

National culture, institutional quality and firm R&D investment: Evidence from the Asia-Pacific IT industry

This paper investigates the effects of national culture and formal institutions on firm R&D investment from an institution-based perspective. Specifically, we investigate whether national culture affects the extent to which firms rely on the quality of formal institutions in making their R&D investment decisions. Using a panel of IT firms from the Asia-Pacific region, we find evidence that 1) the quality of formal institutions stimulates firm R&D after controlling for other potential determinants of R&D at firm and country level, and 2) this positive association is more pronounced for firms embedded in short-term oriented and individualistic cultures. This suggests that the impact of formal institutions on firm-level R&D may be contingent on the configuration of informal institutions in the firm's environment. Regarding practical implications, policymakers are made aware that national culture may affect the extent to which firms respond to institutional reforms aimed at stimulating R&D investment.

Keywords: National culture, formal institutional quality, intellectual property rights, R&D investment.

1. Introduction

Both policymakers and scholars have an enduring interest in understanding the factors that drive R&D investment decisions by firms. R&D investment is widely recognized as a critical lever that firms use to continuously improve their products, service and operations. Prior studies have also reported that R&D investment contributes to improving firm performance (Eberhardt, Helmers, and Strauss 2013; Gui-long et al. 2017, Yeh et al. 2010). While R&D is an essential component of the survival and growth of firms (Shefer and Frenkel 2005), R&D investment tends to fall well below the socially optimal investment level, mainly because firms do not appropriate all the returns from R&D and face severe constraints in raising external capital due to a high information asymmetry between investors and firms (Hall 2002). Therefore, there is a continuing research interest on the factors that may stimulate R&D investment decisions.

This paper embraces an institution-based perspective on firm-level R&D decisions (Peng 2002; 2003; Peng et al. 2009; Peng et al. 2023), assuming that the configuration of formal and informal institutions in the firm's environment and their interplay affects a firm's incentives to invest in R&D.

In recent years, a growing number of studies (e.g., Aldieri et al. 2020; Castellacci, Oguguo, and Freitas 2022; Della Malva and Santarelli 2016; Vlachos 2022; Lee, Wang, and Ho 2020; Xiao 2013; Xu 2020) have linked firm R&D investment to the quality of formal institutions, such as the functioning of rule-of-law

institutions, the strength of intellectual property rights (IPR) protection, government effectiveness and control of corruption. Recent research, however, suggests that the effectiveness of formal institutions in stimulating firm R&D may depend on the configuration of the informal institutions in the firm's environment – meant as the informal systems of shared meanings and collective understandings that concur to shape the firm-level strategic decisions (Brinkerink and Rondi 2021; Duran et al. 2019; Naveed and Shabbir 2022). Therefore, institution-based analyses of firm R&D should not limit themselves to the role of formal institutions, but should also account for the impact of informal institutions, if they are to provide a more fine-grained understanding of firms' innovation-relevant institutions.

This paper focuses on the role of national culture as an influential informal institution and investigates whether national culture affects the extent to which firms rely on the quality of formal institutions in their R&D resource allocation decisions. Specifically, we focus on the cultural dimensions of individualism and long-term orientation as conceptualized and operationalized by Hofstede, Hofstede, and Minkiv (2010), which have been shown to affect R&D investment at both firm and country level. Thus far, the effects of national culture and formal institutions on R&D have largely been examined as separate research streams but studies linking these two areas are still limited. This paper is an attempt to fill this gap.

To empirically examine our research question, we use a sample of information technology (IT) firms from developed countries in the Asia Pacific region, these including Australia, Hong Kong, Japan, New Zealand, the Republic of Korea and Singapore. We focus on IT firms because, as all high-technology firms, they find it more difficult to appropriate the value of their R&D investment because they tend to focus on product innovation, which is easier to imitate than process innovation (Brown, Martinsson, and Petersen 2017). High-tech R&D is also more subject to financing constraints due to more severe asymmetric information problems, greater uncertainty and the large scale of the required investment (Brown, Fazzari, and Petersen 2009). As such, the IT industry provides an interesting setting to assess whether formal and informal institutions influence firms' incentives to invest in R&D.

The decision to focus on developed Asia Pacific countries is motivated by the following reasons. First, according to the Global Innovation Index 2023, the developed countries in the Asia-Pacific region are in the top 30 innovation economies, where Singapore is 5th, Republic of Korea 10th, Hong Kong 17th, Japan 13th, Australia 24rd and New Zealand 27th position (WIPO 2023). According to the International Monetary Fund (IMF) Regional Economic Outlook report (2024), the Asia Pacific region was overall resilient and dynamic, and contributed to two third of the global growth in 2023. The growth in the developed countries is projected to be at 1.8 percent for 2025 in comparison to 1.7 percent in 2023.

Second, a recent study by the Organization for economic cooperations and development (OECD) and European Commission (Dernis et al. 2019) covering the top R&D corporate investors worldwide shows that Asian countries are leading technological developments in IT-related sectors, with two thirds of IT-related patents developed in Asia (e.g., approximately 43% in Japan and 10% in Korea). This study also shows that among the 50 top patenting companies the majority are headquartered in Asia. This

indicates the strong specialization of Asian economies in the development of IT innovations, which further motivates this selection of countries.

The empirical findings of this study add to the existing research in at least two respects. First, we provide fresh evidence that quality of formal institutions may stimulate firm R&D investment. Second, and perhaps more insightfully, we show that firms from long-term oriented cultures are less reliant on formal institutional quality in their R&D resource allocation decisions, while firms embedded in high individualistic cultures tend to invest more on R&D when the formal institutional framework is tighter. This finding extends previous research by providing evidence that national culture is a contingency factor that potentially moderates the effectiveness of formal institutions in stimulating firm R&D investment. On a broader theoretical level, this finding supports the notion at the core of the institutional perspective that formal and informal institutions conjointly influence firm behaviour (Peng et al. 2009), to such an extent that the same formal rules may lead to different investment choices depending on the configuration of informal institutions (North 2005) such as cultural values.

The remainder of this paper is organized as follows. Section 2 provides the theoretical background for this paper, which is grounded in the institution-based view of firm strategy, reviews prior empirical studies that have analysed the impact of formal institutions and national culture on firm-level R&D investments and develops the research hypotheses accordingly. Section 3 presents the methodology adopted for the study. Section 4 covers the overall results and discussion. Section 5, which concludes the paper, discusses the limitations of the study and outlines future research directions.

2. Theoretical background and hypotheses

This study takes an institution-based perspective on firm-level decisions to invest in R&D. In recent decades, the institution-based perspective has emerged as a leading perspective in management research (Peng 2002; 2003; Peng et al. 2009; Peng et al. 2023), fuelled by the broader new institutionalism movement thriving throughout the social sciences, pioneered by economists (North 1990; Williamson 2000) and sociologists (DiMaggio and Powell 1983; Scott 1987; 1995; 2008b). While the sociological perspective of new institutionalism mainly focuses on the need for organizations to adopt mimetic behaviour when confronting the institutional environment to gain legitimacy, the economic perspective led by the work of Douglass North under the label of new institutional economics (NIE) focuses on explaining why firms from a given industry and with a similar resource endowment make different decisions depending on the institutional environment that they face. Given our focus on the R&D investment decisions made by firms depending on the institutional context, we mainly refer to North's (1990) approach in defining institutions and their influence on the behaviour of economic players.

North (1990, 2005) defines institutions as 'the rules of the game' or 'humanly devised constraints' that structure political, economic and social interactions, including both formal rules such as constitutions, laws and property rights, and informal constraints such norms of behaviour, conventions and self-

imposed codes of a conduct. While formal institutions define the formal structure of incentives and constraints for economic players, their actual behaviour also depends on the informal structure of norms, conventions and codes of conduct that underlie and supplement formal rules, and also importantly on the effectiveness of their enforcement mechanisms. Thus, in the words of North (1991), institutions and their enforcement characteristics define 'the choice set' of economic actors determining transaction and production costs and therefore the profitability and feasibility of engaging in economic activity. According to this view, the most fundamental role of institutions is to reduce uncertainty and provide guidance for firm decision makers by conditioning the ruling norms of behaviours and defining the boundaries of what is legitimate (Peng et al. 2009).

Rooted in the NIE tradition, the institution-based view argues that firms make strategic choices such as R&D investment within the formal and informal constraints of the particular institutional environment confronting managers (Peng et al. 2009). Although the institution-based view argues that formal and informal institutions combine to govern firm behaviour, formal institutions have attracted far more research attention (Peng et al. 2023).

Studies linking institutional quality to R&D investment decisions describe several mechanisms through which the quality of formal institutions may affect firm R&D investment.

First, institutional quality in the form, e.g., of strong rule-of-law, government effectiveness and political stability may reduce the uncertainty and riskiness that are inherent in R&D investment (Alam, Uddin, and Yazdifar 2019; Aldieri et al. 2020; Castellacci, Oguguo, and Freitas 2022; Lee, Wang, and Ho 2020; Vlachos 2022).

Rule-of-law refers to the judicial strength of a country, which ensures strict enforcement of law and contracts. Strong rule-of-law provides an effective protection and enforcement of intellectual property rights (IPRs) and thus reduces the risk of IPRs infringement. Instead, in countries where the possibility to enforce contracts is low, the risk of opportunistic behaviours and leakage of proprietary knowledge to competitors is high (Seitz and Watzinger 2017) thus raising the overall riskiness associated with R&D investment.

Effective government (the quality of public services and policy formulation and implementation) may also incentivizes firms to invest in R&D (Jiao, Koo, and Cui 2015), particularly by providing direct support (grants) or fiscal incentives (Guceri and Liu 2019). Overall, an effective government is more credible in designing long-term innovation strategies as well as better able to target the right areas of investment and to implement the adequate measures to make these strategies effective (Rodríguez-Pose and Di Cataldo 2015; Zhou and Liu 2024).

Political stability creates further incentives for firms to engage in R&D because it ensures the continuation of government policies that promote R&D investment (Alam, Uddin, and Yazdifar 2019). As a risky and long-term investment, R&D is more sensitive to political uncertainty than other forms of corporate investment and this may lead firms to postpone R&D investments due to the uncertainties related to possible changes of government policies (Wang, Wei, and Song 2017). Furthermore, as recent

research suggests (Xu 2020), the instability of government economic policy increases firms' cost of capital, which may translate into lower investments in innovation.

A second but related mechanism linking institutional quality to firm-level R&D decisions relates to the possibility for innovating firms to reap the benefits of their R&D investment. In this respect, a strong system of intellectual property rights (IPRs), coupled with an efficient law enforcement system (strong rule-of-law), may contribute to strengthen the appropriability conditions related to R&D investments, by granting innovating firms a temporary monopoly over their inventions (Arrow 1962) and this provides them with the incentive to engage in R&D investment. Strong and enforceable IPRs not only protects innovators from rapid imitation but also allows them to partially appropriate the value generated by subsequent innovators building on their prospective technology through, for instance, future licensing fees (Andersen and Konzelmann 2008). Nevertheless, IPRs protection involves a trade-off between opportunity and appropriability (Arrow 1962; Nordhaus 1969; Laursen and Salter 2014). On the one hand, strong and enforceable IPRs regimes enable firms to internalize part of the spillovers that stem from R&D activities and hence provide incentives to engage in R&D even more intensively (Cohen and Levinthal 1990). On the other hand, stronger IPRs also induce firms to disclose the outcome of their R&D activities thus increasing the pool of knowledge available for third parties (Murray and Stern 2007). Horstmann et al. (1985) argue that, in the case of patented technology, the costs of disclosing the underlying knowledge can more than offset the private gains from IPR protection. Indeed, what stronger IPRs do is to make the commercial use of technological inputs more expensive because firms must pay licensing fees to employ patented technologies or copyrighted works. More precisely, the IPR holder has the right to exclude others from using the protected item but his or her action does not impede knowledge spillovers (Della Malva and Santarelli 2006). These arguments challenge the view that a strong IPR protection straightforwardly leads to increased R&D investments.

A firm's ability to appropriate the value of its R&D investment is also affected by the level of corruption in a given country, where corruption is typically defined as the abuse of public power or authority for private benefit (Rodriguez et al. 2006). Anokhin and Schuzle (2009) argue that corruption affects the magnitude of the rewards that can be earned from innovation, because innovating firms face increased risk that the agents involved in their value chain will behave opportunistically and appropriate profits to which the innovators are entitled. In other words, corruption as an institutional failure increases the transaction costs of R&D investment and erodes the potential value of its returns. Conversely, control of corruption should increase the likelihood that innovators will capture a higher portion of the value of R&D thus stimulating higher levels of this investment.

Third, institutional quality may relieve the difficulties to raise external finance for R&D investments. Financing constraints are particularly pronounced for R&D investment (Brown, Martinsson, and Petersen 2012). In particular, limited collateral value and asymmetric information between investors and firms may severely constrain access to external finance, keeping R&D investment well below the level that would have occurred in the absence of capital market imperfections (Arrow 1962; Hall 2002).

Good institutions may address this issue to some extent. A well-enforced IPR protection regime may help to raise external finance because it reduces the risk of infringement of IPR (resulting in investment losses) and thereby increases investor willingness to finance innovation (Brown, Martinsson, and Petersen 2017). Relatedly, strong rule-of-law helps to develop liquid financial market by reducing the magnitude of market imperfections caused by agency problems and the informational asymmetries between corporate insiders and investors (La Porta et al. 1997). This in turn affects investors' willingness to provide external financing to support firm-level R&D (Pindado, de Queiroz, and de la Torre 2015). Finally, institutional quality may affect corporate R&D investment through affecting the costs of agents' interactions within the innovation ecosystem (Castellacci, Oguguo, and Freitas 2022), **going beyond the issue of knowledge spillovers to competitors**. Since the innovation process involves interactions with a number of partners within and above the value chain, firms' incentives to innovate are influenced by the perceived (transaction) costs of interacting and contracting with external partners (such as innovation partners, suppliers, users and public research institutions) as well as by the possibilities to learn and appropriate value from their R&D activities. In countries where formal institutions that regulate and enforce contracts in case of legal disputes among partners are poor and ineffective, firms face higher transaction costs, as their innovation partners or technology suppliers have limited incentives to comply timely and according to stipulated quality standards. For instance, in the presence of poor formal institutions, there may arise informational asymmetries and hold-up problems between suppliers and producers, implying that suppliers may underinvest in relationship-specific assets. This, in turn, may affect firms' innovation incentives and performance. Conversely, good institutions foster an ecosystem that promotes innovation and protects the returns of R&D (Krammer 2015).

In sum, as North (2005) puts it, institutional quality may raise the benefits of cooperative solutions (or the costs of defections), increase the incentives to invent and innovate, and lower the costs of contract enforcement, thus making the economic environment more predictable and less uncertain.

2.1 Formal institutions and firm-level R&D: empirical evidence

Over recent decades, many empirical studies have documented that good formal institutions are conducive to R&D investment. However, much research has analysed the impact of institutional quality on R&D at the country level and at the industry level. Overall, these studies tend to support the notion that a higher institutional quality leads to increased investments on R&D, although this positive effect is not always consistent across industries and countries at different stage of economic development. For instance, studies have shown that stronger IPR protection and enforcement has a positive impact on R&D in developed countries but not in developing countries (e.g.: Ginarte and Park 1997; Sharma, Sousa, and Woodward 2022; Sweet and Maggio 2015; Yang, Huang, and Lin 2014). Furthermore, industry-level studies show that R&D investment increases with the quality of the judicial system, especially in industries that cannot buy inputs on competitive markets and thus depend more on contracts to acquire inputs (Seitz and Watzinger 2017).

Relatively less research has analysed the association between the quality of formal institutions and *firm-level* R&D investment (Castellacci, Oguguo, and Freitas 2022), although this research has been growing in recent years. These studies have generally confirmed the expectation that firms located in countries with high-quality institutions are more likely to engage in R&D. To name a few, Arora, Ceccagnoli, and Cohen (2008) show that patent protection stimulates R&D across all US manufacturing industries, especially in those industries where the ‘patent premium’ tends to be high such as drugs, biotech and medical instruments. Cho, Kim, and Shin (2015) also analyse the effect of IPR protection across industries using firm-level panel data in semiconductor, pharmaceutical and ship building industries in Korea, showing a positive impact of IPR protection on firm R&D, especially for large domestic companies with strong R&D capabilities.

Other recent studies have focused on China as the Chinese IPR protection system has been gradually improved in the past two decades. For instance, Li (2017) documents that the increased IPR protection has produced structural increases in the R&D investment of Chinese firms. However, studies also show there are significant variation in the enforcement of IPR protection across Chinese regions and that better enforcement of IPRs at local level plays an important role in encouraging and financing investment in R&D (Ang, Cheng, and Wu 2014; Fang, Lerner and Wu 2017).

Della Malva and Santarelli (2016) use data from transition countries in Eastern Europe and Central Asia and show that firms’ propensity to invest in R&D is higher in those countries which have strengthened their IPRs protection. Castellacci, Oguguo, and Freitas (2022), also using a sample of developing and transition economies across Europe, Asia, Africa, Caucasus and Latin America, find that the R&D propensity of firms is higher for those countries with sound political stability and efficient legal institutions. Finally, research by Vlachos (2022) shows that political stability, strong rule-of-law, government effectiveness and control of corruption play a key role in retaining the levels of firms’ R&D investment in developed countries during times of economic crisis.

The present research focuses on information technology (IT) firms from developed Asia-Pacific countries. As Brown, Martinsson, and Petersen (2017) point out, firms in high-technology industries such as IT find it more difficult to appropriate the value of their investment in innovation because they tend to focus on product innovation (easier to imitate than process innovation) and face more severe financial constraints due to higher information asymmetries, greater uncertainty and the large scale of the required investment. These researchers find that across OECD countries formal institutional quality is associated with differentially higher rates of R&D investment in high-tech industries. Taking stock of this empirical literature, we state our first hypothesis as follows:

H1: The quality of formal institutions increases the firm’s R&D investment.

2.2. The contingency role of national culture

The institution-based view also argues that when formal institutions are unclear or fail, informal institutions will play a larger role in reducing uncertainty, providing guidance and conferring legitimacy

and rewards to managers and firms (Peng et al. 2023). An implication of this argument is that firms may not always rely on strong formal institutions in making strategic choices such as R&D decisions because informal institutions may 'fill the void' left by poor formal institutions. The other core proposition of the institution-based view is that formal and informal institutions 'combine' to govern firm behaviour (Peng 2002; Peng et al. 2009), which suggests that formal and informal institutions may also act as complements in influencing firm strategic choices.

Together, these propositions suggest that the extent to which firms base their investment decisions on the quality of formal institutions may depend on the configuration of informal institutions, which together with the formal institutions and their enforcement mechanisms shape the overall institutional environment facing firms (North 1991). Informal institutions as embodied in norms, conventions and codes of conduct reflect shared mental models and collective belief systems, which are socially constructed over time and transmitted between generations as cultural values (North 2005). As such, informal rules tend to change much more slowly than formal rules, which are made and enforced by the polity and therefore can be altered overnight (North 2005). This is why the same formal rules imposed in different societies (cultures) may lead to dissimilar outcomes, due to the influence of informal rules of behaviour on the effectiveness of formal institutions. Thus, according to North, the reason why so many institutional reforms fail is because reformers focus on changing the formal rules of the game, but disregard informal constraints. He concludes that governments willing to promote economic growth must ensure that informal institutions favour the effectiveness of formal rules. In sum, the institution-based view of firm strategy as rooted in the new institutional economics suggests that the effectiveness of formal institutions in affecting strategic choices should not be considered in a contextual vacuum (Brinkerink and Rondi 2021; Duran et al. 2019) because it is likely to be contingent on the configuration of informal institutions in the firm's environment.

On this backdrop, this paper investigates whether national culture as an influential informal institution affects the extent to which firms rely on strong formal institutions in R&D investment decisions. Recent research shows that national culture may either fill the void left by poor formal institutions (Brinkerink and Rondi 2021) or even reinforce the R&D stimulating incentives created by strong formal institutions (Jayasekara and Fredriksson 2021; Saka-Helmhout, Chappin, and Vermeulen 2020). This study builds upon and extends this emerging line of research.

Following Hofstede (2001), we define national culture as 'the collective programming of mind' that reflects a country's "central tendencies in terms of values, beliefs, and preferences" (Hofstede, Hofstede, and Mink 2010). Specifically, we focus on the cultural traits of long-term orientation and individualism for which there is a theoretical rationale and some prior evidence to suggest that they may affect the impact of formal institutions on firms' R&D intensity.

2.2.1. Long-term orientation

Long-term orientation as a cultural value factor refers to a tendency to nurture virtues oriented to future rewards, whereas short-term orientation tends to promote virtues related to the past and the present (Hofstede, Hofstede, and Minkiv 2010). The values inherent in long-termism such as thrift and perseverance are argued to support innovation (Jones and Davis 2000) because the outcomes of innovation-related investments such as R&D are highly uncertain and payoffs are realized over a long-time horizon.

According to Lewellyn and Bao (2015), firms from cultures that value investing in the future are more intrinsically prone to long-run investments such as R&D. They prioritize future achievements even to the detriment of immediate results, and managers are accorded time and resources to achieve long-term goals (Hofstede, Hofstede, and Minkiv 2010). Consequently, managers tend to be less concerned about R&D leading to temporary performance shortfalls and less sensitive to business-cycle fluctuations and unfavourable demand conditions in their R&D decisions (Kim 2021). On the contrary, short-termism raises pressure for immediate financial results and the bottom line, leading managers to view R&D as a discretionary expense (rather than an investment) to be slashed in tough economic times. In support of this argument, Kim (2021) shows that firm-level R&D expenditures behave less pro-cyclically – that is, tend to follow business cycles less closely – and are less volatile over time in long-term oriented cultures. Long-term orientation is therefore expected to have a positive impact on the R&D intensity of firms. Empirical studies supporting this claim include Attah-Boakye et al. (2020), Boubakri et al. (2021), Gallego-Álvarez and Pucheta-Martínez (2021), Kim (2021) and Lorca and de Andrés (2019).

As an important informal institution, long-term orientation may affect the importance and the need for strong formal institutions as a means of stimulating R&D investment (Brinkerink and Rondi 2021). Specifically, we conjecture that firms located in long-term oriented cultures, which are more supportive of innovation, rely to a lesser extent on strong IPR and other formal institutions in R&D resource allocation decisions as compared to firms in short-term oriented cultures. Hence, we posit that:

H2. The effect of strong formal institutions on R&D investment is more pronounced for firms located in short-term oriented vs long-term oriented cultures.

2.2.2. Individualism

According to Hofstede (2001) individualism as opposed to collectivism captures the degree to which individuals tend to hold an independent rather than interdependent self-image or sense of self-esteem. Individualistic cultures thus emphasize individual freedom and encourage individual achievements, whereas collectivistic cultures (low on individualism) emphasize strong group cohesion and prioritize collective achievements over individual ones.

Individualism is regarded as the cultural dimension with potentially the strongest impact on innovation at both the firm and national level (Rinne, Steel, and Fairweather 2012; Shane 1993; Taylor and Wilson 2012). Innovation scholars describe multiple causal mechanisms by which individualism should affect

innovation. Gorodnichenko and Rolan (2017) argue that individualistic cultures promote more innovation than collectivistic ones because individualism awards a higher social status to individuals making important achievements such as innovation or artistic achievements. A second but related route by which individualism may foster innovation is through its impact on corporate risk-taking. Shao, Kwok, and Zhang (2013) argue that managers in individualistic cultures are more prone to take risk because they tend to be highly confident about their forecasts and ability to achieve satisfactory outcomes (Markus and Kitayma 1991). Individualism is therefore expected to foster firm innovation through its effect on managerial self-confidence and risk-taking attitude.

Recent studies provide evidence that firms located in countries with high levels of individualism tend to invest more on innovation (e.g.: Boubakri et al. 2021; Chen, Podolski, and Veeraraghavan 2017; Choi 2020; Li et al. 2013). However, since individualistic cultures emphasize individual freedom, autonomy and self-interested competition, they require strong formal institutions to protect the need of competing parties. Li et al. (2013) suggest that cultural values such as individualism may influence R&D investment decisions both directly through managerial decision-making and indirectly, through promoting the development of good formal institutions. In a similar vein, Díez-Esteban, Farinha, and García-Gómez (2019) argue that high levels of individualism may be associated with better formal institutions and this in turn may lead to increased risk-taking behaviour, such as R&D investment.

Jayasekara and Fredriksson (2021) provide evidence that a strong IPR protection and a high level of individualism exert a positive and mutually reinforcing effect on firm innovation.

Based on the above arguments and findings, we hypothesize that individualism may strengthen the effect of high-quality formal institutions on firm-level R&D investments. Hence, we propose that:

H3. The effect of strong formal institutions on R&D investment is more pronounced for firms located in individualistic vs collectivistic countries.

3. Methods

3.1. Data Collection

This research focuses on information technology (IT) firms that heavily invest in research and development. IT firms are perennially threatened by new entrants due to the fast pace of changing technology, shorter product cycles, low cost of entry and uncertainty related to new innovation (Banker, Wattal, and Plehn-Dujowich 2011). They respond to this dilemma by investing in research and development or through the acquisition of other firms or both (Blonigen and Taylor 2000).

Specifically, we use a sample of listed IT companies from the Asia-Pacific developed countries (i.e., Australia, Hong Kong, Japan, South Korea, New Zealand and Singapore) extracted from the Standard and Poors (S&P) Capital IQ database, which provides extensive financial data on public and privately held

companies around the world. The database uses the Global Industry Classification Standard (GICS), which breaks the IT sector (two-digit code 45) down into three major industry groups: first, Technology software and services (four-digit code 4510), including companies that primarily develop software in various fields such as the Internet, applications, systems, databases management and/or home entertainment, and companies that provide IT consulting and services, as well as data processing and outsourced services; second, Technology hardware and equipment (four-digit code 4520), including manufacturers and distributors of communications equipment, computers and peripherals, electronic equipment and related instruments; and third, Semiconductors and semiconductor equipment manufacturers (four-digit code 4530). Thus, our sample consists of firms belonging to both the IT-related manufacturing sectors and the IT service sectors (Table 1).

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The Capital IQ database provided firm-level financial and accounting data, while country-level data such as inflation and GDP were obtained from the World bank database. The country scores on the cultural dimensions of individualism and long-term orientation were obtained from the Geerte Hofstede website (<https://geerthofstede.com/research-and-vsm/dimension-data-matrix/>), which makes publicly available the data for each cultural dimension as presented in Hofstede et al. (2010).

The initial sample consisted of 1800 listed firms in the IT industry. Firms that had missing data on R&D expenditures over the period of study were deleted. This resulted in a final sample of 700 firms with 3500 firm-year observations covering the years from 2015 to 2019. Our sample comprises 530 manufacturing firms from IT-related sectors and 170 service firms from IT service sectors. Table 1 provides a sample breakdown based on the four-digit, six-digit and eight-digit GICS codes, which indicate the industry group, the industry and the sub-industry, respectively.

3.2. Research Model

To test our research hypotheses, we estimate the following baseline models using panel data regression analysis:

$$R\&D\_In_{i,t} = \beta_0 + \beta_1 IPR_{i,t} + \beta_2 FirmSize_{i,t} + \beta_3 Leverage_{i,t} + \beta_4 CFtoCap_{i,t} + \beta_5 Growth_{i,t} + \beta_6 GDP_{i,t} + \beta_7 Inflation_{i,t} + u_i + \varepsilon_{i,t} \quad (\text{Equation 1})$$

$$R\&D\_In_{i,t} = \beta_0 + \beta_1 InstInd_{i,t} + \beta_2 FirmSize_{i,t} + \beta_3 Leverage_{i,t} + \beta_4 CFtoCap_{i,t} + \beta_5 Growth_{i,t} + \beta_6 GDP_{i,t} + \beta_7 Inflation_{i,t} + \text{year effects} + u_i + \varepsilon_{i,t} \quad (\text{Equation 2})$$

where R&D_In is the natural logarithm of research and development expenditures. IPR and InstInd are two alternative proxies for the quality of formal institutions. The remaining regressors are control variables at the firm and country level. The subscript i represents the firm and t represents the year, u_i

denotes firm specific or firm fixed effects, which are accounted for because they may affect R&D investment decisions. These firm-specific effects take into account unobservable organizational features (the unobservable firm heterogeneity), which do not change over time and change across firms, while $\varepsilon_{i,t}$ is the idiosyncratic error term.

In order to assess whether that national culture affects the relation between firm R&D and the quality of formal institutions, Equations 1 and 2 are estimated by segregating the firms using the cultural dimensions of time orientation (long term vs short term) and individualism (individualistic vs collectivist) proposed by Hofstede, Hofstede, and Minkiv (2010).

3.3. Variables Measurement

3.3.1. Dependent variables

This study uses the natural logarithm of R&D expenditures consistent prior studies (Huang and Hou 2019; Meng et al. 2020). R&D intensity is also measured by R&D expenditures divided by total sales as part of the robustness check (Alam et al. 2020).

3.3.2. Independent variables

The independent variable of interest is the quality of formal institutions, which we measure by two alternative proxies. The first one is the Intellectual Property Rights (IPR) protection index proposed by the Property Rights Alliance. This measure is based on information from multiple sources encompassing an array of dimensions of the IPR system, such as enforcement and patent and copyright protection. Specifically, the index is based on: (1) national experts' opinions on the actual functioning of the intellectual property system and its enforcement; (2) objective criteria such as coverage, membership in international treaties, restrictions on patent rights, enforcement, and the duration of protection; and (3) the Office of the United States Trade Representative "Special 301" watch list, reflecting piracy rates in the business software, entertainment software, motion picture, and music industries. Thus, it is an index that combines de jure and de facto measures of IPRs' strength (Della Malva and Santarelli 2016). It ranges between 0 and 10.

The second proxy for institutional quality used in this study is the KKM index developed by Kaufmann, Kraay, and Mastruzzi (2009). The KKM index is based on six governance indicators namely: voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule-of-law and control of corruption. Following prior studies (Aluko and Ajayi, 2018; Le, Kim, and Lee 2016) the arithmetic mean of the six indicators was used to measure formal institutional quality. On each indicator, countries score a value between 0 and 100, with higher values corresponding to better institutional quality. The individual indicators were sourced from World Governance Indicators (WGI) database. This research assumes that formal and informal institutions are equal all over the country.

The firms are segregated using Hofstede et al. (2010) cultural factors of time orientation (long term vs short term) and individualism (individualistic vs collectivist). Hofstede study was based on a large global survey administered to IBM's employees worldwide. The dimension of individualism and long-term orientation for each country is measured as the index value that ranges from 0 to 100. The higher the index value the higher the individualism of a country whereby individuals care only for themselves and their immediate family members. A low time orientation index signifies short-term orientation of a country that values tradition and fulfils social obligations. A high score signifies long-term orientation that aims at future rewards such as perseverance and thrift. In this study we split the sample into long vs short-term orientation countries and high vs low individualism countries according to the cross-sectional medians of the respective scores.

3.3.3. Control variables

Following previous research (Alam et al. 2020, Alam, Uddin, and Yazdifar 2019; Lee, Wu, and Pao 2014), this study uses several firm-level control variables that include firm size, leverage, cash-flow-to-capital ratio and sales growth. Firm size is measured as the natural logarithm of total assets and denoted as FirmSize. Sales growth is measured as the annual sales growth of the firm (Alam, Uddin, and Yazdifar 2019). Sales growth is a source of motivation for managers to retain talented employees and invest in R&D. Leverage is measured as the ratio of total assets to total liabilities. Previous studies suggest that a high leverage is associated with high agency costs and this could lead to an underinvestment problem (Ibhagui and Olokoyo 2018). This study also controls for the impact of the firm's cash flow on R&D investment using the cash flow-to-total-capital ratio (CFtoCap). A firm's innovation ability is highly sensitive to its internal cash flow (Liu et al. 2017). Beladi, Deng, and Hu (2021) reported that cash flow uncertainty led to conservative R&D investment decisions. The country-level controls are gross domestic product (GDP) and inflation. Refer to Table 2 for variable definitions.

INSERT TABLE 2 ABOUT HERE

4. Results and Discussion

4.1. Descriptive Statistics

Table 3 presents the descriptive statistics for all the firm and country-level variables used in this study. For the sake of readability, the descriptives for R&D expenditures and total assets were computed prior to the logarithmic transformation. The average R&D expense is 34.8 million with a standard deviation of 423.4771 and a maximum value of 13019 millions. This huge variation in R&D expenditures can be attributed to the variation in firm size throughout the sample. The average firm size as measured by total assets is 776 millions with a standard deviation of 7777 million and a maximum value of 239 billions.

Regarding the country variables, the mean individualism score is 31.38 with a standard deviation of

20.15, and the average long-term orientation score is 89.17 with a standard deviation of 20.59. The IPR protection index is on average 5.99 with a standard deviation of 0.50, and the composite institutional quality index is 80.69 with a standard deviation of 7.13.

INSERT TABLE 3 ABOUT HERE

4.2. Pairwise correlations

Table 4 presents the pairwise correlations between the main variables of interest. Notably, we show a positive correlation between the log-transformed R&D expenditures (RD_In) and the two indicators of formal institutional quality (IPR and InstInd). This lends some initial support to H1. The size of the firm is positively associated with RD_In. This is consistent with prior studies that suggest large firms have better economies of scale in comparison to small firms and thus undertake more investment in R&D (Khoshnevis and Teirlinck 2018; Shefer and Frenkel 2005). There is a negative correlation between R&D expenditures (RD_In) and macroeconomic variables such as GDP and Inflation, consistent with previous research (Wang, Wei, and Song 2017).

The correlation matrix is also useful to detect potential multicollinearity issues between explanatory variables. The IPR and InstInd variables are highly correlated (0.92), thus they are not included in the same models. For the remaining variables, the highest correlation is -0.72, which is still below the commonly accepted cut-off levels (Kennedy 1985).

INSERT TABLE 4 ABOUT HERE

4.3. Regression results

Table 5 presents the fixed-effects estimation results of models 1 to 2. The fixed-effects estimator is chosen based on the Hausman test (untabulated) which rejects the null that the individual effects are random.

INSERT TABLE 5 ABOUT HERE

Results in column (1) provide evidence of IPR protection having a positive and significant association with R&D investments. This suggests that countries having a stronger IPR protection provide a supportive environment for IT firms to invest in R&D. This finding is consistent with prior studies that reported a positive and significant association between strong IPR protection and R&D investments (e.g.: Arora, Ceccagnoli, and Cohen 2008; Della Malva and Santarelli 2016; Meng et al. 2020). Results in column (2) show that the composite institutional quality (InstInd) index has a positive and significant association with R&D (RD_In), which suggests that investment in R&D increases in countries with higher formal institutional quality. This result lends support to H1. Prior studies have also concluded that high quality formal institutions foster R&D investments (Alam et al. 2019; Hillier et al. 2011; Jiao, Koo, and Cui 2015; Seitz and Watzinger 2017).

Both models indicate that larger firms have a higher investment in R&D, consistent with prior studies (Alam, Uddin, and Yazdifar 2019; Lai, Lin, and Lin 2015; Limanlı 2015). Alam, Uddin, and Yazdifar (2019) argue that larger firms have an easier access to financial markets and therefore a greater fund availability for R&D. The coefficient on leverage is negative for both models suggesting that firms with a higher leverage ratio engage in less R&D investments. This is consistent with the notion that the high failure rate of R&D investments makes debt holders, who are not compensated for higher risk taking, unwilling to fund substantial R&D investments. However, recent research suggests (Yang and Lai 2021) that corporate debt may also have a positive effect on managerial decision-making leading to investment in R&D projects with positive net present value.

In order to examine the effect of national culture on the relation between formal institutional quality and firm R&D, we segregate the sample of Asian-Pacific IT firms based on the level of individualism and long-term orientation in their home country. Specifically, we split the sample into long vs short-term orientation countries and high vs low individualism countries according to the cross-sectional medians of the respective scores. Thus, firms with time orientation scores higher than the median score are classified as long-term oriented and all others as short-term oriented. Similarly, firms with high individualism score vis-à-vis the median are classified as individualistic and all others are collectivist.

We resort to a sub-sample analysis instead of interacting the cultural variables with institutional quality indicators because the fixed-effects estimator cannot estimate time-invariant variables such as the Hofstede's cultural scores for individualism and time orientation, since they get wiped out by the within transformation (time de-meaning) of the data. However, we provide the results with the interaction term specification as a robustness check using a multilevel (ML) mixed-effects modelling approach.

The results of the fixed-effects estimation for each cultural subsample are presented in Table 6.

INSERT TABLE 6 ABOUT HERE

The results in Table 6 show a positive association between the IPR index and RD_In for both short-term and long-term oriented firms (Columns 1 and 2) but this association is more pronounced for short-term oriented firms. Similarly, the composite indicator of formal institutional quality (InstInd) has a more pronounced association with R&D investment (RD_In) in short-term oriented cultures (columns 3 and 4). Together, these results lend support to H2 suggesting that firms embedded in long-term oriented cultures are less reliant on strong formal institutions to make their R&D decisions. Among the control variables, a low ROA is associated with a higher R&D investment (RD_In) for short-term oriented firms (Column 2).

Regarding the effect of individualism, we show (columns 5 to 8) that firms from both individualistic and collectivist cultures invest more on R&D when formal institutional quality is higher, but this effect is more pronounced in individualistic cultures (columns 6 and 8) thus verifying H3. This result supports the argument that individualism and institutional quality have a mutually enforcing effect on corporate innovation (Li et al. 2013) and is consistent with recent findings by Jayasekara and Fredriksson (2021).

Noticeably, the coefficient estimate on firm size remains positive and significant across all cultural

subsamples, while the leverage ratio turns negative and significant for collectivist firms (columns 6 and 8). This suggests that collectivist firms tend to reduce their R&D investment when they are highly leveraged, because this would expose them to additional risks of financial distress that could jeopardize the future of the business. This explanation is supported by prior research that examines the impact of national culture on corporate debt (e.g., Farooq et al. 2020; Mogha and Williams 2021; Zheng et al. 2012). The rest of controls remain the same as in the baseline specification.

We performed some robustness tests to confirm our results using a multilevel (ML) mixed-effects modelling approach. The multi-level (ML) mixed effects estimation allowed us to model the hierarchical structure of our dataset where observations are nested within firms, which in turn are nested within countries. From a modelling perspective, this permits to distinguish the effects that take place at the country level from those that take place at the firm level and to appropriately model their interactions. Specifically, we employ a hierarchical nested form of the general linear model to explore our multilevel data (see Raudenbush and Bryk, 2002 or Goldstein, 2003), where the set of firms within countries form the base-level observations, while countries serve as the higher-level observations.

First, we re-estimate the baseline model and results remain qualitatively unaffected from this alternative estimation technique (see Table 7). Second, we conduct a robustness check for the results presented in Table 6 by interacting the cultural scores on individualism and time orientation with the alternative institutional quality indicators. The results of this alternative estimation shown in Table 8 lend support to our previous findings. Again, it is shown that the impact of strong formal institutions is more pronounced for firms embedded in short-term oriented and individualistic cultures, since the coefficients on the interaction terms are negative and positive, respectively, and statistically significant. Third, we interact the individual components of the KKM index with the individualism and time orientation indicators in separate regressions, in order to ascertain whether the results regarding this composite indicator are driven by any specific individual component. The results of this additional check, presented in Tables 9 to 10, indicate that the results are mainly driven by the regulatory quality, rule-of-law and control of corruption components of the KKM index, while the coefficients on government effectiveness and voice and accountability are not statistically significant.

Finally, we constrain the analysis to domestic firms, excluding multinational firms (MNEs) to ensure that they were not distorting our findings. Specifically, firms that had subsidiaries outside their home country (da Sila et al., 2009) were eliminated thus focusing only on pure domestic firms (654) totalling up to 3270 firm-year observations. We did so because the R&D investment decisions of MNEs may also be influenced by the culture of the host countries in which they establish a presence, while the cultural contingency hypothesis that drives this study is theoretically put forward from the perspective of domestic firms. Results also survive this sample restriction, as shown in Table 11.

INSERT TABLE 7 ABOUT HERE

INSERT TABLE 8 ABOUT HERE

INSERT TABLE 9 ABOUT HERE

INSERT TABLE 10 ABOUT HERE

INSERT TABLE 11 ABOUT HERE

5. Conclusions

Taking an institution-based perspective, this study explored the association between the quality of formal institutions and firm-level R&D investment using a sample of IT firms from the Asia-Pacific region. We also examined whether national culture as an informal institution affects the importance of strong formal institutions in driving firm R&D decisions. Recently, a growing body of research has separately examined the effect that formal institutions and national culture have on firm R&D, but research linking these two areas is still limited. This paper was an attempt to fill this gap.

Merging insights from these two strands of research, we hypothesized that the association between institutional quality and firm R&D investment is more pronounced in individualistic and short-term oriented cultures. In doing so, we subscribe to the view that the formal and informal constraints that firms confront in a given institutional environment combine to influence firm behaviour (Peng et al. 2009), which implies that the same formal rules imposed in different institutional settings may result in different investment choices due to variations in informal institutions (North 1990) such as cultural values.

Our empirical findings provide support for our institutional contingency hypothesis, extending previous research in at least two respects. First, we provide fresh evidence that the quality of formal institutions stimulates firm R&D after controlling for other potential determinants of R&D at firm and country level. Second, we show that the effectiveness of strong institutions in stimulating R&D is more pronounced for firms embedded in short-term oriented and individualistic cultures. This suggests that national culture may either strengthen or lower firms' dependency on strong formal institutions in R&D investment decisions. These findings have implications for both research and policymaking.

On the one hand, researchers concerned with the effect of formal institutions on firm R&D should take into account the influence of national culture, and by the same token research on the effect of national culture should consider the influence of formal institutions and the potential interplay of these factors. Estimates that do not take into account this reciprocal influence may be biased (Jayasekara and Fredriksson 2021; Saka-Helmhout, Chappin, and Vermeulen 2020). On the other hand, policymakers are made aware that national culture may affect the extent to which firms respond to institutional reforms aimed at stimulating R&D investments. Therefore, they should take national culture into account when designing policies that improve institutional quality with a view to promoting firm R&D investment. In other words, as Brinkerink and Rondi (2021) say, there might be value in a culturally-sensitive policy

agenda. A broader implication of this research is that policymakers should take into account the configuration of informal institutions in the firm's environment to understand whether institutional reforms are likely to achieve their R&D-stimulating goals. This resonates with the argument put forward by North (1996) that policymakers willing to promote economic growth must ensure that informal institutions favour the effectiveness of formal rules.

Overall, the findings of our investigation lend support to an institution-based perspective on firm R&D decisions, which in turn builds on the core idea of the new institutional economics (NIE) that firm behaviour is best explained by considering the impact of formal and informal institutions together, because they jointly influence the behaviour of economic actors by providing the incentives and constraints under which decisions are made (North 1990; 2005).

This study suffers from certain limitations. The study considers the impact of IPR protection and institutional quality on R&D investment, but does not consider productivity indicators such as new product introductions or patents. Second, we use aggregate measures of institutional quality, implicitly assuming that national institutions do not vary substantially across different regions of a country (Wang et al. 2020). Thus, by considering measures of institutional quality at the country level, we neglect the institutional differences that may exist across regions of a country. Future studies may address this shortcoming by investigating whether the institutional variations *within* national boundaries influence the R&D investment decisions. Also, culture is operationalized only along the dimensions of individualism and long-term orientation, while other cultural dimensions may also have consequences on the relevance of formal institutions on R&D decisions. Furthermore, our cultural contingency hypothesis is theoretically put forward from the perspective of domestic firms, thus neglecting that, in the case of MNEs, the culture of the host countries may also affect the R&D investment and location choices of firms. This limitation also paves the way for further research.

Additionally, future research should also consider the role of technology spillovers in the innovation behaviour of firms, which has not been accounted for in our institutional contingency model of R&D investments. Finally, this study is focused on IT firms in selected Asian pacific countries, which may rise concerns regarding the generalizability of our findings. Thus, future studies may extend the analysis to other industry sectors and countries.

Statements and Declarations

The authors have no competing interests to declare that are relevant to the content of this article. No funds, grants, or other support were received.

References

- Alam, A., M. Uddin, and H. Yazdifar. 2019. "Institutional determinants of R&D investment: Evidence from emerging markets." *Technological Forecasting and Social Change* 138: 34–44. <https://doi.org/10.1016/j.techfore.2018.08.007>.
- Alam, A., M. Uddin, H. Yazdifar, S. Shafique, and T. Lartey. 2020. "R&D investment, firm performance and moderating role of system and safeguard: Evidence from emerging markets." *Journal of Business Research* 106: 94–105. <https://doi.org/10.1016/j.jbusres.2019.09.018>.
- Aldieri L., C. Barra, N. Ruggiero, and C. P. Vinci. 2020. "Innovative performance effects of institutional quality: an empirical investigation from the Triad" *Applied Economics* 52 (50): 5464-5476. <https://doi.org/10.1080/00036846.2020.1764483>.
- Aluko, O.A., and M.A. Ajayi. 2018. "Determinants of banking sector development: Evidence from Sub-Saharan African countries." *Borsa Istanbul Review* 18 (2): 122–139. <https://doi.org/10.1016/j.bir.2017.11.002>.
- Andersen, B., and S. Konzelmann. 2008. "In search of a useful theory of the productive potential of intellectual property rights." *Research Policy*, 37 (1): 12–28. <https://doi.org/10.1016/j.respol.2007.02.024>.
- Ang, J. S., Y. Cheng, and C. Wu. 2014. "Does enforcement of intellectual property rights matter in China? Evidence from financing and investment choices in the high-tech industry." *The Review of Economics and Statistics* 96 (2): 332–348. <https://www.jstor.org/stable/43554934>.
- Anokhin, S., and W. S. Schulze. 2009. "Entrepreneurship, innovation and corruption." *Journal of Business Venturing*, 24 (5): 465–476. <https://doi.org/10.1016/j.jbusvent.2008.06.001>.
- Arora, A., M. Ceccagnoli, and W. M. Cohen. 2008. "R&D and the patent premium." *International Journal of Industrial Organization* 26 (5): 1153–1179. <https://doi.org/10.1016/j.ijindorg.2007.11.004>.
- Arrow, K. J. 1962. "Economic Welfare and the Allocation of Resources for Invention." In *The Rate and Direction of Inventive Activity*, edited by Richard R. Nelson, 609-625. Princeton: Princeton University Press.
- Attah-Boakye, R., K. Adams, D. Kimani, and S. Ullah. 2020. "The impact of board gender diversity and national culture on corporate innovation: A multi-country analysis of multinational corporations operating in emerging economies." *Technological Forecasting & Social Change* 161: 120247. <https://doi.org/10.1016/j.techfore.2020.120247>.
- Banker, R. D., S. Wattal, and J.M. Plehn-Dujowich. 2011. "R&D Versus Acquisitions: Role of Diversification in the Choice of Innovation Strategy by Information Technology Firms." *Journal of Management Information Systems* 28 (2): 109-144. <https://doi.org/10.2753/MIS0742-1222280205>.

- Beladi, H., J. Deng, and M. Hu. 2021. "Cash flow uncertainty, financial constraints and R&D investment." *International Review of Financial Analysis* 76: 101785. <https://doi.org/10.1016/j.irfa.2021.101785>.
- Blonigen, B. A., and C. T. Taylor. 2000. "R&D Intensity and Acquisitions in High-Technology Industries: Evidence from the US Electronic and Electrical Equipment Industries." *The Journal of Industrial Economics* 48 (1): 47–70. <https://doi.org/10.1111/1467-6451.00112>
- Boubakri, N., I. Chkir, S. Saadi, and H. Zhu. 2021. "Does national culture affect corporate innovation? International evidence." *Journal of Corporate Finance* 66: 101847. <https://doi.org/10.1016/j.jcorpfin.2020.101847>.
- Brinkerink, J., and E. Rondi. 2021. "When can families fill voids? Firms' reliance on formal and informal institutions in R&D decisions." *Entrepreneurship Theory and Practice* 45 (2): 219–318. <https://doi.org/10.1177/1042258719899423>.
- Brown, J.R., G. Martinsson, and B.C. Petersen. 2012. "Do financing constraints matter for R&D?" *European Economic Review*, 56 (8): 1512–1529. <https://doi.org/10.1016/j.eurocorev.2012.07.007>.
- Brown, J.R., G. Martinsson, and B.C. Petersen. 2017. "What promotes R&D? Comparative evidence from around the world." *Research Policy* 46 (2): 447–462. <https://doi.org/10.1016/j.respol.2016.11.010>.
- Brown, J.R., S.M. Fazzari, and B.C. Petersen. 2009. "Financing Innovation and Growth: Cash Flow, External Equity, and the 1990s R&D Boom." *The Journal of Finance*, 64 (1): 151–185. <https://doi.org/10.1111/j.1540-6261.2008.01431.x>.
- Castellacci, F., P.C. Oguguo, and I.M.B. Freitas. 2022. "Quality of pro-market national institutions and firms' decision to invest in R&D: evidence from developing and transition economies." *Eurasian Business Review* 12 (1): 35–37. <https://doi.org/10.1007/s40821-022-00202-7>.
- Chen, Y., E. J. Podolski, and M. Veeraraghavan. 2017. "National culture and corporate innovation." *Pacific-Basin Finance Journal* 43 (June 2017): 173–187. <https://doi.org/10.1016/j.pacfin.2017.04.006>.
- Cho, K., C. Kim, and J. Shin. 2015. "Differential effects of intellectual property rights on innovation and economic performance: A cross-industry investigation." *Science and Public Policy* 42 (6): 827–840. <https://doi.org/10.1093/scipol/scv009>.
- Choi, K.-S. 2020. "National culture and R&D investments." *The European Journal of Finance* 26 (6): 500–531. <https://doi.org/10.1080/1351847X.2019.1697324>.
- Cohen, W. M., and D. A. Levinthal. 1990. "Absorptive capacity: A new perspective on learning and innovation." *Administrative Science Quarterly* 35 (1): 128–152. <https://www.jstor.org/stable/2393553>.
- da Silva, J.F., A. da Rocha, and J. Carneiro. 2009. "The international expansion of firms from emerging markets: toward a typology of Brazilian MNEs." *Latin American Business Review*, 10 (2-3): 95–115. <https://doi.org/10.1080/10978520903303638>.

- Della Malva, A., and E. Santarelli. 2016. "Intellectual property rights, distance to the frontier, and R&D: evidence from microdata." *Eurasian Business Review* 6: 1–24. <https://doi.org/10.1007/s40821-015-0022-4>.
- Dernis H., P. Gkotsis, N. Grassano, S. Nakazato, M. Squicciarini, B. van Beuzekom, and A. Vezzani. 2019. "World Corporate Top R&D investors: Shaping the Future of Technologies and of AI. A joint JRC and OECD report". EUR 29831 EN, Publications Office of the European Union: Luxembourg. <https://doi.org/10.1007/s40821-018-0105-0>.
- Díez-Esteban, J.M., J.B. Farinha, and C.D. García-Gómez. 2019. "How does national culture affect corporate risk-taking?" *Eurasian Business Review* 9 (1): 49–68. <https://doi.org/10.1007/s40821-018-0105-0>.
- DiMaggio, P.J., and W.W. Powell. 1983. "The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields." *American Sociological Review*, 48 (2): 147–160. <https://doi.org/10.2307/2095101>.
- Duran, P., M. van Essen, Pursey P.M.A.R. Heugens, T. Kostova, and Mike W. Peng. 2019. "The impact of institutions on the competitive advantage of publicly listed family firms in emerging markets." *Global Strategy Journal*, 9 (2): 243–274. <https://doi.org/10.1002/gsj.1312>.
- Eberhardt, M., C. Helmers, and H. Strauss. 2013. "Do spillovers matter when estimating private returns to R&D?" *The Review of Economics and Statistics* 95 (2): 436–48. <http://www.jstor.org/stable/43554396>.
- Fang, L. H., J. Lerner, and C. Wu. 2017. "Intellectual Property Rights Protection, Ownership, and Innovation: Evidence from China" *The Review of Financial Studies*, 30 (7): 2446–2477. <https://doi.org/10.1093/rfs/hhx023>.
- Farooq, U., J. Ahmed, K. Ashfaq, GuH Khan, and S. Khan. 2020. "National culture and firm financial performance: A mediating role of firm financing decision." *Cogent Business & Management* 7 (1): 1858640. <https://doi.org/10.1080/23311975.2020.1858640>.
- Gallego-Álvarez, I., and M. C. Pucheta-Martínez. 2021. "Hofstede's cultural dimensions and R&D intensity as an innovation strategy: a view from different institutional contexts." *Eurasian Business Review* 11: 191–220. <https://doi.org/10.1007/s40821-020-00168-4>.
- Ginarte, J. C., and W. G. Park. 1997. "Determinants of patent rights: A cross-national study." *Research Policy* 26: 283–301. [https://doi.org/10.1016/S0048-7333\(97\)00022-X](https://doi.org/10.1016/S0048-7333(97)00022-X).
- Gorodnichenko, Y., and G. Rolan. 2017. "Culture, institutions and the wealth of nations." National Bureau of Economic Research. <http://www.nber.org/papers/w16368>.
- Guceri, I., and L. Liu. 2019. "Effectiveness of Fiscal Incentives for R&D: Quasi-experimental Evidence." *American Economic Journal: Economic Policy* 11 (1): 266–291. <https://doi.org/10.1257/pol.20170403>.
- Gui-long, Z., Z. Yi, C. Kai-Hua, and Y. Jiang. 2017. "The impact of R&D intensity on firm performance in an emerging market: Evidence from China's electronics manufacturing firms." *Asian Journal of Technology Innovation* 25: 41–60. <https://doi.org/10.1080/19761597.2017.1302492>.

- Hall, B.H. 2002. "The financing of research and development." *Technology Policy* 18 (1): 35–51. <https://www.jstor.org/stable/23606869>.
- Hillier, D., J. Pindado, V. de Queiroz, and C. de la Torre. 2011. "The impact of country-level corporate governance on research and development." *Journal of International Business Studies* 42 (1): 76–98. <https://www.jstor.org/stable/25790106>.
- Hofstede, G. 2001. "Culture's recent consequences: using dimension score in theory and research." *International Journal of Cross-Cultural Management* 1 (1): 11–30. <https://doi.org/10.1177/147059580111002>.
- Hofstede, G., G.J. Hofstede, and M. Minkiv. 2010. *Cultures and organizations: Software of the mind*. New York: McGraw-Hill.
- Horstmann, I., J.M. MacDonald, and A. Slivinski. 1985. "Patents as information transfer mechanisms: to patent or (maybe) not to patent." *Journal of Political Economy* 93: 837–858. <https://www.jstor.org/stable/1833059>.
- Huang, C.-H., and T. C.-T. Hou 2019. "Innovation, research and development, and firm profitability in Taiwan: Causality and determinants." *International Review of Economics and Finance* 59: 385–394. <https://doi.org/10.1016/j.iref.2018.10.004>.
- Ibhagui, O. W., and F. O. Olokoyo. 2018. "Leverage and firm performance: New evidence on the role of firm size." *The North American Journal of Economics and Finance* 45: 57–82. <https://doi.org/10.1016/j.najef.2018.02.002>.
- International Monetary Fund. Asia and Pacific Dept (2024). Asia and Pacific: Steady Growth amid Diverging Prospects. In *Regional Economic Outlook, Asia and Pacific*, April 2024, USA: International Monetary Fund. available from: <https://doi.org/10.5089/9798400272349.086.CH001> [Accessed 21 June 2024]
- Jayasekara, D. N., and P. G. Fredriksson. 2021. "Culture, intellectual property rights, and technology adoption." *The Quarterly Review of Economics and Finance* 80: 317–330. <https://doi.org/10.1016/j.qref.2021.03.007>.
- Jiao, H., C.K. Koo, and Y. Cui. "Legal environment, government effectiveness and firms' innovation in China: Examining the moderating influence of government ownership." *Technological Forecasting and Social Change* 96: 15–24. <https://doi.org/10.1016/j.techfore.2015.01.008>.
- Jones, G. K., and H. J. Davis. 2000. "National Culture and Innovation: Implications for Locating Global R&D Operations." *Management International Review* 40 (1): 11–39. <https://www.jstor.org/stable/40835865>.
- Kaufmann, D., A. Kraay, and M. Mastruzzi. 2009. "Governance matters VIII: Aggregate and individual governance indicators 1996–2008" *World Bank policy research paper* 4978. Washington DC: World Bank. <https://doi.org/10.1596/1813-9450-4978>.
- Kennedy, P. 1985. "A rule of thumb for mixed heteroskedasticity." *Economics Letters* 18 (2–3): 157–159.
- Khoshnevis, P., and P. Teirlinck. 2018. "Performance evaluation of R&D active firms." *Socio-Economic Planning Sciences* 61: 16–28. <https://doi.org/10.1016/j.seps.2017.01.005>.

- Kim, J. S. 2021. "National Culture and the Cyclical Behavior of Research-and-Development Expenditure." *Journal of International Marketing* 29 (2): 81–102. <https://doi.org/10.1177/1069031X21994106>.
- Krammer, Sorin M. S. 2015. "Do good institutions enhance the effect of technological spillovers on productivity? Comparative evidence from developed and transition economies." *Technological Forecasting and Social Change* 94: 133–154. <https://doi.org/10.1016/j.techfore.2014.09.002>.
- La Porta, R., F. Lopez-De-Silanes, A. Shleifer, and R.W. Vishny. 1997. "Legal determinants of external finance." *The Journal of Finance* 52 (3): 1131–1150. <https://doi.org/10.2307/2329518>.
- Lai, Y.-L., F.-J. Lin, and Y.-H. Lin. 2015. "Factors affecting firm's R&D investment decisions." *Journal of Business Research* 68 (4): 840–844. <https://doi.org/10.1016/j.jbusres.2014.11.038>.
- Laursen, K., and A.J. Salter. 2014. "The paradox of openness: appropriability, external search and collaboration." *Research Policy* 43 (5): 867–878. <https://doi.org/10.1016/j.respol.2013.10.004>.
- Le, T.-H., J. Kim, and M. Lee. 2016. "Institutional quality, trade openness, and financial sector development in Asia: An empirical investigation." *Emerging Markets Finance and Trade*, 52 (5): 1047–1059. <https://doi.org/10.1080/1540496X.2015.1103138>.
- Lee C.-C., C.-W. Wang, and S.-J. Ho. 2020. "Country governance, corruption, and the likelihood of firms' innovation" *Technovation* 34 (10): 582–593. <https://doi.org/10.1016/j.technovation.2014.05.003>.
- Lee, C.-Y., H.-L. Wu, and H.-W. Pao. 2014. "How does R&D intensity influence firm explorativeness? Evidence of R&D active firms in four advanced countries." *Technovation* 34 (10): 582–593. <https://doi.org/10.1016/j.technovation.2014.05.003>.
- Lewellyn, K. B., and S. R. Bao. 2015. "R&D Investment in the Global Paper Products Industry: A Behavioral Theory of the Firm and National Culture Perspective." *Journal of International Management* 21 (1): 1–17. <https://doi.org/10.1016/j.intman.2014.12.001>.
- Li, K., D. Griffin, H. Yue, and L. Zhao. 2013. "How does culture influence corporate risk-taking." *Journal of Corporate Finance* 23: 1–22. <https://doi.org/10.1016/j.jcorpfin.2013.07.008>.
- Li, W. 2017. "Can intellectual property rights protection and governmental R&D investment promote Chinese enterprises' R&D investment?" *Knowledge Management Research & Practice* 15 (4): 551–559. <https://doi.org/10.1057/s41275-017-0076-4>.
- Limanlı, Ö. 2015. "Determinants of R&D Investment Decision in Turkey." *Procedia - Social and Behavioral Sciences* 195: 759–767. <https://doi.org/10.1016/j.sbspro.2015.06.471>.
- Liu, B., Z. Li, H. Wang, and J. Yang. 2017. "Cash flow uncertainty and corporate innovation." *Economic Research Journal* 52 (3): 166–180.
- Lorca, P., and J. de Andrés. 2019. "The Importance of Cultural Factors in R&D Intensity." *Cross-Cultural Research* 53 (5): 483–507. <https://doi.org/10.1177/1069397118813546>.
- Markus, H. R., and S. Kitayama. 1991. "Culture and the Self. Implications for Cognition, Emotion, and Motivation." *Psychological Review* 98 (2): 224–253. <https://psycnet.apa.org/doi/10.1037/0033-295X.98.2.224>.

- Meng, Y., X. Wang, G. Zhang, and S. Zheng. 2020. "Trust and corporate R&D investment: Cross-country evidence." *Finance Research Letters* 40, 101696. <https://doi.org/10.1016/j.frl.2020.101696>.
- Mogha, V., and B. William. 2021. "Culture and capital structure: What else to the puzzle?" *International Review of Financial Analysis* 73: 101614. <https://doi.org/10.1016/j.irfa.2020.101614>.
- Murray, F., and S. Stern. 2007. "Do formal intellectual property rights hinder the free flow of scientific knowledge?: An empirical test of the anti-commons hypothesis". *Journal of Economic Behavior & Organization* 63 (4): 648–687. <https://doi.org/10.1016/j.jebo.2006.05.017>.
- Naveed, A., and G. Shabbir. 2022. "Effect of Formal and Informal Institutional Indicators on Innovation Activities: An Empirical Analysis for a Global Sample." *Social Indicators Research* 164: 665–691, <https://doi.org/10.1007/s11205-022-02975-w>.
- Nordhaus, W.D. 1969. "An economic theory of technological change." *American Economic Review* 59 (2): 18–28. <https://www.jstor.org/stable/1823649>.
- North, D. C. 1990. *Institutions, institutional change, and economic performance*. Cambridge, MA: Harvard University Press.
- Peng, M. W. 2002. "Towards an Institution-Based View of Business Strategy." *Asia Pacific Journal of Management* 19 (2-3): 251–267. <https://doi.org/10.1023/A:1016291702714>.
- Peng, M. W. 2003. "Institutional Transitions and Strategic Choices." *Academy of Management Review* 28 (2): 275–296. <https://doi.org/10.2307/30040713>.
- Peng, M. W., J. C. Wang, N. Kathuria, J. Shen, and M. J. Welbourne Eleazar. 2023. "Toward an institution-based paradigm." *Asia Pacific Journal of Management* 40 (2): 353–382. <https://doi.org/10.1007/s10490-022-09861-6>.
- Peng, M. W., S. L. Sun, B. Pinkham, and H. Chen. 2009. "The Institution-Based View as a Third Leg for a Strategy Tripod." *Academy of Management Perspectives* 23 (3): 63–81. <https://www.jstor.org/stable/27747526>.
- Pindado, J., V. de Queiroz, and C. de la Torre. 2015. "How do country-level governance characteristics impact the relationship between R&D and firm value?" *R&D Management* 45 (5): 515–526. <https://doi.org/10.1111/radm.12115>.
- Rinne, T., G. D. Steel, and J. Fairweather. 2012. "Hofstede and Shane Revisited: The Role of Power Distance and Individualism in National-Level Innovation Success." *Cross-Cultural Research* 46 (2): 91–108. <https://doi.org/10.1177/1069397111423898>.
- Rodriguez, P., D. Siegel, A. Hillman, and L. Eden. 2006. "Three lenses on the multinational enterprise: politics, corruption, and corporate social responsibility." *Journal of International Business Studies* 37 (6): 733–746. <https://doi.org/10.1057/palgrave.jibs.8400229>.
- Rodríguez-Pose, A., and M. Di Cataldo. 2015. "Quality of government and innovative performance in the regions of Europe." *Journal of Economic Geography* 15 (4): 673–706. <https://doi.org/10.1093/jeg/lbu023>.

- Saka-Helmhout, A., M. Chappin, and P. Vermeulen. 2020. "Multiple Paths to Firm Innovation in Sub-Saharan Africa: How informal institutions matter." *Organization Studies* 41 (11): 1551–1575. <https://doi.org/10.1177/0170840619882971>.
- Scott, W. R. 1987. "The adolescence of institutional theory." *Administrative Science Quarterly* 32 (4): 493–511. <https://doi.org/10.2307/2392880>.
- Scott, W. R. 1995. *Institutions and organizations*. Thousand Oaks, CA: Sage.
- Scott, W. R. 2008a. "Approaching Adulthood: The Maturing of Institutional Theory." *Theory and Society* 37 (5): 427–442. <https://www.jstor.org/stable/40345595>.
- Scott, W. R. 2008b. *Institutions and organizations: Ideas and interests*. Thousand Oaks, CA: Sage.
- Seitz, M., and M. Watzinger. 2017. "Contract enforcement and R&D investment." *Research Policy* 46 (1): 182–195. <https://doi.org/10.1016/j.respol.2016.09.015>.
- Shane, S. 1993. "Cultural influences on national rates of innovation." *Journal of Business Venturing* 8 (1): 59–73. [https://doi.org/10.1016/0883-9026\(93\)90011-S](https://doi.org/10.1016/0883-9026(93)90011-S).
- Shao, L., C. C. Y. Kwok, and R. Zhang. 2013. "National culture and corporate investment." *Journal of International Business Studies* 44 (7): 745–763. <https://www.jstor.org/stable/43653754>.
- Sharma, A., C. Sousa, and R. Woodward. 2022. "Determinants of innovation outcomes: The role of institutional quality." *Technovation* 118: 102562. <https://doi.org/10.1016/j.technovation.2022.102562>.
- Shefer, D., and A. Frenkel. 2005. "R&D, firm size and innovation: an empirical analysis." *Technovation* 25 (1): 25–32. [https://doi.org/10.1016/S0166-4972\(03\)00152-4](https://doi.org/10.1016/S0166-4972(03)00152-4).
- Sweet, C. M., and D. S. E. Maggio. 2015. "Do Stronger Intellectual Property Rights Increase Innovation?" *World Development* 66: 665–677. <https://doi.org/10.1016/j.worlddev.2014.08.025>.
- Taylor, M. Z., and S. Wilson. 2012. "Does culture still matter?: The effects of individualism on national innovation rates." *Journal of Business Venturing* 27 (2): 234–247. <https://doi.org/10.1016/j.jbusvent.2010.10.001>.
- Vlachos, V. 2022. "The effect of institutions on R&D investment: the case of four mediterranean euro area states." *Journal of Applied Accounting Research* 23 (4): 788–805. <https://doi.org/10.1108/JAAR-07-2021-0191>.
- Wang, C., M. Kafourous, J. Yi, J. Hong, and P. Ganotakis. 2020. "The role of government affiliation in explaining firm innovativeness and profitability in emerging countries: evidence from China." *Journal of World Business* 55 (3): 101047. <https://doi.org/10.1016/j.jwb.2019.101047>.
- Wang, Y., Y. Wei, and F. M. Song. 2017. "Uncertainty and corporate R&D investment: Evidence from Chinese listed firms." *International Review of Economics & Finance* 47: 176–200. <https://doi.org/10.1016/j.iref.2016.10.004>.
- Williamson, O. E. (2000). "The New Institutional Economics: Taking Stock, Looking Ahead." *Journal of Economic Literature*, 38 (3): 595–613. <https://www.jstor.org/stable/2565421>.
- WIPO (World Intellectual Property Organization). 2023. *Global innovation index 2023. Innovation in the face of uncertainty*. Accessed November 9, 2023.

<https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023-en-main-report-global-innovation-index-2023-16th-edition.pdf>.

World Bank. 2020. Worldwide Governance Indicators [Online]. World Bank. Accessed October 1, 2020. <http://info.worldbank.org/governance/wgi/>.

Xiao, G. 2013. "Legal shareholder protection and corporate R&D investment." *Journal of Corporate Finance* 23: 240–266. <https://doi.org/10.1016/j.jcorpfin.2013.08.009>.

Xu, Z. 2020. "Economic policy uncertainty, cost of capital, and corporate innovation." *Journal of Banking & Finance* 111: 105698. <https://doi.org/10.1016/j.jbankfin.2019.105698>.

Yang, C.-H., Y.-J. Huang, and H.-Y. Lin. 2014. "Do stronger intellectual property rights induce more innovations? A cross-country analysis." *Hitotsubashi Journal of Economics* 55 (2): 167–188. <https://www.jstor.org/stable/43296295>.

Yang, C.-L., and J.-H. Lai. 2021. "Influence of Cross-Listing on the Relationship between Financial Leverage and R&D Investment: A Sustainable Development Strategy." *Sustainability* 13 (18): 10341. <https://doi.org/10.3390/su131810341>.

Yeh, M.-L., H.-P. Chu, P. J. Sher, and Y.-C. Chiu. 2010. "R&D intensity, firm performance and the identification of the threshold: fresh evidence from the panel threshold regression model." *Applied Economics* 42 (3): 389–401. <https://doi.org/10.1080/00036840701604487>.

Zheng, X., S. El Ghouli, O. Guedhami, and C.C.Y. Kwok. 2012. "National culture and corporate debt maturity." *Journal of Banking & Finance* 36 (2): 468–488. <https://doi.org/10.1016/j.jbankfin.2011.08.004>.

Zhou, L., and X. Liu. 2024. "The new government–business relationship and corporate philanthropy: An analysis based on political motivation." *Eurasian Business Review* 14 (3): 807–840. <https://doi.org/10.1007/s40821-024-00269-4>.