactions now occur at provincial levels, such as business registration, inspections, government procurement and land permission (Bai et al., 2019). These contribute to substantial variation in institutional quality across provinces, making Vietnam a rich context to empirically examine the relationship between institutions and FDI spillovers (as shown in Fig. 2). More than three decades after the reform, the overall institutional quality in Vietnam remains relatively low, ranked 135th out of 213 countries worldwide according to the Worldwide Governance Indicators provided by the World Bank in 2021. Despite laudable achievements in terms of political stability, low expropriation risks and reduced policy uncertainties, several aspects, including corruption, transparency, public service delivery and regulatory quality, still manifest as institutional bottlenecks for doing business in Vietnam (Malesky et al., 2020).

Under *Doi Moi*, Vietnam started to attract foreign capital with the promulgation of the *Law on FDI* in 1987 which was later amended in 1990, 1992, 1996 and 2000, thereby establishing a legal framework for the entry and operation of foreign-invested enterprises. Accordingly, many government incentives have been granted to foreign investors, including favourable corporate income tax, exemption and reduction of import and export taxes, easy land access and site clearance, and investment guarantee measures. The enactment of *Investment Law* in 2005 and its later revision in 2014 continue to remove administrative barriers to FDI and discrimination between foreign firms and domestic firms (Huynh et al., 2019). Yearly registered FDI inflows surged by more than 250% from 6,840 million USD in 2005 to 24,155 in 2015, which continued to increase steadily, reaching 38,951.7 million USD in 2019 (see Fig. 3). The highest growth rate was observed in 2008, one year after the accession of Vietnam to the World Trade Organization (WTO).

Privatization has resulted in a rapid growth of the country's private sector, most of which are SMEs, accounting for 98% of the total number of enterprises. SMEs play an important role in Vietnam's economy as they contribute to approximately 60% of the labour hiring, 40% of the total GDP, 30% of the public budget, 33% of industrial outputs and 30% of exports (OECD, 2021). The government issued decrees to support SME development in 2001,[6] 2009[7] and most recently, the *Law on* Supporting *SMEs* which took effect in early 2018. These policies provide preferential treatment for SMEs on various aspects, including finance and credit support, tax incentives, simplified accounting regimes, reduced land rents, technology support, human resources development through training courses, information and consulting services, and market promotion. Although well-intended, these measures are not effective in practice, with limited SMEs' access to support, probably due to complicated administrative procedures in applying for support and the incapability of provincial governments in implementing these policies (OECD, 2021). Vietnamese SMEs still encounter constraints on technical capacity and a shortage of skilled labour and management expertise, which hinders their interactions with MNEs as well as the potential of FDI technological spillovers (Asya et al., 2017).

[5] Wang et al. (2013) examine FDI spillovers in China. Ethnic-linked foreign investment is FDI from Hong Kong, Macau and Taiwan, while non-ethnic-linked FDI refers to FDI from elsewhere.

[6] Decree No.90/2001/ND-CP on 23 November 2011.

[7] Decree No.56/2009/ND-CP on 30 June 2009.

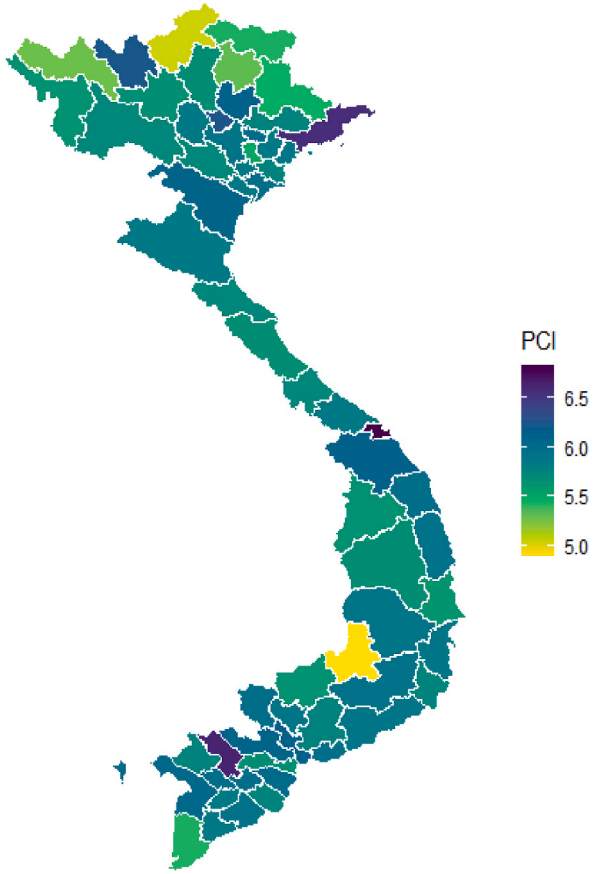


Fig. 2. Map of mainland Vietnam - Vietnam Provincial Competitiveness Index (PCI) in 2015.
Data source: PCI Vietnam.

4. Data and methodology

4.1. Data

This research employs data from three sources. The first data source is the Vietnam Small and Medium Enterprises Survey (SME survey), provided by the United Nations University World Institute for Development Economics Research in cooperation with the Central Institute for Economic Management, the Institute of Labour Science and Social Affairs, and the Development Economics Research Group at the University of Copenhagen. The data are collected biennially from 2005 to 2015 in 9 out of 63 provinces of Vietnam,[8] namely Hanoi, Hai Phong, Ho Chi Minh City, Phu Tho, Nghe An, Quang Nam, Khanh Hoa, Lam Dong, and Long An. More than 2500 non-state-owned manufacturing SMEs participate in each survey round. The data include detailed firm-specific characteristics, such as demographic information, accounting, product and technology, management, labour force data, and a wide range of strategic behaviours including R&D investment. This paper employs the survey rounds in 2011–2015 and excludes those in 2005–2009 since they lack the critical information on the Vietnam Standard Industrial Classification (VSIC).

The second dataset comes from the Annual Survey of Enterprises (ASE) conducted by the General Statistics Office of Vietnam. The data cover virtually all Vietnamese firms in operation with formal legal status,[9] providing basic information on firms' identity, ownership, sales, costs, profits and employment. This allows us to extract information about FDI presence by industry in a given period. The number of firms included in the dataset ranges from 339,217 firms in 2011 to 455,300 firms in 2015.

The third dataset is from the Vietnam Provincial Competitiveness Index (PCI) annual surveys, which are conducted by the Vietnam Chamber of Commerce and Industry (VCCI) to measure and rank different aspects of provincial institutions, including the quality of

[8] The General Statistic Office of Vietnam groups the country's 63 provinces into 6 regions, comprising: Northern Midlands and Mountains, Red River Delta, North and Central Coast, Central Highlands, South East, and Mekong River Delta. The classification is based on similarities in geographical location, natural, historical and socio-economic characteristics, and regional economic linkages. The nine provinces covered in our data sample represent all 6 regions across the country.

[9] The sampling only excludes domestic firms with less than 20 employees in several provinces.

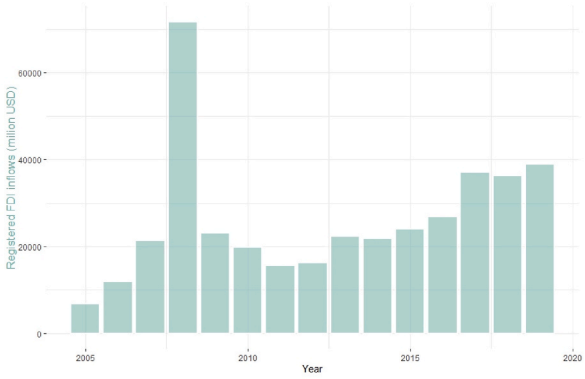


Fig. 3. Registered FDI inflows in Vietnam 2005–2019. *Data source:* GSO Vietnam.

economic governance, the degree of business friendliness, and the administrative reform efforts. The index gathers the perception of the private business community about the business environment across provinces in Vietnam. The index helps to explain why some provinces outperform others in terms of private economic development, job creation and economic growth, thereby allowing provincial leaders and policymakers to identify bottlenecks in economic administration and enhance economic governance.

We combine the three aforementioned sources of data to create a unique panel dataset that allows us to evaluate the impact of FDI on R&D investment of domestic SMEs and how this relationship is contingent upon the quality of the local business environment. After excluding unreasonable values and winsorizing data at the 1st and 99th percentile, our final dataset consists of 7563 firm-year observations covering 2690 Vietnamese SMEs during 2011–2015.

4.2. Empirical models

To investigate the moderating effect of institutions on the relationship between FDI and R&D investment of domestic SMEs, we employ the following models:

$$Pr\left(RDD_{ijdt}=1|RDD_{ijdt-1},FDI_{jdt},INST_{kt},X_{ijdt},dregion_d,dyear_t,dindustry_j\right)=\Phi\left(\alpha_0+\alpha_1FDI_{jdt}+\alpha_2INST_{kt}+\alpha_3FDI_{jdt}\times INST_{kt}+\alpha_4RDD_{ijdt-1}+\alpha_5dregion_d+\alpha_6dyear_t+\alpha_7dindustry_j+\alpha'X_{ijdt}\right) \quad (1)$$

$$RDE_{ijdt}=\beta_0+\beta_1FDI_{jdt}+\beta_2INST_{kt}+\beta_3FDI_{jdt}\times INST_{kt}+\beta_4RDD_{ijdt-1}+\beta_5dregion_d+\beta_6dyear_t+\beta_7dindustry_j+\beta'X_{ijdt}+\varepsilon_{ijdt} \quad (2)$$

where i, j, k, d, and t denote firm, 4-digit industry, province, economic region, and year respectively; *RDD* is a dummy variable taking the value of 1 if the firm engages in R&D investment, and 0 otherwise; *RDE* represents real R&D expenditure in natural logarithm form; FDI_{jdt} is FDI presence in industry j in region d and year t; $INST_{kt}$ represents institutional quality in province k in year t; X_{ijdt} is the vector of control variables that capture firm-specific and industry-specific characteristics; regional dummies ($dregion_d$) and industry dummies ($dindustry_j$) are employed to account for regional-specific and industry-specific characteristics that are stable over time, while year dummies ($dyear_t$) capture common macro shocks; ε_{ijdt} is the error term.

To examine the moderating role of institutions, we interact FDI_{jdt} with $INST_{kt}$. In Equations (1) and (2), we include RDD_{ijdt-1} to control the effect of the entry cost of R&D investment. As such, we use the 2009 SME survey round to obtain RDD_{ijdt-1} in 2011 for the purpose of minimizing data loss.

4.2.1. Measuring FDI presence

In our baseline analysis, FDI is proxied by the horizontal FDI presence (FDI_H_{jdt}) measured as the proportion of FDI firms' outputs in each 4-digit industry in each region and year:

$$FDI\_H_{jdt}=\frac{\sum_{i\in N^F_{jdt}}Y_{ijdt}}{\sum_{i\in N^F_{jdt}\cup N^D_{jdt}}Y_{ijdt}}$$

where Y denotes outputs; N^F_{jdt} is the set of FDI firms and N^D_{jdt} is the set of domestic firms.

Later, we also carry out the analysis for different aspects of FDI presence, including forward FDI (FDI_F_{jdt}) and backward FDI (FDI_B_{jdt}). Following prior literature on FDI spillovers (e.g., Anwar and Nguyen (2011), Newman et al. (2015) and Nguyen et al. (2019)), the backward linkage is measured as followed:

$$FDI\_B_{jdt}=\sum\nolimits_{l\neq j}\gamma_{ljd}FDI\_H_{ldt}$$

Table 1
Summary statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
RDD	7563	0.007	0.083	0	1
RDE	7563	2.213	53.296	0	2281.235
FDI_H	7563	0.279	0.271	0	1
FDI_B	7563	0.220	0.159	0	0.860
FDI_F	7563	0.199	0.162	0	0.690
FDI_index	7563	0.248	0.180	0	1
INST	7563	4.089	2.153	1	1
ROA	7563	0.295	0.416	−0.033[a]	2.440[b]
FIRMSIZE	7563	4,833,111	9,877,635	22,100	6.49e+07
FIRMAGE	7563	15.204	9.973	2	76
GENDER	7563	0.607	0.488	0	1
AGE	7563	46.122	10.851	17	94
HUMANCAP	7563	0.680	0.467	0	1
EXPORT	7563	0.064	0.245	0	1
ZONE	7563	0.048	0.213	0	1
LSKILL	7563	0.024	0.059	0.000	0.800
HERFINDAHL	7563	0.065	0.098	0.002	1
TECHGAP	7563	1.021	1.674	−0.890[c]	14.367

Notes: This table reports the summary statistics of the main variables in our analysis.
[a] A negative ROA means that the firm is making a loss, which accounts for 2% of the sample.
[b] Approximately 10% of the sample have a value of ROA greater than 1.
[c] The negative values for the technological gap variable mean that the average productivity of domestic firms is greater than that of foreign firms in the same industries. Only 18% of 4-digit industries in our sample have negative values of technological gap.

where γ_{ljd} is the proportion of the outputs of industry j supplied to industry l in region d. In addition, the forward linkage is measured as followed:

$$FDI\_F_{jdt} = \sum\nolimits_{h \neq j} \lambda_{hjd} FDI\_H_{hdt}$$

where λ_{hjd} is the proportion of the output of industry j purchased from industry h in region d. The values of γ_{ljd} and λ_{hjd} are calculated from the 2012 Input-Output Tables, estimated by the General Statistics Office (GSO) of Vietnam. Since different measures of FDI presence are highly correlated with each other, later in the analysis, we also use the principal component analysis (PCA) to construct a composite FDI index (FDI_index_{jdt}) that incorporates both horizontal FDI and vertical FDI.

4.2.2. Measuring institutions

The PCI from 2011 to 2015 assesses institutional development based on the following nine criteria: (i) *entry cost*, (ii) *land access*, (iii) *transparency*, (iv) *control of corruption*, (v) *time cost*, (vi) *proactivity*, (vii) *business* support, (viii) *labour training*, and (ix) *rule of law*.[10] These indicators have been widely accepted as appropriate and comprehensive measures of institutional quality and have been used in institutional related literature (see e.g., Bai et al., 2019; Nguyen & Van Dijk, 2012; Tran, 2019). These sub-indices are continuous variables that take values from 1 to 10, with a higher score indicating higher institutional quality.[11] Due to the multi-dimensional nature of institutions, we utilise principal component analysis (PCA) to construct a single index that captures the overall quality of the institutional environment. PCA is a statistical method used to reduce the dimensions of data by linearly transforming a set of correlated variables to a smaller number of uncorrelated principal components (Dhahri & Omri, 2020). Following the steps set out by Phan et al. (2020), we first calculate factor scores from the nine initial institutional sub-indices as mentioned earlier. We then take the linear weighted combination of the factors that explains the largest variations in the data[12]; and finally, for ease of interpretation, rescale the index to the range of 1–10 using the formula: $INST = \frac{x - x_{min}}{x_{max} - x_{min}} \times 9 + 1$ where, x is a particular factor score, x_{max} and x_{min} are respectively the maximum and minimum factor scores of all province-year observations.

4.2.3. Control variables

Following prior studies on determinants of R&D investment (e.g. Anwar & Sun, 2014; Banerjee & Gupta, 2021; Lai et al., 2015), we include several firm-specific and industry-specific characteristics as control variables in our analysis. Specifically, firm size (*FIRMSIZE*) is measured by the natural logarithm of total assets. Firm age (*FIRMAGE*) is the number of years in operation. Returns on Asset (*ROA*), which indicates profitability, is measured by the ratio of net profit against total assets. We also incorporate several managerial

[10] The definitions of these indices are presented in Table A1 of the Appendix.
[11] Details on questionnaires and methodology can be found on the official PCI website at https://pcivietnam.vn/, and the PCI handbook of instructions available online at https://pcivietnam.vn/uploads//VN-Nghien-cuu-khac/So-tay-2018-PCI.pdf.
[12] We follow the common practice and employ the factors of which the eigen values are not less than 1. The factor score coefficients are provided in Table A1 of the Appendix.

Table 2
Correlation matrix.

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	*FDI*	1												
2	*INST*	0.021	1											
3	*ROA*	0.006	0.027*	1										
4	*FIRMSIZE*	0.168***	−0.144***	−0.484***	1									
5	*FIRMAGE*	−0.125***	−0.024*	−0.025*	−0.133***	1								
6	*GENDER*	−0.093***	−0.033**	−0.010	−0.060***	0.040***	1							
7	*AGE*	−0.080***	0.008	−0.069***	−0.090***	0.353***	0.167***	1						
8	*HUMANCAP*	0.126***	−0.107***	−0.058***	0.305***	−0.152***	−0.010	−0.146***	1					
9	*LSKILL*	0.103***	0.008	−0.040***	0.360***	−0.128***	−0.092***	−0.110***	0.232***	1				
10	*EXPORT*	0.056***	−0.065***	0.007	0.262***	−0.043***	−0.051***	−0.074***	0.140***	0.161***	1			
11	*ZONE*	−0.005	−0.095***	−0.044***	0.260***	−0.055***	−0.042***	−0.063***	0.129***	0.184***	0.156***	1		
12	*HERFINDAHL*	−0.055***	0.047***	0.004	−0.074***	0.041***	−0.036**	0.035**	−0.096***	−0.044***	−0.060***	−0.048***	1	
13	*TECHGAP*	0.032**	0.099***	0.060***	−0.079***	−0.049***	−0.032**	0.008	−0.022	0.046***	−0.0111	−0.0115	0.229***	1

Note: *FDI* is measured by horizontal FDI presence (*FDI_H*). *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

Table 3
FDI presence and the probability of R&D investment of domestic SMEs.

	Probit	IV-Probit	IV-2SLS	IV-GMM
	(1)	(2)	(3)	(4)
FDI	**−1.347*****	**−6.186*****	**−0.155*****	**−0.793*****
	(0.487)	**(0.991)**	**(0.043)**	**(0.298)**
Lag RDD	0.492*	0.353	0.074*	−0.027
	(0.287)	(0.271)	(0.044)	(0.023)
ROA	−0.151	0.017	0.002	0.027***
	(0.260)	(0.198)	(0.004)	(0.009)
FIRMSIZE	0.198***	0.162***	0.004**	0.020***
	(0.065)	(0.051)	(0.002)	(0.006)
FIRMAGE	−0.028**	−0.022**	−0.000*	−0.001
	(0.014)	(0.011)	(0.000)	(0.001)
GENDER	0.112	0.007	−0.001	0.002
	(0.167)	(0.120)	(0.004)	(0.013)
AGE	−0.006	−0.003	−0.000	−0.001
	(0.007)	(0.005)	(0.000)	(0.001)
HUMANCAP	0.056	0.098	0.001	−0.004
	(0.221)	(0.161)	(0.003)	(0.011)
LSKILL	2.539***	2.647***	0.202**	−0.023
	(0.721)	(0.634)	(0.081)	(0.156)
EXPORT	0.554**	0.293	0.031*	0.113**
	(0.235)	(0.181)	(0.016)	(0.046)
ZONE	−0.045	−0.007	0.001	−0.027
	(0.251)	(0.180)	(0.015)	(0.043)
HERFINDAHL	−18.290*	6.645	0.002	0.079
	(9.926)	(9.745)	(0.074)	(0.210)
TECHGAP	−0.085	−0.154*	−0.006	0.001
	(0.113)	(0.091)	(0.006)	(0.035)
Year dummies	Y	Y	Y	Y
Industry dummies	Y	Y	Y	Y
Region dummies	Y	Y	Y	Y
Cragg-Donald Wald F statistic	–	109.480	109.480	20.464
Stock-Yogo critical value at 10%	–	19.93	19.93	19.93
Underidentification test	–	201.990***	201.990***	39.000***
Overidentification test	–	0.969	0.969	1.636
Endogeneity test	–	10.69***	11.401***	5.453**
Observations	3107	3107	3234	3278

Notes: This table reports the estimation results of the impact of FDI presence on R&D investment of domestic SMEs. Columns 1–3 are based on Equation (1) that examines the probability of conducting R&D. Robust standard errors are in parentheses. Column 4 reports the estimation results of of Equation (2) to examine the impacts of FDI presence on R&D expenditure (in natural logarithm), using IV-GMM estimation. *Lag RDD* is replaced by its predicted value obtained from equation (1) and the standard errors are bootstrapped. Constants are excluded for brevity. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

characteristics, including *GENDER* which equals 1 if the SME owner/manager is a male, and 0 otherwise; *AGE* which is the age of the SME owner/manager; and *HUMANCAP* which equals 1 if the owner/manager had obtained upper secondary education, and 0 otherwise. The quality of the labour force (*LSKILL*) is the ratio of professional employees with qualifications to the total workforce. *EXPORT* equals 1 if the firm exported its products in the survey period, and 0 otherwise; while *ZONE* is a dummy variable indicating whether the firm is located in an industrial zone. Finally, industry effects are controlled by the technological gap (*TECHGAP*), measured by the percentage difference between the average productivity of the foreign firms and that of domestic firms in the same industry; and market concentration is measured by the Herfindahl index (*HERFINDAHL*), which is calculated by the sum of squared market shares in a 4-digit industry.

Table 1 reports summary statistics, while Table 2 presents the correlation matrix of the main explanatory variables. All correlations in Table 2 are well below 0.5, indicating that multicollinearity is not a serious problem in our analysis. The description of the main variables, including variable names, definitions and sources of data, are presented in Table A2 of the Appendix.

4.3. Estimation strategy

Equations (1) and (2) are derived from a two-stage decision process by firms. In stage one, a firm chooses whether to conduct R&D to maximize its profit, and in stage two, it decides how much to spend on R&D, if it has decided to innovate. Solving the two-stage problem backward, one can derive the optimal R&D expenditure as a function of a set of right-hand-side variables (Equation (2)). In stage one, the firm compares the profits with and without R&D. Assuming the profit difference is a standard normal random variable, conditional on the right-hand-side variables, one can derive the probability of conducting R&D as Equation (1). Note that R&D status (RDD_{ijdt-1}) in the previous period can be correlated with the random component of the profit function, which is then integrated out to derive the probability.

Table 4
FDI presence and the probability of R&D investment: the role of institutions.

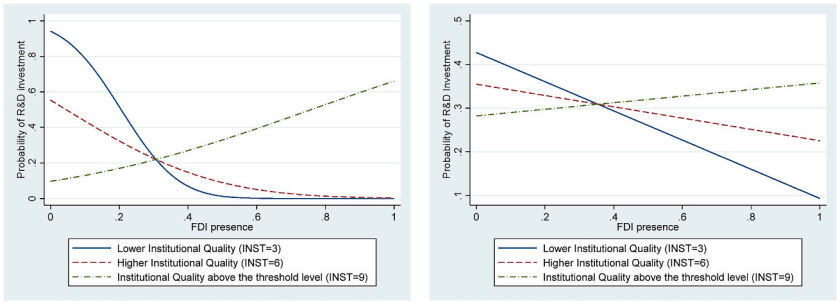
	Probit		IV-Probit		IV-2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)
FDI	−1.689*	−3.220***	−11.529***	−12.296***	−0.647***	−0.539***
	(0.926)	(1.081)	(1.672)	(1.934)	(0.198)	(0.174)
FDI* × *INST	**0.171**	**0.337****	**1.380*****	**1.557*****	**0.070****	**0.068****
	(0.136)	**(0.154)**	**(0.497)**	**(0.569)**	**(0.029)**	**(0.027)**
INST	0.012	0.034	−0.404**	−0.478**	−0.024**	−0.024**
	(0.050)	(0.055)	(0.205)	(0.219)	(0.011)	(0.012)
Lag RDD	0.818***	0.509*	0.520**	0.336	0.093**	0.072
	(0.271)	(0.282)	(0.255)	(0.263)	(0.046)	(0.045)
ROA		−0.154		0.029		0.004
		(0.262)		(0.174)		(0.005)
FIRMSIZE		0.212***		0.153***		0.005**
		(0.068)		(0.052)		(0.002)
FIRMAGE		−0.028*		−0.022**		−0.0005**
		(0.014)		(0.011)		(0.0002)
GENDER		0.097		−0.033		−0.004
		(0.168)		(0.115)		(0.005)
AGE		−0.006		−0.001		−0.0001
		(0.007)		(0.005)		(0.0002)
HUMANCAP		0.058		0.132		0.0031
		(0.219)		(0.143)		(0.004)
LSKILL		2.463***		2.152***		0.205**
		(0.722)		(0.816)		(0.080)
EXPORT		0.566**		0.221		0.027*
		(0.237)		(0.195)		(0.016)
ZONE		−0.017		0.027		0.0002
		(0.248)		(0.169)		(0.015)
HERFINDAHL		−19.855**		4.419		0.097
		(9.806)		(8.645)		(0.098)
TECHGAP		−0.074		−0.287***		−0.015**
		(0.109)		(0.083)		(0.007)
Year dummies	Y	Y	Y	Y	Y	Y
Industry dummies	Y	Y	Y	Y	Y	Y
Region dummies	Y	Y	Y	Y	Y	Y
Cragg-Donald Wald F statistic			9.705	10.710	10.196	10.710
Stock-Yogo critical value at 10%			7.77	7.77	7.77	7.77
Underidentification test			53.362***	58.776***	63.685***	58.776***
Overidentification test			0.920	1.125	0.432	1.125
Endogeneity test			34.25***	28.51***	19.728***	14.845***
Observations	3115	3101	3115	3101	3244	3228

Note: This table reports the estimation results of the impact of FDI presence on the probability of R&D investment by SMEs, taking into account the moderating role of institutions. FDI presence in a given manufacturing industry is instrumented by the FDI presence in two service industries in a non-neighbouring region. Institutions are instrumented by *TENURE* and *SWITCH*. Robust standard errors are in parentheses. The marginal effects of the IV-Probit model (Column 4) are reported in Column 1 of Table A3 of the Appendix. The first stage regression results are reported in Table A4 of the Appendix. Constants are excluded for brevity. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

Equation (1) naturally leads to the maximum likelihood estimation method, where we first assume the exogeneity of the right-hand-side variables. However, FDI and institutions can be endogenous. Foreign firms are more likely to enter industries with high innovation performance (Ito et al., 2012; Wang & Kafouros, 2009). This entry decision may partially contribute to the observed positive correlation between FDI presence and R&D activities in the industry, leading to an upward bias in the estimation of FDI spillovers. Institutions can also be endogenous due to the reverse causality from R&D investment to institutions. Arguably, with profits from R&D projects, firms can collectively put upward pressure on the government to enhance institutional quality (Tran, 2019). In addition, other uncontrolled factors that influence institutions and/or FDI presence may lead to a correlation between institutions/FDI and the error term.

We use instrumental variables to address the endogeneity issue. An appropriate instrumental variable (IV) needs to be correlated with the endogenous variable, and uncorrelated with the error term. In this research, we follow the approach proposed by Nguyen et al. (2019), and instrument FDI presence in a manufacturing industry *j* in region *d* by the output share of FDI in two service industries in a region not adjacent to region *d*. It is reasonable to expect a correlation between FDI in manufacturing industries and FDI in service industries, since national competitive advantages, such as cheap labour, growing market, and policy incentives, affect FDI in both sectors (Nguyen et al., 2019). On the other hand, FDI presence in an unrelated service industry in a non-neighbouring region is unlikely to directly affect R&D investment of domestic firms in the manufacturing sector.

Institutional variables are instrumented by the characteristics of the provincial leader - the Secretary of the provincial Communist party committee. Previous literature suggests a potential association between institutional quality and provincial leader characteristics, such as leadership tenure (Tran, 2019), frequency of turnover (Nguyen et al., 2018), education (Svensson, 2005) and leader



a. Visualising the result of the IV-Probit model **b.** Visualising the result of the IV-2SLS model

Fig. 4. Relationship between FDI presence and the probability of R&D investment of SMEs at different levels of institutional quality.

origin (Nie & Wang, 2016). Therefore, we employ the following IVs: *TENURE* - the tenure of the provincial leader as months in position; *SWITCH* - the turnover of the provincial leader which is a dummy variable indicating whether there is a leader switch in a given year; *HIGHEDU* - the educational level of the provincial leader which is a dummy variable taking the value of one if the leader holds a postgraduate degree; *NONLOCAL* - a dummy variable indicating whether the leader originates from a different province. Importantly, since the appointment of provincial leaders in Vietnam complies with the direction, guidance and procedures set out by the central government, their characteristics are unlikely to be correlated with the error term.

With the instruments, we then use the maximum likelihood estimation to estimate Equation (1). In addition, the two-stage least squares (2SLS) approach is employed to estimate a linear probability model as a robustness check. We perform several diagnostic tests to ensure the validity of our instruments, including the endogeneity test, the overidentification test (Hansen J statistic) for overidentifying restrictions, and the underidentification test (Kleibergen-Paap rk LM statistic). We also test for weak instruments using the critical value (at 10%) for first-stage F-statistic provided by Stock and Yogo (2005).

For Equation (2), taking expectation at both sides of the equation, conditional on the instruments of FDI and institutions and the exogenous right-hand-side variables (excluding RDD_{ijdt-1}), we can derive a set of moment conditions which in turn leads to the generalised method of moments (GMM) estimation. Note firms' R&D status in the previous period (RDD_{ijdt-1}) is correlated with the error term due to unobserved firm fixed effects, resulting in RDD_{ijdt-1} being endogenous. By taking expectation (integration), we have $E\left[RDD_{ijdt-1}|Z\right] = Pr\left(RDD_{ijdt-1} = 1|Z\right)$ where Z denotes the instruments and exogenous right-hand-side variables. Hence, from the estimation of Equation (1), we predict the lagged probability of conducting R&D and plug it into the GMM estimation of Equation (2). Such a two-step procedure allows us to control the endogeneity of RDD_{ijdt-1}. The standard errors in Equation (2) estimation are bootstrap standard errors, to account for the fact that the predicted probability contains estimation errors in Equation (1).

5. Empirical results

5.1. FDI and R&D investment

We first estimate the direct effect of FDI presence on R&D investment of domestic SMEs before taking into account the moderating effects of institutions. Table 3 presents the estimation results of Equations (1) and (2) without the institutional variable (*INST*) and its interaction term with FDI (*INST* × *FDI*). FDI presence is proxied by the output share of horizontal FDI in a given industry. Columns 1–3 examine the effect of FDI on SMEs' probability of conducting R&D based on Equation (1). Column 1 reports the result of the Probit model which assumes the exogeneity of all explanatory variables, while the IV-Probit model is used in Column 2 and IV-Two-stage least squares (IV-2SLS) in Column 3 to address the endogeneity issue of FDI and institutions. It is worth noting that the use of industry fixed effects in the Probit and IV-Probit models drops all observations with no within-industry variation in R&D status (*RDD*), leading to a considerably smaller sample size. To ensure the results are comparable across different estimation methods, we create a sub-sample by excluding industries with values of all 0 or all 1 for *RDD* and use this sample to estimate the IV-2SLS model in Column 3. As shown in Table 3, the coefficients of *FDI* are negative and statistically significant throughout Columns 1 to 3, indicating that FDI adversely affects the R&D probability of domestic SMEs.

Finally, Column (4) presents the estimation results of Equation (2) using IV-GMM estimation. The coefficient of *FDI* is negative and statistically significant, suggesting a negative impact on R&D expenditure of domestic SMEs.

The results from Table 3 are in line with prior studies which confirm the negative crowding-out effects of FDI on domestic firms' R&D activities (see e.g. Anwar & Sun, 2014; Cheung & Lin, 2004; Huang & Zhang, 2020), although alternative explanations exist. That is, the low absorptive capacity of SMEs may prevent them from efficiently exploiting FDI technological spillovers, while the intensified foreign competition may also reduce their incentive to launch R&D projects due to a large innovation gap. In addition, SMEs with disadvantages in economies of scale and low market power may easily be crowded out by foreign firms in the product, labour and financial markets, leading to the depletion of resources necessary for R&D investment.

Table 5
FDI and R&D expenditure of domestic SMEs: the role of institutions.

	No controls	Controls included
	(1)	(2)
FDI	−0.311*	−0.334**
	(0.167)	(0.164)
FDI* × *INST	**0.136****	**0.099****
	(0.053)	**(0.048)**
INST	−0.060***	−0.051**
	(0.019)	(0.020)
Lag RDD	0.062*	0.036
	(0.035)	(0.038)
ROA		0.017*
		(0.009)
FIRMSIZE		0.021***
		(0.008)
FIRMAGE		−0.0008*
		(0.0005)
GENDER		0.014
		(0.015)
AGE		−0.0002
		(0.0005)
HUMANCAP		0.003
		(0.010)
LSKILL		0.005
		(0.205)
EXPORT		0.128***
		(0.050)
ZONE		−0.061
		(0.037)
HERFINDAHL		−0.090
		(0.199)
TECHGAP		−0.007
		(0.032)
Year dummies	Y	Y
Industry dummies	Y	Y
Region dummies	Y	Y
Cragg-Donald Wald F statistic	8.721	8.618
Stock-Yogo critical value at 10%	7.77	7.77
Underidentification test	52.342***	51.937***
Overidentification test	0.142	0.362
Endogeneity test	8.850**	7.082*
Observations	3300	3278

Note: This table reports the estimation results of the impacts of FDI presence on R&D expenditure (in natural logarithm) of SMEs, taking into account the moderating role of institutions. We control for endogeneity bias by instrumenting FDI presence in a given manufacturing industry by FDI presence in two service industries in a non-neighbouring region. *Lag RDD* is replaced by its predicted value obtained from equation (1). Institutions are instrumented by *HIGHEDU* and *NONLOCAL*. The first stage regression results are reported in Table A5 of the Appendix. Bootstrapped standard errors are in parentheses. Constants are excluded for brevity. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

5.2. FDI, institutions and the probability of R&D investment

Table 4 presents the estimation results of Equation (1) to estimate the moderating effect of institutions on the relationship between FDI and the probability of R&D investment of domestic SMEs. FDI presence is proxied by the output share of horizontal FDI in a given industry. Columns 1–2 report the results of the Probit model which assumes the exogeneity of all explanatory variables, while the two specifications of the IV-Probit model in Columns 3–4 and the two specifications of the IV-Two-stage least squares (IV-2SLS) model in Columns 5–6 are used to address the endogeneity issue of FDI and institutions. In each set of estimations, we start with a minimum specification and then add the control variables to test the sensitivity to different specifications.

As shown in Table 4, the coefficients of the interaction term *FDI* × *INST* are positive and statistically significant (except for Column (1)), indicating a complementarity between *FDI* and *INST* in influencing an SME's likelihood of conducting R&D. That is, at a given level of FDI presence, SMEs in provinces with higher institutional quality have a higher probability of engaging in R&D investment, and *vice versa*.

This result provides support for Hypothesis 1 that institutions positively moderate the impact of FDI on SME's R&D investment. Arguably, more developed institutions may promote the foreign investors' incentive and ability to create technological spillovers, leading to a higher possibility of technological spillovers in the local market (Gorodnichenko et al., 2014; Wang et al., 2013; Yi et al., 2015). Regarding domestic SMEs, strong institutions allow these firms to spend the resources on developing the absorptive capacity for

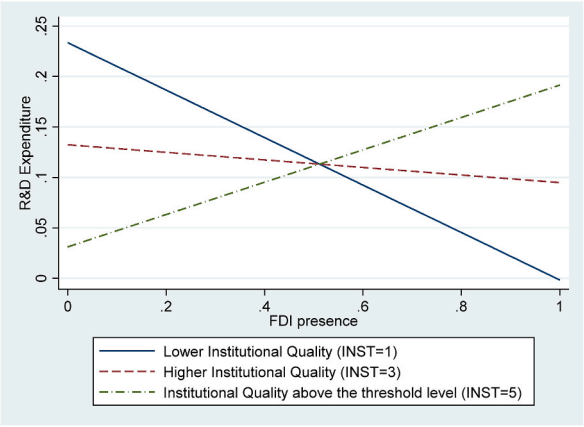


Fig. 5. Relationship between FDI presence and R&D expenditure of SMEs at different levels of institutional quality.

foreign technologies rather than coping with institutional constraints. In addition, the vertical linkages between foreign firms and domestic firms are strengthened in a better institutional environment, which fosters technological transfer and knowledge sharing (Yi et al., 2015; Zhang, 2019).

From Column 6 of Table 4, the marginal impact of *FDI* can be derived as $\frac{\partial Pr(RDD=1)}{\partial (FDI)} = -0.539 + 0.068 \times INST$, which is positive when *INST* is greater than 7.926. In other words, *ceteris paribus*, the impact of FDI on the R&D probability of domestic SMEs is positive when the quality of institutions is higher than 7.926 points. Below this threshold, FDI reduces the probability of domestic SMEs engaging in R&D investment. Fig. 4 a (IV-probit) and b (IV-2SLS) illustrate this point by plotting the probability of R&D investment against FDI presence at different levels of institutional quality. Further differentiating the marginal impact of FDI with respect to institutions, we obtain the moderating effect of institutions as $\frac{\partial^2 Pr(RDD=1)}{\partial (FDI)\partial (INST)} = 0.068$, namely a one-unit increase in institutional quality raises the marginal impact of FDI on an SME's R&D probability by 6.8%.

5.3. FDI, institutions and R&D expenditure

Table 5 presents the estimation results of Equation (2) using IV-GMM estimation to examine how institutions moderate FDI impact on the R&D expenditure of domestic SMEs. Similar to Table 3, horizontal FDI is employed to measure FDI presence in a given industry. We report the results of both minimum and full specifications in Columns 1 and 2, respectively. The coefficients of $FDI \times INST$ are positive and statistically significant in both Columns, which confirms the positive moderating effect of institutions on the relationship between FDI and R&D expenditure of domestic firms. That is, at a given level of FDI presence, SMEs in provinces with higher (lower) institutional quality have a higher (lower) level of R&D expenditure.

From Column 2 of Table 5, the marginal impact of *FDI* is $\frac{\partial (RDE)}{\partial (FDI)} = -0.334 + 0.099 \times INST$, which is positive when *INST* is greater than 3.374. That is, when the quality of institutions is higher than 3.374, FDI begins to exert a positive impact on R&D expenditure of domestic SMEs, *ceteris paribus*. Fig. 5 illustrates this point by plotting the R&D expenditure (in natural logarithm) against FDI presence at different levels of institutional quality. Further differentiating the marginal effect with respect to institutions, we obtain its moderation effect as $\frac{\partial^2 (RDE)}{\partial (FDI)\partial (INST)} = 0.099$. Specifically, a one-unit increase in the quality of institutions leads to a 9.9% increase in the marginal impact of FDI on SMEs' R&D expenditure.

Taken all together, the results of Tables 3 and 4 support Hypotheses 1 and corroborate the findings of previous literature that institutional development plays an important role in facilitating FDI technological spillovers in the host economy (Gorodnichenko et al., 2014; Krammer, 2015; Wang et al., 2013; Yi et al., 2015; Zhang, 2019), despite these studies do not explicitly explore FDI impact on domestic firms' innovation. Better institutions can promote the foreign investors' incentive and ability to create technological spillovers, mitigate FDI crowding-out effects, enhance domestic SMEs' absorptive capacity, and facilitate interaction and knowledge sharing in the local business environment.

The coefficient estimates for control variables are consistent with previous literature. Firms engaging in R&D in the prior period have a higher probability of investing in the current period, which confirms a persistent pattern in R&D investment of small firms as suggested by Manez et al. (2015). Firm size and export participation are positively associated with both R&D probability and R&D expenditure (as in Anwar and Sun (2014)). The skill level of the labour force promotes the probability of firms conducting R&D (as suggested by Lai et al. (2015)), while older firms tend to engage less in the activity (as in Banerjee & Gupta, 2021).[13] In addition,

[13] We also include the square of firm age in our specifications to test for the possibility of an inverted-U shape relationship between firm age and R&D investment as suggested by Fan and Wang (2021). The results do not confirm this proposition hence are not reported here for the sake of brevity.

Table 6
The role of institutional moderating effect and FDI origins.

	Dependent variable: *RDD*		Dependent variable: *RDE*	
	FDI from countries with low institutional quality	FDI from countries with high institutional quality	FDI from countries with low institutional quality	FDI from countries with high institutional quality
	(1)	(2)	(3)	(4)
FDI	−52.433**	−11.000***	2.706	−1.009**
	(20.886)	(1.557)	(1.661)	(0.461)
FDI* × *INST	**7.453**	**1.729*** **	**−0.392**	**0.146****
	(5.619)	**(0.467)**	**(0.434)**	**(0.065)**
INST	−0.143	−0.498**	−0.020**	−0.053**
	(0.188)	(0.212)	(0.008)	(0.022)
Lag RDD	0.351	0.364	0.023	0.001
	(0.294)	(0.265)	(0.018)	(0.031)
ROA	−0.090	−0.075	0.007	0.021*
	(0.209)	(0.199)	(0.015)	(0.013)
FIRMSIZE	0.165***	0.169***	0.020*	0.021**
	(0.050)	(0.061)	(0.011)	(0.009)
FIRMAGE	−0.024*	−0.024*	−0.001	−0.001*
	(0.012)	(0.012)	(0.001)	(0.001)
GENDER	0.110	0.019	−0.006	0.011
	(0.135)	(0.129)	(0.012)	(0.011)
AGE	−0.005	−0.002	0.00002	0.001
	(0.006)	(0.006)	(0.001)	(0.001)
HUMANCAP	−0.000	0.103	0.003	0.013
	(0.173)	(0.164)	(0.010)	(0.011)
LSKILL	2.148***	1.891**	−0.154	0.002
	(0.692)	(0.923)	(0.149)	(0.161)
EXPORT	0.388*	0.339	0.081*	0.116**
	(0.203)	(0.215)	(0.046)	(0.053)
ZONE	−0.094	0.020	−0.079**	−0.060*
	(0.206)	(0.198)	(0.037)	(0.034)
HERFINDAHL	−16.813**	−4.638	−0.353	0.009
	(8.407)	(9.938)	(0.276)	(0.219)
TECHGAP	−0.174*	−0.248***	0.017	0.035
	(0.089)	(0.094)	(0.028)	(0.030)
Year dummies	Y	Y	Y	Y
Industry dummies	Y	Y	Y	Y
Region dummies	Y	Y	Y	Y
Cragg-Donald Wald F statistic	8.460	10.839	7.865	8.349
Stock-Yogo critical value at 10%	7.77	7.77	7.77	7.77
Underidentification test	43.372***	58.927***	47.021***	49.396***
Overidentification test	4.096	4.975	6.151	3.931
Endogeneity test	9.67**	19.51***	6.292*	6.439*
Observations	3101	3101	3278	3278

Note: This table reports the estimation results on how institutions moderate the impact of FDI on R&D investments of domestic firms using alternative measures of FDI. In Columns 1–2, IV-probit model is used to estimate the impacts on the probability of R&D investment, and institutions are instrumented by *HIGHEDU* and *NONLOCAL*. In Columns 3-4, GMM is used to estimate the impacts for R&D expenditure (in natural logarithm), and institutions are instrumented by *TENURE* and *SWITCH*. FDI presence in a given manufacturing industry is instrumented by the FDI presence in two service industries in a non-neighbouring region. The marginal effects of the IV-Probit model (Columns 1 and 2) are reported in Columns 2 and 3 of Table A3 of the Appendix. The first stage regression results are reported in Table A6 of the Appendix. Robust standard errors are in parentheses. Constants are excluded for brevity. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

profitability measured by ROA is important to the expansion of R&D spending. We also find some evidence of the negative effect of technological gap on R&D investment of SMEs.

5.4. The role of institutional quality in the FDI origin

To test for Hypothesis 2 which distinguishes FDI inflows from countries with different levels of institutional development, we classify FDI origin into two groups: countries with higher institutional quality and those with lower institutional quality compared to Vietnam.[14] The country-level institutional measure comes from the Worldwide Governance Indicators provided by the World Bank. This data source has a large country coverage and has been the most widely used in literature to measure the variation in institutional

[14] The list of countries in the two groups is presented in Table A8 of the Appendix.

Table 7
Alternative measures of FDI.

	Dependent variable: *RDD*			Dependent variable: *RDE*		
	Forward FDI	Backward FDI	FDI index	Forward FDI	Backward FDI	FDI index
	(1)	(2)	(3)	(4)	(5)	(6)
FDI	−19.913***	−24.246***	−15.046***	−1.756**	−1.555*	−1.098***
	(4.402)	(6.544)	(3.171)	(0.761)	(0.872)	(0.399)
FDI* × *INST	**2.042*** **	**2.478*** **	**2.842*** **	**0.368*** **	**0.314** **	**0.188** **
	(0.619)	**(0.627)**	**(0.553)**	**(0.131)**	**(0.133)**	**(0.092)**
INST	0.059	−0.472***	−0.558**	−0.081***	−0.082***	−0.064***
	(0.232)	(0.170)	(0.261)	(0.023)	(0.026)	(0.024)
Lag RDD	0.373	0.320	0.416	0.042	0.033*	0.021
	(0.259)	(0.283)	(0.262)	(0.027)	(0.020)	(0.025)
ROA	−0.160	−0.077	−0.091	0.020**	0.018	0.022**
	(0.193)	(0.233)	(0.206)	(0.010)	(0.011)	(0.011)
FIRMSIZE	0.142**	0.162***	0.180***	0.025***	0.024***	0.025***
	(0.060)	(0.055)	(0.051)	(0.008)	(0.007)	(0.009)
FIRMAGE	−0.022*	−0.018	−0.025**	−0.0003	−0.0004	−0.001*
	(0.011)	(0.013)	(0.013)	(0.000)	(0.001)	(0.0005)
GENDER	−0.004	0.047	0.045	0.007	0.006	0.010
	(0.145)	(0.141)	(0.136)	(0.015)	(0.013)	(0.013)
AGE	−0.002	−0.004	−0.002	−0.0001	−0.0002	−0.0003
	(0.005)	(0.006)	(0.005)	(0.001)	(0.001)	(0.001)
HUMANCAP	0.013	0.031	0.076	−0.001	−0.001	0.0002
	(0.158)	(0.181)	(0.172)	(0.008)	(0.010)	(0.010)
LSKILL	1.462	1.945**	1.705**	0.057	0.032	0.008
	(0.936)	(0.841)	(0.727)	(0.180)	(0.189)	(0.154)
EXPORT	0.448**	0.496**	0.355	0.117**	0.104**	0.116**
	(0.207)	(0.222)	(0.217)	(0.059)	(0.049)	(0.054)
ZONE	−0.124	−0.115	−0.086	−0.054	−0.050	−0.063*
	(0.192)	(0.211)	(0.209)	(0.050)	(0.041)	(0.036)
HERFINDAHL	−32.621***	−25.893***	−16.372*	−0.004	0.051	0.014
	(7.168)	(8.464)	(9.149)	(0.240)	(0.197)	(0.203)
TECHGAP	0.078	0.116	−0.197**	−0.020	−0.012	−0.010
	(0.105)	(0.114)	(0.090)	(0.034)	(0.030)	(0.034)
Year dummies	Y	Y	Y	Y	Y	Y
Industry dummies	Y	Y	Y	Y	Y	Y
Region dummies	Y	Y	Y	Y	Y	Y
Cragg-Donald Wald F statistic	14.602	17.393	14.602	18.448	14.619	19.797
Stock-Yogo critical value at 10%	7.77	7.77	7.77	7.77	7.77	7.77
Underidentification test	95.880***	104.563***	95.880***	105.402***	81.210***	119.393***
Overidentification test	2.954	3.687	2.954	0.710	0.599	0.184
Endogeneity test	16.86***	8.39**	15.21***	9.874**	8.860**	6.982*
Observations	3101	3101	3101	3278	3278	3278

Note: This table reports the estimation results on how institutions moderate the impact of FDI on R&D investments of domestic firms using alternative measures of FDI. In Columns 1–3, IV-probit model is used to estimate the impacts on the probability of R&D investment, and institutions are instrumented by *HIGHEDU* and *NONLOCAL*. In Columns 4–6, GMM is used to estimate the impacts for R&D expenditure (in natural logarithm), and institutions are instrumented by *TENURE* and *SWITCH*. FDI presence in a given manufacturing industry is instrumented by the FDI presence in two service industries in a non-neighbouring region. The marginal effects of the IV-Probit model (Columns 1–3) are reported in Columns 4–6 of Table A3 of the Appendix. The first stage regression results are reported in Table A7 of the Appendix. Robust standard errors are in parentheses. Constants are excluded for brevity. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

quality across countries (see, e.g., Godinez & Liu, 2015; Krammer, 2015; Omri, 2020). We re-estimate our models for FDI from the two groups of countries and present the results in Columns 1–4 in Table 6. Specifically, Columns 1–2 report the results of Equation (1) using the IV-Probit model to estimate the impacts on the probability of R&D (*RDD*), whereas Columns 3–4 present the results of Equation (2) using the IV-GMM estimation and the natural logarithm of R&D expenditure (*RDE*) as the dependent variable.

The coefficients of *FDI* × *INST* are not statistically significant in Columns 1 and 3, but positive and significant in Columns 2 and 4. This indicates that the institutional impacts are less pronounced for FDI from countries with lower institutional quality compared to that from countries with higher institutional quality, thereby confirming Hypothesis 2. The finding reinforces the proposition that FDI experiencing low institutional quality at home are familiar with institutional weakness and therefore less susceptible to institutional impacts in the host economies (Cuervo-Cazurra, 2006; Godinez & Liu, 2015).

5.5. Alternative measures of FDI

In our baseline results presented in Tables 3 and 4, FDI presence is proxied by the output share of horizontal FDI in a given industry in a given region. In fact, the technological spillovers between FDI and domestic SMEs may also occur via vertical linkages. Therefore,

in this subsection, we check the sensitivity of our main results by using alternative measures of FDI presence, including forward FDI, backward FDI and a composite FDI index that captures both horizontal and vertical channels. The calculation of forward FDI and backward FDI is presented in subsection 4.2. The composite FDI index is constructed by using principal component analysis.

The estimation results are presented in Table 7. Specifically, Columns 1–3 report the results of Equation (1) using the IV-Probit model to estimate the impacts on the probability of R&D (*RDD*), whereas Columns 4–6 present the results of Equation (2) using the IV-GMM estimation and the natural logarithm of R&D expenditure (*RDE*) as the dependent variable. The coefficients of $FDI \times INST$ are positive and statistically significant in all columns, suggesting that our main results are robust to alternative measures of FDI presence.

6. Discussion and conclusion

This paper sheds light on understanding the impacts of FDI on R&D investment of domestic firms by highlighting the moderating effects of local institutions and focusing on SMEs in the context of Vietnam. Previous studies have not thoroughly considered the role of institutional idiosyncrasies in emerging markets to explain FDI spillovers, nor have they focused on SMEs whose low absorptive capacity, large technological gap, lack of economies of scale and low market power set them apart from large firms in terms of the likelihood of FDI spillovers.

Combining the largest enterprise survey in Vietnam and a survey specifically designed for SMEs, our empirical analysis is based on a large panel dataset of more than 2500 manufacturing SMEs in Vietnam from 2011 to 2015. We utilise the IV approach to address the potential endogeneity of FDI and institutions. We find that institutions positively moderate the effect of FDI on the R&D probability and R&D spending of domestic SMEs. Specifically, as institutional quality increases, the negative impacts of FDI decrease, and when the institutional quality reaches a threshold level, FDI encourages R&D investment of SMEs. Finally, we show that the institutional moderating effects are more pronounced for FDI from countries with higher institutional quality than FDI from countries with lower institutional quality.

By confirming institutions as a significant moderator of FDI spillovers to the R&D investment of domestic firms, we argue that ignoring institutional factors may contribute to the mixed findings in past literature. Therefore, this paper encourages future research to incorporate institutions into FDI spillovers research, especially in the context of emerging economies.

SMEs often constitute a major part of the private sector in emerging countries, hence the negative effect of FDI on the R&D effort of SMEs is concerning to policymakers who try to encourage FDI inflows. Consequently, understanding the transmission mechanisms between FDI inflows and domestic SMEs' R&D efforts is of importance. We focus on institutional quality, which is a factor in the interplay between FDI inflow and SME's R&D efforts, over which policymakers have some control and find that the quality of the institutional setting is instrumental in reversing negative FDI spillover effects on domestic SMEs' R&D efforts into positive spillover effects. Therefore, measures to enhance the institutional quality should be implemented hand-in-hand with policy incentives given to encourage FDI, in order to fully capture beneficial FDI spillovers to domestic SMEs while mitigating its negative impacts.

FDI inflows originating from developed countries with stronger institutions often incorporate more advanced technological resources (Bhaumik et al., 2016; Javorcik, 2004). These types of FDI have a higher potential for R&D spillovers. However, as suggested by our findings, FDI from countries with relatively higher institutional quality are more susceptible to local institutional arrangements. These FDI inflows can do more harm than good, while they can create significant spillovers in more conducive institutional environments if the institutions are less developed. In the context of Vietnam, the country's FDI policies have placed strong emphasis on attracting FDI in high-tech industries through various tax and land use incentives.[15] Therefore, to encourage R&D spillovers from FDI in high-tech industries, Vietnam should promote institutional quality with a focus on provinces that are receiving large proportions of FDI from institutionally developed countries, such as Vinh Phuc, Bac Ninh, An Giang, Quang Ninh, Ho Chi Minh, Ha Noi, Da Nang, Lam Dong, Hue, Ninh Thuan, Son La, Gia Lai, Ca Mau.

In addition, our findings hold significant implications for domestic firms seeking to promote their R&D activities in the context of FDI presence. It is imperative for domestic firms, particularly SMEs, to recognize and address the potential negative crowding-out effects of FDI, which could impede their capacity for R&D investment. A viable strategy for these incumbents involves enhancing their absorptive capacity to foreign technologies and advocating for institutional reforms within their local environment. The empirical analysis of control variables reveals that certain firm-specific characteristics of domestic SMEs exert a direct influence on their R&D investments. Specifically, augmenting total assets, acquiring highly qualified personnel, engaging in export activities and establishing a presence in industrial zones empower domestic SMEs to strengthen their inherent R&D capabilities, thereby mitigating the potential adverse impacts of foreign competition.

[15] This is one the of main objectives specified in the Resolution No. 50-NQ/TW dated 20th August 2019 of the Politburo on improvement of regulations and policies to enhance the quality and efficiency of foreign direct investment by 2030. Specifically, the government shall take initiative to promote selective attraction and cooperation in foreign investment. Selection criteria shall be based on quality, investment efficiency, technology and environmental protection. The priority shall be given to projects that adopt advanced, emerging, or clean technologies, apply modern management methods, have high value-added, and have positive spillover effects on global supply chains. The expected percentages of enterprises that meet environmental requirements and adopt advanced technology and modern management methods compared with those in 2018 are 50% and 100% in 2025 and 2030, respectively. In addition, according to the Law on investment 2020 No. 61/2020/QH14 of the National Assembly, investment incentives given to high-tech projects include: corporate income tax incentives; exemption from import tax on goods imported to form fixed assets, raw materials, supplies and components for manufacturing purposes; exemption from and reduction of land levy and land rents; accelerated depreciation that increases the deductible expenses upon calculation of taxable income.

This study has several limitations, which can serve as avenues for future research. First, given the current focus is on SMEs, future research can compare the moderating effect of institutions on FDI spillovers between small and large firms to draw relevant policy recommendation. Second, this paper adopts a single composite index to measure the overall quality of institutions in the host economy. Future studies can examine the relative importance of different institutional aspects in influencing FDI spillovers on innovation of domestic firms. Third, although R&D investment is a widely used measure of innovation, further analysis is needed to consider the innovation outputs of domestic SMEs, such as product innovation and process innovation.

Data availability

Data will be made available on request.

Appendix

Table A1
Definition and principal component analysis of nine institutional sub-indices

Components	Definition	Factor 1	Factor 2	Factor 3
Entry cost	low entry costs for business start-up	0.264	0.329	−0.545
Land access	easy access to land and security of business premises	0.401	−0.025	0.372
Transparency	a transparent business environment and equitable business information	−0.159	0.647	0.142
Time cost	limited time requirements for bureaucratic procedures and inspections	0.253	0.542	0.212
Control of corruption	low level of informal payment to local public officials	0.449	0.124	0.049
Proactivity	proactive and creative provincial leadership in solving problems for enterprises	0.203	−0.266	0.523
Business support	developed and high-quality business support services	−0.382	0.224	0.110
Labour trainning	sound labor training policies	−0.405	0.169	0.435
Rule of law	fair and effective legal procedures for dispute resolution	0.358	0.117	0.149
Percent of variance (%)		36.96	17.93	14.18
Cumulative (%)		36.96	54.89	69.07

Table A2
Variable description

Variables	Description	Data source
RDD	A dummy variable taking the value of 1 if the firm engages in R&D investment, and 0 otherwise	SME survey
RDE	Natural logarithm of real R&D expenditure	SME survey
FDI_H	Horizontal FDI presence	GSO
FDI_B	Backward FDI presence	GSO
FDI_F	Forward FDI presence	GSO
INST	Institutional quality index	PCI survey
ROA	The ratio of net profit to total assets	SME survey
FIRMSIZE	Natural logarithm of total asset	SME survey
FIRMAGE	Firm age which is the difference between the survey year and year of establishment	SME survey
GENDER	Dummy variable, equals 1 if the SME's owner/manager is a male, and 0 otherwise	SME survey
AGE	Age of SME's owner/manager	SME survey
HUMANCAP	Dummy variable, equal 1 if the educational level of the SME's owner/manager is upper secondary or above, 0 otherwise	SME survey
LSKILL	The proportion of professional employees with qualifications	SME survey
EXPORT	Dummy variable, equal 1 if the firm is an exporter, and 0 otherwise	SME survey
ZONE	Dummy variable, equal 1 if the firm is located in an industrial zone, and 0 otherwise	SME survey
HERFINDAHL	Herfindahl index for market concentration	GSO
TECHGAP	Percentage difference between the average productivity of foreign firms and that of domestic firms in the same sector	GSO

Table A3
Marginal effects

	Horizontal FDI	FDI from countries with low institutional quality	FDI from countries with high institutional quality	Forward FDI	Backward FDI	FDI index
	(1)	(2)	(3)	(4)	(5)	(6)
INST = 1	−0.012	−15.600	−0.011	−4.564	−7.427	−0.952
INST = 2	−0.012	−13.114	−0.011	−2.338	−6.305	−0.556
INST = 3	−0.011	−10.588	−0.010	−0.948	−5.236	−0.288
INST = 4	−0.010	−8.021	−0.008	−0.303	−4.233	−0.119
INST = 5	−0.009	−5.416	−0.005	−0.076	−3.302	−0.019
INST = 6	−0.007	−2.773	−0.002	−0.015	−2.450	0.032
INST = 7	−0.004	−0.095	0.003	−0.002	−1.683	0.054
INST = 8	0.0005	2.618	0.010	0.000	−1.002	0.057
INST = 9	0.006	5.365	0.018	0.000	−0.407	0.051

(*continued on next page*)

Table A3 (*continued*)

	Horizontal FDI	FDI from countries with low institutional quality	FDI from countries with high institutional quality	Forward FDI	Backward FDI	FDI index
	(1)	(2)	(3)	(4)	(5)	(6)
INST = 10	0.013	8.143	0.028	0.000	0.102	0.042

Notes: This table reports the marginal effects of FDI on the probability of SMEs' R&D investment at different levels of institutional quality for all IV-probit models (full specification) in the study. Other independent variables are at the sample average.

Table A4
First stage regression results of Table 3

Dependent variable:	IV-Probit			IV-2SLS		
	FDI	*FDI × INST*	*INST*	*FDI*	*FDI × INST*	*INST*
FDI_IV1	0.187***	0.900***	−0.689***	0.201***	1.035***	−0.647***
	(0.020)	(0.158)	(0.201)	(0.021)	(0.167)	(0.201)
FDI_IV2	0.022	−0.218**	−0.007	0.012	−0.291***	−0.002
	(0.015)	(0.087)	(0.109)	(0.015)	(0.087)	(0.108)
FDI_INST_IV1	−0.000	0.001	0.018***	−0.001*	0.001	0.017***
	(0.000)	(0.002)	(0.003)	(0.000)	(0.003)	(0.003)
FDI_ INST_IV2	0.014	−0.494*	−1.795***	−0.024	−0.794***	−1.957***
	(0.033)	(0.267)	(0.451)	(0.034)	(0.295)	(0.453)
TENURE	0.001***	0.001	−0.006***	0.001***	0.002	−0.005***
	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.002)
SWITCH	0.030**	0.416***	0.813***	0.045***	0.559***	0.868***
	(0.012)	(0.095)	(0.145)	(0.013)	(0.101)	(0.144)
Controls	Y	Y	Y	Y	Y	Y
Observations	3101	3101	3101	3228	3228	3228

Notes: This table reports the estimation results of the first stage regressions of Table 4. *FDI_IV1* and *FDI_IV2* are FDI presence in two service industries in a non-neighbouring region. *TENURE* is the tenure of the provincial leader measured by months in position, while *SWITCH* is a dummy variable indicating whether there is a leader switch in a given province in a given year. *FDI_INST_IV1* is the interaction term between *FDI_IV1* and *TENURE*. *FDI_INST_IV2* is the interaction term between *FDI_IV2* and *SWITCH*. Robust standard errors are in parentheses. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

Table A5
First stage regression results of Table 5

Dependent variable:	FDI	*FDI × INST*	INST
FDI_IV1	0.086***	−0.046	−0.279
	(0.022)	(0.145)	(0.172)
FDI_IV2	−0.082***	−0.259***	0.105
	(0.017)	(0.079)	(0.106)
FDI_INST_IV1	−0.057**	−0.218	0.182
	(0.023)	(0.144)	(0.192)
FDI_ INST_IV2	0.121***	0.500***	0.239
	(0.032)	(0.140)	(0.170)
HIGHEDU	−0.035***	−0.754***	−1.364***
	(0.013)	(0.112)	(0.154)
NONLOCAL	0.032*	0.494***	−0.145
	(0.019)	(0.130)	(0.176)
Controls	Y	Y	Y
Observations	3278	3278	3278

Notes: This table reports the estimation results of the first stage regressions of the full specification in Table 5. *FDI_IV1* and *FDI_IV2* are FDI presence in two service industries in a non-neighbouring region. *HIGHEDU* is the educational level of the provincial leader which is a dummy variable taking the value of one if the leader holds a postgraduate degree, while *NONLOCAL* is a dummy variable indicating whether the leader originated from another province. *FDI_INST_IV1* is the interaction term between *FDI_IV1* and *HIGHEDU*. *FDI_INST_IV2* is the interaction term between *FDI_IV2* and *HIGHEDU*. Bootstrapped standard errors are in parentheses. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

Table A6
First stage regression of Table 6

Dependent variable *FDI*	(1)	(2)	Dependent variable *FDI*	(3)	(4)
FDI_IV1	0.078***	−0.110***	*FDI_IV1*	0.033***	0.152***
	(0.016)	(0.021)		(0.008)	(0.018)
FDI_IV2	0.078***	−0.022	*FDI_IV2*	0.025***	−0.005
	(0.016)	(0.016)		(0.009)	(0.019)

(*continued on next page*)

Table A6 (*continued*)

Dependent variable *FDI*	(1)	(2)	Dependent variable *FDI*	(3)	(4)
FDI_INST_IV1	−0.001***	−0.000	*FDI_INST_IV1*	−0.039***	−0.003
	(0.000)	(0.000)		(0.009)	(0.020)
FDI_INST_IV2	−0.051***	0.025	*FDI_INST_IV2*	0.027**	−0.012
	(0.015)	(0.036)		(0.012)	(0.020)
TENURE	0.000**	0.000**	*HIGHEDU*	0.001	−0.032**
	(0.000)	(0.000)		(0.005)	(0.014)
SWITCH	0.002	0.023*	*NONLOCAL*	0.006	0.054***
	(0.002)	(0.013)		(0.008)	(0.016)
Control variables	Y	Y	*Control variables*	Y	Y
Observations	3101	3101	Observations	3278	3278
Dependent variable *FDI* × *INST*	(1)	(2)	Dependent variable *FDI* × *INST*	(3)	(4)
FDI_IV1	0.346***	−0.286**	*FDI_IV1*	0.225***	1.244***
	(0.064)	(0.134)		(0.057)	(0.133)
FDI_IV2	0.346***	−0.317***	*FDI_IV2*	0.134***	−0.155
	(0.064)	(0.089)		(0.039)	(0.106)
FDI_INST_IV1	−0.003***	−0.002	*FDI_INST_IV1*	−0.172***	−0.349**
	(0.001)	(0.002)		(0.059)	(0.162)
FDI_INST_IV2	−0.280***	−0.417	*FDI_INST_IV2*	0.050	0.462***
	(0.063)	(0.274)		(0.049)	(0.115)
TENURE	0.000	0.001	*HIGHEDU*	−0.012	−0.706***
	(0.000)	(0.001)		(0.021)	(0.098)
SWITCH	−0.005	0.408***	*NONLOCAL*	0.070	0.365***
	(0.011)	(0.098)		(0.044)	(0.113)
Control variables	Y	Y	*Control variables*	Y	Y
Observations	3101	3101	Observations	3278	3278
Dependent variable *INST*	(1)	(2)	Dependent variable *INST*	(3)	(4)
FDI_IV1	1.150***	1.437***	*FDI_IV1*	0.518***	0.555***
	(0.373)	(0.233)		(0.136)	(0.143)
FDI_IV2	1.150***	0.067	*FDI_IV2*	0.246***	0.028
	(0.373)	(0.108)		(0.087)	(0.102)
FDI_INST_IV1	−0.014***	−0.014***	*FDI_INST_IV1*	−0.406*	−0.615***
	(0.004)	(0.003)		(0.209)	(0.219)
FDI_INST_IV2	−2.805***	−1.725***	*FDI_INST_IV2*	−0.293*	0.366**
	(0.536)	(0.457)		(0.151)	(0.143)
TENURE	0.000	0.001	*HIGHEDU*	−1.040***	−1.225***
	(0.002)	(0.002)		(0.148)	(0.159)
SWITCH	0.998***	0.868***	*NONLOCAL*	−0.176	−0.236
	(0.156)	(0.147)		(0.159)	(0.173)
Control variables	Y	Y	*Control variables*	Y	Y
Observations	3101	3101	Observations	3278	3278

Notes: This table reports the estimation results on the first stage regressions of Table 6. *FDI_IV1* and *FDI_IV2* are FDI presence in two service industries in a non-neighbouring region. *TENURE* is the tenure of the provincial leader measured by months in position, while *SWITCH* is a dummy variable indicating whether there is a leader switch in a given province in a given year. In Columns 1 and 2, *FDI_INSTI_IV1* is the interaction term between *FDI_IV1* and *TENURE*, and *FDI_INSTI_IV2* is the interaction term between *FDI_IV2* and *SWITCH*. In Columns 3 and 4, *FDI_INST_IV1* is the interaction term between *FDI_IV1* and *HIGHEDU*, and *FDI_INST_IV2* is the interaction term between *FDI_IV2* and *HIGHEDU*. Robust standard errors are in parentheses. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

Table A7
First stage regression of Table 7

Dependent variable *FDI*	(1)	(2)	(3)	Dependent variable *FDI*	(4)	(5)	(6)
FDI_IV1	0.070***	0.046***	0.200***	*FDI_IV1*	0.007	−0.034***	−0.006
	(0.010)	(0.006)	(0.018)		(0.006)	(0.008)	(0.008)
FDI_IV2	0.032***	0.022***	0.009	*FDI_IV2*	0.077***	0.032***	−0.065***
	(0.005)	(0.004)	(0.007)		(0.011)	(0.009)	(0.007)
FDI_INST_IV1	−0.000***	−0.000***	−0.003***	*FDI_INST_IV1*	−0.009	−0.002	0.011
	(0.000)	(0.000)	(0.000)		(0.006)	(0.009)	(0.009)
FDI_INST_IV2	0.006	0.053***	0.037**	*FDI_INST_IV2*	−0.019	−0.004	−0.003
	(0.008)	(0.017)	(0.016)		(0.012)	(0.011)	(0.009)
TENURE	0.012***	0.001	0.010*	*HIGHEDU*	−0.015***	−0.012*	−0.032***
	(0.004)	(0.004)	(0.005)		(0.005)	(0.006)	(0.006)
SWITCH	−0.000	0.000	0.000***	*NONLOCAL*	0.010**	−0.002	0.021***
	(0.000)	(0.000)	(0.000)		(0.005)	−0.034***	(0.007)
Control variables	Y	Y	Y	*Control variables*	Y	Y	Y
Observations	3101	3101	3101	Observations	3278	3278	3278
Dependent variable *FDI* × *INST*	(1)	(2)	(3)	Dependent variable *FDI* × *INST*	(4)	(5)	(6)
FDI_IV1	0.532***	0.002	1.229***	*FDI_IV1*	−0.051	−0.197***	−0.135**

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Table A7 (*continued*)

Dependent variable *FDI*	(1)	(2)	(3)	Dependent variable *FDI*	(4)	(5)	(6)
	(0.080)	(0.048)	(0.120)		(0.044)	(0.047)	(0.067)
FDI_IV2	0.056*	0.491***	−0.124***	*FDI_IV2*	0.212***	0.075	−0.192***
	(0.034)	(0.035)	(0.041)		(0.045)	(0.047)	(0.044)
FDI_INST_IV1	−0.001	0.002**	−0.013***	*FDI_INST_IV1*	−0.130***	−0.117**	−0.058
	(0.001)	(0.001)	(0.001)		(0.046)	(0.053)	(0.066)
FDI_INST_IV2	−0.007	−0.504***	−0.236*	*FDI_INST_IV2*	0.093*	−0.108	−0.127**
	(0.049)	(0.073)	(0.129)		(0.056)	(0.068)	(0.053)
TENURE	−0.045*	0.066**	0.081*	*HIGHEDU*	−0.276***	−0.236***	−0.440***
	(0.026)	(0.029)	(0.044)		(0.035)	(0.049)	(0.053)
SWITCH	−0.004***	−0.004***	−0.001**	*NONLOCAL*	0.040	−0.040	0.200***
	(0.000)	(0.000)	(0.001)		(0.037)	(0.056)	(0.057)
Control variables	Y	Y	Y	*Control variables*	Y	Y	Y
Observations	3101	3101	3101	Observations	3278	3278	3278
Dependent variable *INST*	(1)	(2)	(3)	Dependent variable *INST*	(4)	(5)	(6)
FDI_IV1	1.182***	−0.675***	1.156***	*FDI_IV1*	−0.051	−0.176	−0.318*
	(0.272)	(0.194)	(0.269)		(0.044)	(0.167)	(0.167)
FDI_IV2	0.081	0.835***	0.087	*FDI_IV2*	0.212***	−0.172	−0.085
	(0.111)	(0.097)	(0.113)		(0.045)	(0.107)	(0.098)
FDI_INST_IV1	−0.011***	0.018***	−0.011***	*FDI_INST_IV1*	−0.130***	−0.037	0.260
	(0.003)	(0.003)	(0.003)		(0.046)	(0.182)	(0.176)
FDI_INST_IV2	−1.856***	−3.904***	−1.844***	*FDI_INST_IV2*	0.093*	0.101	0.154
	(0.457)	(0.526)	(0.458)		(0.056)	(0.169)	(0.175)
TENURE	0.839***	1.204***	0.838***	*HIGHEDU*	−0.276***	−1.294***	−1.397***
	(0.145)	(0.170)	(0.147)		(0.035)	(0.146)	(0.154)
SWITCH	−0.000	−0.004	−0.000	*NONLOCAL*	0.040	−0.306*	−0.132
	(0.002)	(0.002)	(0.002)		(0.037)	(0.163)	(0.172)
Control variables	Y	Y	Y	*Control variables*	Y	Y	Y
Observations	3101	3101	3101	Observations	3278	3278	3278

Notes: This table reports the estimation results on the first stage regressions of Table 7. *FDI_IV1* and *FDI_IV2* are FDI presence in two service industries in a non-neighbouring region. *TENURE* is the tenure of the provincial leader measured by months in position, while *SWITCH* is a dummy variable indicating whether there is a leader switch in a given province in a given year. In Columns 1 and 2, *FDI_INSTI_IV1* is the interaction term between *FDI_IV1* and *TENURE*, and *FDI_INSTI_IV2* is the interaction term between *FDI_IV2* and *SWITCH*. In Columns 3 and 4, *FDI_INST_IV1* is the interaction term between *FDI_IV1* and *HIGHEDU*, and *FDI_INST_IV2* is the interaction term between *FDI_IV2* and *HIGHEDU*. Robust standard errors are in parentheses. *,** and *** denote significant levels at 10%, 5% and 1%, respectively.

Table A8
List of home countries and regions

Countries and regions with higher institutional quality compared to Vietnam	
Country name	**Country code**
American Samoa	ASM
Anguilla	AIA
Argentina	ARG
Australia	AUS
Austria	AUT
Belgium	BEL
Belize	BLZ
Bermuda	BMU
Brazil	BRA
Brunei Darussalam	BRN
Bulgaria	BGR
Canada	CAN
Cayman Islands	CYM
Cyprus	CYP
Czechia	CZE
Denmark	DNK
Dominica	DMA
Estonia	EST
Finland	FIN
France	FRA
Germany, Federal Republic of	DEU
Greenland	GRL
Hong Kong SAR, China	HKG
Hungary	HUN
Iceland	ISL
India	IND
Indonesia	IDN
Ireland	IRL
Philippines	PHL
Poland	POL
Romania	ROU
Samoa	WSM
San Marino	SMR
Saudi Arabia	SAU
Serbia and Montenegro	SRB
Seychelles	SYC
Singapore	SGP
Slovakia	SVK
Slovenia	SVN
South Africa	ZAF
Spain	ESP
Sri Lanka	LKA
Sweden	SWE
Switzerland	CHE
Taiwan	TWN
Thailand	THA
Tonga	TON
Turkey	TUR
United Arab Emirates	ARE
United Kingdom	GBR
United States of America	USA
Uruguay	URY
Virgin Islands	VIR
Countries with lower institutional quality compared to Vietnam	
Country name	**Country code**
Afghanistan	AFG
Angola	AGO

(*continued on next page*)

Table A8 (*continued*)

Countries and regions with higher institutional quality compared to Vietnam		Philippines	PHL
Israel	ISR	Bangladesh	BGD
Italy	ITA	Cambodia	KHM
Japan	JPN	China	CHN
Jordan	JOR	Cuba	CUB
Korea, Republic of	KOR	Egypt	EGY
Liechtenstein	LIE	Guatemala	GTM
Luxembourg	LUX	Iran, Islamic Rep.	IRN
Macau	MAC	Iraq	IRQ
Malaysia	MYS	Kazakhstan	KAZ
Maldives	MDV	Korea, Dem. People's Rep. of	PRK
Malta	MLT	Kyrgyz Republic	KGZ
Mauritius	MUS	Lao PDR	LAO
Mongolia	MNG	Nepal	NPL
Netherlands	NLD	Pakistan	PAK
New Zealand	NZL	Russian Federation	RUS
Norway	NOR	Sudan	SDN
Panama	PAN	Ukraine	UKR

Note: Cross-country data on institutional development is retrieved from the World Governance Indicators (WGI) provided by the World Bank in 2015. The WGI data reflects the diverse views on institutional quality of stakeholders worldwide regarding six indicators: (*i*) Voice and accountability, (*ii*) Political stability and absence of violence/terrorism, (*iii*) Government Effectiveness, (*iv*) Regulatory quality, (*v*) Rule of law, and (*vi*) Control of corruption. We take the average of these indicators to construct a single institutional index that allows us to compare the overall institutional quality among countries, particularly countries that have FDI to Vietnam.

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