R&D investment, firm performance and the moderating role of systems and safeguards : evidence from emerging markets

Alam, MA, Uddin, MM, Yazdifar, H, Shafique, S and Lartey, T

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R&D Investment, Firm Performance and the Moderating Role of Systems and Safeguards: Evidence from Emerging Markets

Abstract: *The relationship between R&D and firm performance is highly dependent on the external environment. Therefore, this paper examined the effects of country level investor protection (safeguards) and governance mechanisms (systems) on the relationship between R&D and firm performance. Using GMM estimation and elasticity testing of panel data for 423 firms from 12 emerging countries, we find that a country's safeguards tend to moderate the relationship between R&D and firm performance more than the system of a country. The results indicate that safeguarding is relatively more important for the relationship between R&D and firm performance than other country level governance mechanisms, as the former can easily attract outside capital when it is strong. These results have significant implications for innovation policy. In particular, managers may wish to strengthen investor protection to promote high R&D investment in order to increase firm performance.*

Keywords: R&D investment, System, Safeguard, Emerging markets.

1. Introduction

Research and Development (R&D) expenditure has been treated as an important constituent of economic growth (Brown et al., 2009; Alam et al., 2019a). To maximise the potential impact of R&D investment on economic growth and development, it is essential to ensure the efficiency and productivity of such investment. A number of papers have found that strong corporate governance at both firm level and country level helps to improve the efficiency and productivity of R&D investment. For example, Cui and Mak (2002), Chen and Hsu (2009), Ayyagari et al. (2011) and Honoré et al. (2015) concluded that firm level corporate governance helps to improve the efficiency of R&D investment. On the other hand, authors such as Hillier et al. (2011), Pindado et al. (2015), Chu et al. (2016), and Alam et al. (2019b) have concluded that country level governance has a strong effect on the efficiency of R&D investment.

Although from a holistic point of view, both firm and country level governance are important for the productivity and efficiency of R&D investment, this paper has examined country level governance, assuming its relative superiority over firm level governance, as suggested by Doidge et al. (2007), who stated that country level variables explain 39-70% of a firm's governance choices, while firm level variables explain only 4-22%. For emerging economies, firm level factors explain almost nothing, as the cost of adoption of those variables outweighs the benefits (Doidge et al., 2007).

R&D investment involves high levels of information asymmetry. Moreover, it is risky, long term in nature and characterised by opacity of information (Keupp and Gassmann, 2009). This, in turn, leads innovative firms to face external financing constraints and agency conflict, both of which contribute to inefficiency of R&D investment (Xiao, 2013). Hillier et al. (2011) concluded that country level governance helps to reduce the agency problem and external financing constraints and to enhance the efficiency of R&D investment. Country level governance factors such as legal investor protection, financial systems, ownership structure and independence of the board and the market for corporate control may influence the relationship between R&D and firm value (Pindado et al., 2015). Although there is some evidence on the effect of country level governance on R&D efficiency, research on the relative importance of various components of the overall governance system is very rare. In this paper, we examine whether enhanced investor protection as a component of the governance system plays a more critical role to influence firm level R&D performance compared to other components of the country level governance system. The paper argues that among all the various components of the governance system, strong investor protection will have more impact on the relationship between R&D and firm performance.

This paper focuses on emerging markets, considering the importance of those markets within the global economy. R&D investment is growing faster in emerging economies in recent years

(Alam et al., 2019b). Li and Kozikhode (2009) stated that the global R&D landscape is changing very rapidly and emerging markets are attracting more attention from multinational companies (MNCs) as a location for increased levels of R&D investment due to higher demand, lower cost and increased levels of technology adoption. Logue (2011) stated that the rate of return from the same investment is higher in emerging markets than in developed countries. As a result, in recent years, MNCs are establishing large numbers of R&D centres in emerging markets (Patra and Krishna, 2015). Although much of the attention is now towards emerging markets, the fact remains that these countries are poor in terms of corporate governance practices. Claessens and Yurtoglu (2013) pointed out that corporate governance practice is particularly poor in many emerging markets. More importantly, the possibility of managerial expropriation is higher in those economies due to weak enforcement of legal rights. Thenmozhi and Narayanan (2016) argued that country level rule of law and the aggregate enforcement culture may overcome the weaker firm level governance and stop managerial expropriation by giving investors better safeguards. Moreover, country level governance, particularly in emerging markets, has an impact on firms' performance by influencing firms' decision-making mechanisms and strategic choices (Peng et al., 2009; Ruiqi et al., 2017). Therefore, it would be interesting to see whether country level governance in emerging economies has any influence in moderating the link between R&D and firm performance.

Following Haidar (2009) and Kaufmann et al. (1999), we have separated greater investor protection from country level governance factors. The distinction between greater investor protection and country level governance is important, especially from the context of emerging markets, where firm level governance is poor and the possibility of managerial expropriation is higher (Claessens and Yurtoglu, 2013). Country level investor protection provides a 'safeguard' to the investors, as suggested by Agrawal (2013), and positively influences corporate investment policy by reducing the chance of managerial expropriation. Therefore, in

this paper, we consider greater investor protection as a 'safeguard'. We treat country level governance as a 'system', following Sir Adrian Cadbury, who stated that corporate governance is the system by which companies are directed and controlled (Cadbury Committee, 1992). Using generalized method of moments (GMM) estimation of panel data for 2,471 firm-year observations consisting of 423 firms from 12 emerging countries, it is found that a country's safeguards tend to have a greater moderating effect than its system. The results indicate that safeguards promote firm-level innovation in emerging markets, while systems substitute for firm-level corporate governance. Moreover, they show that safeguarding is relatively more important for R&D and firm performance than other country governance, as it easily attracts outside capital when it is strong.

This paper is organised as follows. Section 2 presents the theoretical framework and hypotheses relevant to the study. Section 3 introduces the data and research method, and in Section 4 the results are presented and discussed. Section 5 draws conclusions from this study.

2. Theoretical Framework and Hypotheses

R&D investment is used as a source of competitive advantage, long-term growth and technological advancement, which lead to better firm performance (James and McGuire, 2016; Ruiqi et al., 2017; Patel et al., 2018). The existing literature has found a positive relationship between R&D and firm performance (Chan et al., 2001; Eberhart et al., 2004; Yeh et al., 2010). For example, Chan et al. (2001) found that corporate R&D investment is associated with positive value gain for the investing firms. Eberhart et al. (2004) found that corporate R&D investment helps to improve the operating performance of investing firms in the long run. However, the relationship between R&D investment and firm performance may be strengthened or weakened by country-level factors. In a related study, Pindado et al. (2015) have shown that country-level factors moderate the relationship between R&D and firm

performance. Chan et al. (2001) also found evidence that external corporate governance helps to improve the relationship between R&D and firm performance.

R&D investment may not automatically create value for the investing firms. The agency conflict, as suggested by Jensen and Meckling (1976), may restrict the benefit gained from R&D investment. Based on the free cash flow hypothesis, Jensen (1993) concluded that managers may overspend their free cash flows in projects like R&D. This overinvestment may cause value destruction. Jensen (1993) also pointed out that value destruction in R&D projects may be an outcome of the failure of internal control systems. The possibility of limited gain from R&D investment may also stem from the higher financing cost associated with R&D projects due to the risky nature of R&D (Hillier et al., 2011). However, La Porta et al. (1998), Rajan and Zingales (1998) and Hsu et al. (2014) pointed out that better country level governance mechanisms, including investor protection, legal systems and financial development, may help to overcome the agency problem. Hillier et al. (2011), Xiao (2013), Pindado et al. (2015), and Chu et al. (2016) have concluded that country level governance encourages R&D and improves the efficiency of R&D investment. Existing literature on the relationship between R&D and firm performance has so far identified a number of factors that moderate this relationship. For example, Hillier et al. (2011) and Pindado et al. (2015) highlighted the role of investor protection, financial development and control mechanisms, while Xiao (2013) and Chu et al. (2016) focused on the rule of law and investor protection. For emerging markets, where the overall corporate governance system is poor and the possibility of managerial expropriation is high (Claessens and Yurtoglu, 2013), greater investor protection should play a more critical role in influencing the R&D-performance link compared to other components of the governance system. Strong investor protection reduces the possibility of managerial expropriation (Agrawal, 2013) and makes the investors confident in making risky investments even in markets where general governance is poor. Therefore, in emerging

markets, greater investor protection should have more explanatory power in explaining firm profitability from R&D investment compared to other components of the governance system. Following Haidar (2009) and Kaufmann et al. (1999), and in line with our main research argument about the relative importance of greater investor protection, country level governance factors are separated in this study into two groups. Haidar (2009) used a revised definition of investor protection that represents greater protection for investors and includes disclosure, liabilities and shareholder suits. Following Kaufmann et al. (1999), this study has considered rule of law, government quality, political stability, corruption and accountability as a collective governance system. We are proposing that greater investor protection (safeguard) and collective governance system (system) will have differential impact on the relationship between R&D and firm performance. Figure 1 explains this conceptual model.

Please insert Figure 1 about here

Researchers have long been trying to measure the relationship between R&D and firm performance. However, the results have been inconclusive. Ehie and Oilbe (2010) and Gunday et al. (2011) found a significant positive relationship, while Chan et al. (1990) and Knecht (2013) found a negative relationship between R&D intensity and firm performance. Although there has been a debate as to whether R&D investment contributes to firm performance, we argue that R&D investment may not influence firm performance in the same year, as new product development, new production methods and information technology need time to show results. Moreover, due to its uncertain, risky and costly nature, the R&D process may not always satisfy the current market demands (Liao and Rice, 2010). In a related study, Knecht (2013) pointed out that the current year's R&D investment reduces current year profits but may impact positively on future firm performance. Moreover, Parcharidis and Varsakelis (2007) and Natasha and Hutagaol (2009) found that R&D investment impacts negatively on profit for the year of the investment, but there may be a strong positive relationship after two years.

Similarly, Kothari et al. (2002) and Pandit et al. (2011) found evidence that R&D activities contribute to firms' future performance. It has been argued that firms' investment in R&D can be more productive and cost effective, reduce earnings volatility and generate better profit margin in future periods (Eberhart et al., 2004; Pandit et al. 2011; Bond and Guceri, 2017; Yoo et al.,2019), which is considered as the real value of R&D. Therefore, based on the above analysis, we hypothesize that:

Hypothesis 1_a: *There is a negative relationship between R&D and concurrent firm performance.*

Hypothesis 1_b: *There is a positive relationship between the previous year's R&D and current firm performance.*

Although there could be a positive relationship between the current year's R&D/previous year's R&D and future performance/current performance, this relationship could be stronger in the presence of strong investor protection. Since the seminal works of La Porta et al. (1997, 1998), researchers have found that investor protection has a significant impact on firm finance, investment and growth. Investor protection law increases investor confidence, both legally and psychologically. Anderson and Gupta (2009) argued that stronger investor protection assures investors that, besides their original investment, more of the firm's profits will get back to them as dividends and interests. This protection encourages investors and entrepreneurs to pay more for financial assets that increase the R&D investment of a firm. Moreover, investor protection ensures access to external financing, and therefore has a significant impact on investment in R&D activities (Brown et al., 2013). In addition, investor protection influences the relationship between R&D and firm performance by improving the efficiency of a firm's R&D investment. Pindado et al. (2015) found that effective investor protection leads to a positive relationship between R&D and market value, while Xiao (2013) found that stronger investor protection

facilitates faster sales growth in R&D-intensive industries. From the above discussion, the following hypothesis is postulated:

Hypothesis 2: *Investor protection (safeguard) positively moderates the strength of the relationship between R&D and firm performance.*

In making strategic decisions on risky and uncertain investments such as R&D, firms consider the background of institutional or country-level governance factors (Alam et al., 2019b). Wu et al. (2016) stated that the institutional environment may stimulate R&D activity by providing capacities or constraints beyond those of individual firms. Moreover, Peng et al. (2008) stated that strategic choices such as R&D investment are driven by the institutional framework confronting managers, along with industry conditions and firm-specific resources. In addition, Hiller et al. (2011) argued that better governance ensures greater disclosure and accountability, which in turn facilitates the availability of external financing for R&D. These results indicate that, when country-level governance becomes stronger, financial factors become more effective in boosting R&D investment. They found that country-level governance factors reduce the sensitivity of R&D to internal cash flows. Moreover, dimensions of country-level governance are also related to better performance (Gugler et al., 2013). In line with this result, Pindado et al. (2015) found that country-level governance factors significantly influence the market valuation of firms' R&D investment. Following Pindado et al. (2015), the following hypothesis is postulated:

Hypothesis 3: *Country-level governance (system) positively moderates the strength of the relationship between R&D and firm performance.*

3. Data, model and method

3.1 Data, Sample Selection and Variables

Data were collected from several sources for the sample period of 2006-2013, including DataStream, the World Bank's Protecting Minority Shareholders data, and the International Country Risk Guide (ICRG) database. The post-reform period of R&D reporting was chosen so that the sample firms would treat R&D expenditure homogeneously, following Alam et al. (2019b). Firm-level data were drawn from DataStream, including R&D expenditure, fixed assets, total assets, total debt, sales, earnings before income and tax (EBIT), and return on invested capital (ROIC). Then, in order to control for the effect of inflation over time, the nominal values of all variables were deflated by the annual inflation rate[1]. Investor protection data, measured in terms of disclosure, liability and ability of investors to sue, were obtained from the World Bank's Protecting Minority Shareholders data. Data on country-level governance factors, measured in terms of government effectiveness, regulatory quality, rule of law, control of corruption, political stability and accountability, were obtained from the ICRG database.

We applied several sample selection criteria. In order to be included in the sample, firms must have at least five consecutive years of data to control for short panel bias (see Flannery and Hankins, 2013). We included countries that have at least 40 firm-year observations, following Anton et al. (2019). Moreover, Hong Kong, Singapore, South Korea and Taiwan were excluded, as these countries are now considered as emerged economies. Following Pindado et al. (2015), financial firms were excluded due to their differing corporate structure and strategy. In addition to this, as DataStream contains some missing and unrealistic figures (such as negative values of R&D expenditure), after dropping those values the dataset consisted of 423

[1] We collected annual inflation rates from the World Bank country level database.

firms from 12 emerging countries[2] (see Table 1). Several sources of data and sample selection criteria, particularly missing data, lead to unbalanced panel data. In a relevant study, Hillier et al. (2011) states that unbalanced panel data helps to mitigate the survivorship bias problem. In addition, Arellano (2003) argues that estimations based on unbalanced panel data are as reliable as those based on balanced panel data.

Please insert Table 1 about here

Table 2 shows definitions of the variables. Following Yeh et al. (2010), this study has used ROA as the dependent variable. In addition to ROA, ROIC is also considered as a dependent variable to observe the impact of country-level factors. R&D intensity has been used as an independent variable and is measured by dividing total R&D expenditure by sales, as suggested by Honoré et al. (2015). Another important independent variable that has been used in this study is investor protection. La Porta et al. (2000) observed that investor protection should include rights to receive dividends on *pro rata* terms; to vote for directors; to participate in shareholders' meetings; to subscribe to new issues of securities on the same terms as insiders; to sue directors or the majority for suspected expropriation; and to call extraordinary shareholders' meetings. Djankov et al. (2006) introduced a further measure of investor protection against expropriation by corporate insiders: the anti-self-dealing index. They argued that this new measure predicts a variety of stock market outcomes and works better than the previous anti-directors index. However, La Porta et al.'s measurements of investor protection have been criticised by several authors. For example, Siems (2006) criticises the choice of variables by La Porta et al. as those variables represent significant US bias and also fall short of including some of the significant aspects of law.

[2]To mitigate the potential bias from the dominant country in the sample, we ran separate regressions, except for India. We find similar results as in the main regression. These results can be provided upon request.

In this study, investor protection variables are measured following Haidar (2009). The three components of the Doing Business investor protection index are disclosure, liability and investor suits. Disclosure measures the transparency of transactions and is further subdivided into five sub-indices that include a corporate body that can provide legal approval for transactions; disclosure of transactions to the public; mandatory disclosure in annual reports; mandatory disclosure to the board of directors or supervisor; and pre-audit by an external body. Liability measures directors' liabilities, and includes sub-indices like investors' ability to be included in the approving body, directors and members of supervisory boards being liable for damages due to acting negligently or being influenced by the approving body. Investor suits measures investors' rights to sue officials and directors for misconduct and is composed of sub-indices like whether investors can obtain relevant documents from a company and can recover legal expenses. Investor protection is the sum of the average of disclosure, liability and investor suits, and the shareholder governance index. The index ranges from 0 to 10, with higher values indicating stronger investor protection. Dummy variables are used for each component: disclosure, liability and investor suits, where values higher than the median are assigned the value of 1, and 0 otherwise.

Following Kaufmann et al. (1999), country-level corporate governance (system) is measured by using six components, comprising government effectiveness, regulatory quality, rule of law, control of corruption, political stability and accountability. Different index ranges have been used, such as government effectiveness from 0 to 4; regularity quality and political stability from 0 to 12; rule of law corruption, and accountability from 0 to 6, with higher values indicating stronger institutions. Dummy variables are used for each component, with values higher than the median taking a value of 1, and 0 otherwise. Following Majumdar (1997), Artz et al. (2010), Ehie and Olibe (2010), García-Manjón and Romero-Merino (2012), Pindado et al. (2015), Alam et al. (2019a), Alam et al. (2019b), and Anton (2019), this study has used

several firm level control variables, including firm size, sales growth, leverage, tangibility, financial crisis, and also industry dummy to control the industry effect.

Due to various diverse capabilities such as ability to exploit economies of scales and scope, formalisation of procedures and implementation of effective operations, larger firms generate superior performance than smaller firms (Penrose, 1959; Majumdar, 1997). Therefore, we expect a positive relationship between firm size and firm performance. Firm size is measured as the natural logarithm of total assets, following Alam et al. (2019a) and Anton (2019). Sales growth of the firm motivates managers, retains talented employees, and experiences increasing profitability (Jovanovic, 1982; Brush et al., 2000). Brush et al. (2000) pointed out that growth may provide extra market power, which firms can use to increase performance. In a related study, Frank (1988) found that firm growth is a good signal of the firm's performance expectations and hence implies a positive relation between sales growth and firm performance. Sales growth is measured as annual sales growth of the firm, following Alam (2019a). Lazar (2016) found evidence that leverage is one of the key determinants of firm performance. It is argued that increase in debt creates agency cost, and debt overhang may create underinvestment problems, which weaken firm performance (Myers, 1977; Ibhagui and Olokoyo, 2018). Based on emerging European firms, Anton (2019) found that leverage negatively affects firms' growth. Following Anton (2019), we expect a negative relationship between leverage and firm performance. Leverage is measured as total debt over total assets, following Alam et al. (2019b) and Anton (2019). Previous studies show that higher tangible assets lead firms to face more financial constraints. As a result, firms might be affected adversely in terms of their ability to make investment (Fazzari et al. 1988; Aghion et al., 2004; Hillier et al, 2011). Therefore, we expect a negative relationship between tangibility and firm performance. We have measured tangibility as fixed assets over total assets, following Hillier et al. (2011). Claessens et al. (2011) stated that due to greater sensitivity to aggregate demand and international trade,

financial crisis decreases firms' performance. During the recent global crisis period, there was an equity value reduction of more than $29 trillion and the equity market dropped more than 56% (Chen et al., 2014; Lee et al., 2017). Therefore, we expect a negative relationship between financial crisis and firm performance. We created a dummy variable to control for the financial crisis effect, which takes the value of 1 if the year is between 2007 and 2009 and 0 otherwise, following Beuselinck et al. (2017). All variables are winsorized at the 1% and 99% level to restrict the influence of outliers.

Please insert Table 2 about here

3.2 Summary statistics

Tables 3, 4, and 5 report the descriptive statistics of the sample by firm, industry and country respectively. They are presented in three separate tables to provide a clearer picture of the sample. The firm-level data (Table 3) indicate that, except for ROIC, the values of variables do not vary across firms over time. ROIC has a high standard deviation of 11.01, indicating that this value varies greatly across firms over time. Moreover, the high standard deviations of the firm size and sales growth variables confirm variation in firm observations. It is a common belief that firm size and firm growth vary in all countries worldwide. Table 4 clearly shows that technology-based firms invest more in R&D than do those in non-technology-based sectors, with a difference of approximately 34%. Tabrizi (2005) also points out that technology-based firms spend more on R&D than do non-technology-based firms. In general, technology-based firms place more weight on bringing new knowledge to the markets, advancing technology, and increasing employee skills, internal competencies and capabilities. These results support considering control of the industry effect in the model.

Table 5 shows descriptive statistics for country-level factors, including investor protection and country-level governance variables. Investor protection may vary not only by firm but also

by country. Israel, Malaysia and South Africa have higher than average values for each of the investor protection components, which ensure balanced and strong investor protection. In contrast, in several countries, such as China, Indonesia and Russia, investor protection components vary greatly, indicating unbalanced and low investor protection. For instance, China has a disclosure index of 10, which is strong, but its score for the directors' liability index is 1, which indicates weak investor protection. On the other hand, Malaysia has higher-than-average values for country-level governance components, indicating a strong, balanced governance system. Russia's government effectiveness and Pakistan's voice and accountability are very low compared with other countries. Most interestingly, emerging countries still suffer from a lack of control of corruption. The data shows that this value is low compared with other components. Among emerging countries, only Malaysia has higher than average values for both investor protection and country governance factors. When compared with the median, India, Israel, South Africa, and Malaysia have stronger investor protection, while Greece has higher governance. This suggests that, among the sample countries, investor protection is stronger than governance.

Please insert Table 3 about here

Please insert Table 4 about here

Please insert Table 5 about here

In order to examine the impact of the influence of country governance factors on the relationship between R&D spending and firm performance, the following model was devised.

$$Performance_{it} = \alpha_i + \beta_1(Performance_{it-1}) + \beta_2(R\&D\ Intensity_{it}) + \beta_3 \ln(Firm\ Size_{it}) + \beta_4(Sales\ growth_{it}) + \beta_5(Leverage_{it}) + \beta_6(Tangibility_{it}) + \beta_7(Financial\ crisis_{it}) + \beta_8(R\&D*Investor\ protection_{it}) + \beta_9(R\&D*Country\ governance_{it}) + \eta_i + d_t + I_i + \nu_{it} \quad (1)$$

Subscript *i* represents the country and *t* represents the year. Here, α_i, and $\beta_1$to β_{15} represent relationships between performance and the explanatory variables. The error component ε_{it} is separated into four sub-components $\varepsilon_{it} = \eta_i + d_t + I_i + v_{it}$, while η_i is considered as an individual effect to control for individual heterogeneity, which is then eliminated by taking first differences. The time dummy, denoted by d_t, captures the time-specific effect to control for macroeconomic variables on R&D and performance. As the industries are separated into technology-based and non-technology-based, an industry dummy I_i is used to capture industry-specific effects. v_{it} is a random disturbance term which is assumed to be i.i.d. normal.

3.3 Method

In order to examine the moderating effect of investor protection and country governance on the relationship between R&D investment and firm performance, a two-step system[3] GMM estimation was performed, following Alam et al. (2019a). System GMM is consistent with panel data structure and it is efficient when a panel has a smaller time dimension (T equals 8) compared to its cross-sectional dimension (N equals 423) (Asongu et al., 2018). System GMM estimation helps to address omitted variable bias, measurement errors, unobserved heterogeneity and endogeneity (Teixeira and Queirós, 2016; Mthanti and Ojah, 2017; Alam et al., 2019b), which may arise due to reverse causality. Reverse causality may arise because R&D investment has an impact on firm performance (Ehie and Olibe, 2010), but performance may also impact R&D investment, as a higher firm value may encourage managers to commence new R&D activities (Pindado et al., 2015). The presence of this reverse causality

[3]We used system GMM instead of difference GMM, as system GMM has been found to be more efficient than difference GMM (Blundell and Bond, 1998), while difference GMM estimation has a problem of weak instruments (Alonso-Borrego and Arellano, 1999). A two-step estimation was performed on the grounds that it produces more efficient estimates than one-step estimation. In two-step estimation, the standard covariance matrix is robust to panel-specific heteroscedasticity and serial correlation, but the standard errors are downward biased. To fix the possible downward bias, the Windmeijer (2005) finite-sample corrected covariance matrix was applied.

(i.e. simultaneity bias) may render the OLS regressions results unreliable (Frijns et al., 2014). Moreover, as the current performance of firms may influence their future performance, the lag of performance (a dependent variable) was included as a regressor. Using lag of performance as an independent variable while performance is the dependent variable may cause problems while we use the 'fixed effect' or 'random effect' model. However, this problem could be avoided by using the system GMM method (Teixeira and Queirós, 2016).

Since the first difference of all variables was taken in order to control for unobserved heterogeneity, first-order autocorrelation in the residuals is expected. The results of first-order autocorrelation AR(1) in the first difference residuals show that the null hypothesis of no autocorrelation is rejected in all models. However, second-order autocorrelation AR(2) in the first difference residuals is unable to reject the null hypothesis, which suggests the presence of no autocorrelation. This confirms that the dynamic lag structure of the models is sufficient (i.e. one lag for the firm performance variable).

The acceptability of the dynamic GMM estimation mostly depends on the use of valid instruments in the analysis. As we are using system GMM, lagged values such as t-1, t-2 and t-3 for the difference equation and one lag for the level equation are used. The Hansen J statistic of over-identifying restrictions was applied to test the validity of the instruments, and the results show that the instruments are valid in the models. Moreover, the Difference-in-Hansen test of exogeneity shows that the subset of instruments that are used for the equations in levels is exogenous. Teixeira and Queirós (2016) pointed out that system GMM may suffer from an instrument proliferation problem. However, in order to choose the best possible instruments, there should be a trade-off between exogeneity and the strength of each instrument, as suggested by Keasey et al. (2015). In relation to this, a number of past studies also suggested that the number of instruments, i, should be less than the number of groups, n, which are firms

in our study (i.e. Asiedu and Lien, 2011; Mthanti and Ojah, 2017). The standard value of the ratio should be more than one and our results suggest that the group-to-instruments ratio (r = n/i) is above 1 for all the models that we have used. In addition to this, two Wald tests were used to examine the joint significance of the explanatory variables, z_1, and the joint significance time dummy, z_2. These have provided good results for our models.

4. Results and discussion

Table 6 presents the results of the GMM estimation. Seven models (1 to 7) were used to examine the moderating effects. Model 1 is the basic model of this estimation, the results of which show that current year's R&D intensity and current year's performance have a negative relationship. With a one-unit change in R&D intensity, firm performance changes by 0.2875 units. This is in line with Parcharidis and Varsakelis (2007), who obtained a negative relationship between R&D investment and firm performance in the concurrent year. This implies that R&D intensity takes time to show returns on the investment, confirming the general view that R&D intensity does not create benefits in the same year. Therefore, the results strongly support Hypothesis 1_a. As R&D investment is long term in nature and takes time to affect firm performance, it is expected that R&D has a positive impact on firms' future performance. As expected, the results show that lag of R&D has a positive but insignificant impact on firm performance. Although the results do not fully support our hypothesis 1_b, this finding is aligned with our notion that R&D alone cannot automatically create value for the investing firms. Institutional quality may strengthen or weaken this relationship.

Please insert Table 6 about here

In Model 2, the interaction terms of the investor protection index are added. The lagged R&D intensity is interacted with the investor protection index. The positive coefficient on the

interaction term suggests that investor protection has a significant influence on R&D spending in increasing firm performance. The results remain robust in Model 6 after including the country governance index in the regression. This implies that investor protection enhances the performance of R&D investment by facilitating external finance (Hiller et al., 2011), reduces managers' opportunistic behaviour in diverting cash flows to themselves (Ghosh and He, 2015) and capital allocation (Xiao, 2013), which in turn increase firm performance. Similar results were also reported by Xiao (2013). These results confirm the moderating role of investor protection on the relationship between R&D and firm performance. Therefore, the results support Hypothesis 2.

In Model 3, in order to examine which aspects of investor protection drive the positive effect on firm performance, the investor protection index is split into three sub-components: disclosure, directors' liability and shareholder suits. The base model shows that lagged value of R&D intensity and firm performance have a positive but statistically insignificant relationship, but the relationship becomes positive and significant when the interaction terms, except disclosure, are present. These results suggest that R&D intensity influences firm performance when directors are more liable for their activities, which makes them more accountable for their decisions. The positive relationship between R&D intensity, shareholder suits and firm performance is consistent with the idea that the possibility of shareholder suits puts pressure on directors to make investments, such as into R&D, that will enhance firm value. Directors' liability and shareholder suits remain robust when new governance variables are added into the regression in Model 7. In addition, disclosure becomes significant. The negative coefficient of the interaction term of disclosure and R&D investment implies that disclosure of R&D-related activities does not influence firm performance. This result is not surprising, given the fact that traditional style disclosure of R&D through financial statements fails to convey complete information to investors (Lev, 1999; Aboody and Lev, 2000). The situation could be

improved by following more voluntary disclosure of qualitative information regarding R&D to mitigate information asymmetry (Merkley, 2010), but this would be difficult for emerging markets, as the extent of voluntary disclosure in those markets is very inadequate (Claessens and Yurtoglu, 2013).

In Model 4, the country governance index is interacted. The results show that the interaction between the country governance index and the lagged value of R&D investment has no influence on firm performance. This is because firm-level governance has a greater influence than country governance on strategic decisions such as R&D in generating firm performance. This result is consistent with the findings of Durnev and Kim (2005) and Hugill and Siegel (2014), who concluded that firm level governance factors dominate over country level governance in emerging markets. More specifically, they found that governance variables such as board independence, ownership structure and financial development are more influential at firm level in emerging markets. Therefore, in the case of governance systems, firm level factors play a more critical role in moderating firm performance compared to country level factors, and this is evident from our result. Therefore, the results do not support Hypothesis 3.

In order to examine aspects of country governance in greater depth, country governance is sub-divided into government effectiveness, regulatory quality, rule of law, control of corruption, political stability, and voice and accountability. It can be seen from the results of Model 5 that only government effectiveness, control of corruption and voice and accountability have a positive influence on the lagged value of R&D intensity and firm performance. In an empirical study, Mahmood and Rufin (2005) stated that government effectiveness accelerates the technological innovation through the spillover effect and by creating networks between firms and individuals. Moreover, greater government capacity may promote R&D investment by providing greater support, budgets and subsidies for creative and innovative activities, which in turn increases firm performance. Moreover, control of corruption may facilitate the size of

R&D investment, as it motivates innovation-related FDI and reduces investment costs. Veracierto (2008) stated that detecting corruption or controlling corruption by imposing penalties can result in a large increase in R&D investment, which may improve ethical standards and speed up the work of officials, and therefore, may improve firm performance. A high level of accountability of managers and directors to shareholders influences the relationship between R&D and firm performance. Voice and accountability ensures the responsible behaviour of managers, which influences investments in general and R&D investment in particular. Moreover, high accountability ensures responsible decisions, actions and commitment to accomplishing the task. In addition, high accountability guarantees organisational learning and innovation. Interestingly, in Model 7, when three more variables of investor protection are introduced into the regression, these country-level governance variables become insignificant. These results suggest that investor protection, whether aggregate (Model 6) or separate (Model 7), tend to have a greater influence on the relationship between R&D and firm performance.

ROA_{t-1} impacts positively on firm performance, indicating the persistent performance of the firm: this is consistent with the findings of Artz et al. (2010), who stated that the current performance of a firm is dependent to some extent on past performance. Firm performance is also influenced by firm size. A larger firm size indicates greater assets, higher capacity, higher investment and greater human capital, which help to utilise more resources and obtain greater returns. Majumder (1997) also obtained similar results. The coefficient of sales growth is positive and significant, implying that growth opportunities help firms to expand knowledge, skills and abilities, and to provide new products to customers, which in turn increases firm performance. Asimakopoulos et al. (2009) also found that firm growth has a positive impact on firm performance. In contrast, leverage shows a negative impact on firm performance, consistent with the findings reported by Asimakopoulos et al. (2009). The negative relationship

between leverage and firm performance has been also reported by Anton (2019) in a sample of firms from emerging Europe. This is because high leverage increases the probability of bankruptcy. Similarly, tangibility and firm performance are negatively related. The results suggest that greater tangibility indicates higher fixed assets, such as equipment and buildings, and lower investment, and in turn lower return. Hillier et al. (2011) also found that tangibility has a negative impact on R&D investment, which in turn reduces firm performance. As expected, the financial crisis adversely affected firm performance during the sample period. Claessens et al.'s (2011) study also reached similar conclusion. It is argued that due to the recent financial crisis, firms' sales, profits, exports, FDI, and even sources of finance were reduced, which caused adverse effects on overall firm performance.

4.1 Robustness Test

In order to test the robustness of the models, ROIC is considered as a dependent variable. ROIC measures the efficiency of the firm on the basis of capital investment, expressed as profit per dollar of invested capital. ROIC has advantages over ROA in measuring profitability. For example, it does not include non-operating items in measuring profitability. Moreover, ROA can easily be skewed when a firm has excess cash. In contrast, ROIC overcomes these shortcomings. Moreover, it helps to compare firms with different financial structures. Thus, robustness was tested using ROIC.

Table 7 reports the results of GMM estimation, where ROIC is the dependent variable. The results show that investor protection factors interacting with R&D have a significant impact on firm performance. All the results in Models 1, 2, 4 and 7 are similar to those for ROA. In Model 3, the results show that disclosure and R&D jointly negatively impact firm performance. This implies that higher disclosure of R&D negatively impacts firm performance. Therefore, R&D disclosure principles play a vital role. If R&D costs are treated as an expense in the period in

which they are incurred, net income decreases. In Model 5, the composite country governance index becomes significant. This is because the capital investments (ROIC) rather than total assets (ROA) of a firm are influenced by both investor protection and country governance. The implication is that the external environment is very important for investment and for the ability to gain returns on it. In Model 6, the results become robust, as control of corruption and voice and accountability, together with R&D, has an impact on firm performance. The results for government effectiveness, control of corruption and voice and accountability remain the same as for ROA. On the other hand, political stability negatively influences R&D investment. This is because political stability varies greatly between emerging markets because many are less democratic and less accountable to their people, and this discourages foreign investment in innovative activities. From the test for robustness, it can be concluded that safeguards (investor protection) have a greater impact on the relationship between R&D and firm performance than systems (country governance).

Please insert Table 7 about here

4.2 Comparing systems and safeguards

In addition to the GMM estimation, we performed an elasticity test to compare the relative strength of systems and safeguards in moderating the relationship between R&D and firm performance. The elasticity test gives a homogenous base for comparison between the variables (Hillier et al., 2011; Alam et al., 2019b). Following Hillier et al. (2011), we computed elasticity using the following formula:

$$E_i = \beta_i \frac{\overline{X}_i}{\beta^p \overline{\mathrm{X}}}$$

Where I represents the institutional variables, β_i indicates its coefficient, $\overline{X_i}$ is its mean, and $\beta^p\overline{\mathrm{X}}$ captures the predicted value of the dependent variable evaluated at the mean of each regressor.

The test results show that safeguarding is more influential than the system in moderating the relationship between R&D and firm performance. Table 8 shows that the elasticity of safeguards (0.16911) is much higher than the elasticity of systems (0.03036). In a similar study based on a developed country, Hillier et al. (pp. 3, 2011) also compared country level governance factors and found that safeguards are the most important factor which reduces the R&D and cash flow sensitivity. This means that safeguards have more explanatory power than systems to facilitate R&D investment.

Please insert Table 8 about here

5. Conclusion

This paper has examined whether better investor protection (safeguards) has a more critical role in moderating the relationship between R&D and firms' performance than other components of country level governance (system). Using unbalanced panel data from 12 emerging countries covering 423 firms and applying the GMM estimation method, this paper has found strong evidence that, in emerging markets, safeguards play a more critical role than systems in moderating the relationship between R&D investment and firms' performance. The results show that R&D investment generates higher profits in countries where investor protection (safeguards) is stronger. More insightful information is provided when investor protection is separated into the sub-components of disclosure index, liability index and shareholder suits index. The results indicate that R&D intensity influences firm performance when directors are more liable for their activities. Moreover, the positive relationship between R&D intensity, shareholder suits and firm performance is consistent with the idea that the

possibility of shareholder suits puts pressure on managers and directors to make investments such as in R&D that will enhance firm value. However, disclosure shows a negative impact when ROIC is considered as the dependent variable. This is because, if R&D costs are treated as an expense in the period in which they are incurred, net income is decreased. Moreover, lack of voluntary disclosure in emerging markets makes it relatively weaker to influence corporate decisions. The results also indicate that the combined country governance factor (system) has little influence on R&D investment and firm performance. This suggests that firm-level governance factors may be more influential in firm-level strategic decisions such as R&D in emerging markets. These results are also confirmed by additional robustness tests. Moreover, the elasticity test conducted in this study also confirms that the relationship between R&D and performance is more sensitive to safeguard factors than system factors in emerging economies.

The results in this study have important implications for researchers, policy makers and investors. It has been documented that firm level governance systems are poor in many emerging economies (Claessens and Yurtoglu, 2013). This state of emerging economies may discourage both domestic and international investors from making risky investments such as R&D. However, the results of this study confirm that strong country level investor protection may be a solution to overcome this underinvestment problem by giving investors more protection against firm level inefficient governance. Firms can improve the profitability by increasing R&D investments in emerging markets where country level investor protection is sufficient, ignoring the weaknesses of micro level governance. Doidge et al. (2007) pointed out that, for emerging economies, firm level governance should not be given importance, as the cost of adopting such governance variables outweighs the benefits. Therefore, putting more emphasis on country level investor protection, as suggested by our results in this study, also helps to avoid costly effort to fix the firm level governance. Although this paper has explored the country level investor protection and governance factors based on the earlier findings that

country level factors are more influential than firm level factors, future research may use firm level factors along with country level factors to see the combined impact of these factors in moderating the relationship between R&D and performance.

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Figure 1: Conceptual Framework

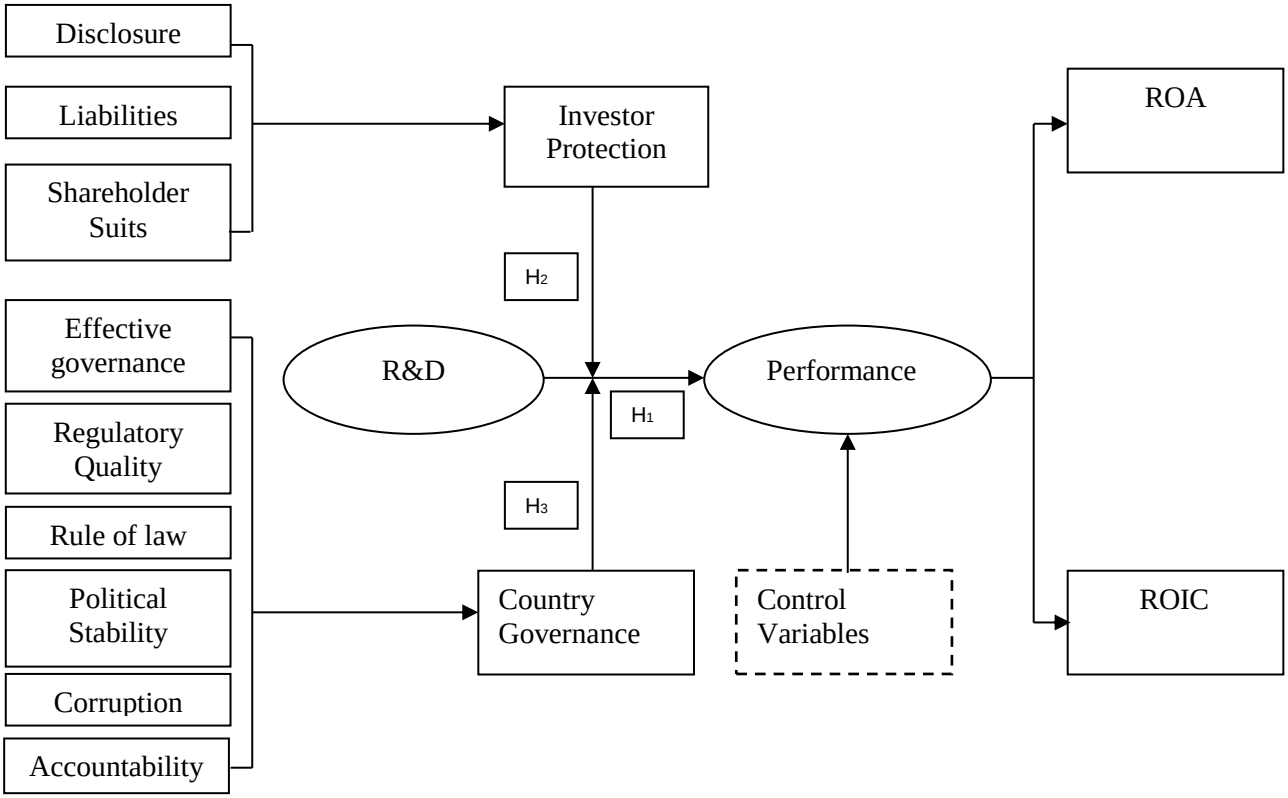

Table 1: Sample Selection[4]

Description	No. of Countries	No. of firms
Initial search on DataStream	51	34,528
Firms with five consecutive years of data	39	2,657
Countries have at least 40 firm-year observations	16	1,625
Dropped: Countries that are already emerged	4	1,202
Final sample	**12**	**423**

Source: DataStream

Table 2: Definition of Variables

Data Type	Variable	Description
Firm data:	Return on assets (ROA)	Earnings before interest and tax over assets
	ROIC	Earnings over invested capital
	R&D intensity	R&D expenditure of the firm in a year over sales
	Firm size	Natural logarithm of firm's total assets
	Sales growth	Changes in sales over sales
	Leverage	Total debt over total assets
	Tangibility	Fixed assets over total assets
	Financial crisis	Financial crisis takes the value 1 if the year is between 2007-2009 period, and 0 otherwise
Industry data	Industry dummy	Takes a value of 1 if the firm is in technology-based industry
Investor protection:	Disclosure	Measures the transparency of transactions
	Liability	Measures directors' liabilities
	Investor suits	Measures investors' rights to sue for misconduct
Country governance:	Government effectiveness	Captures the ability of a country's government
	Regulatory quality	Captures the riskiness of investments
	Rule of law	Captures the quality of the jurisdiction
	Control of corruption	Measures the misuse of power for private gain
	Political stability	Measures the propensity for changes in government, terrorism and violence
	Voice and Accountability	Measures the responsiveness of government to its people

[4]The list of emerging markets is considered following Alam et al. (2019a).

Table 3: Sample by firm

Variable	Mean	Standard Deviation	Minimum	Maximum
ROA	0.09419	0.08632	-0.12399	0.37425
ROIC	11.00860	11.01015	-15.9300	53.8400
R&D intensity	0.01252	0.02550	0.00000	0.17322
Firm size	5.57293	0.84089	3.93788	7.72246
Sales growth	0.12373	0.25528	-0.49473	1.11524
Leverage	0.26688	0.17460	0.00155	0.69098
Tangibility	0.48020	0.18483	0.10609	0.89593
Financial crisis	0.39426	0.48878	0.00000	1.00000

Source: Authors' calculation

Table 4: Sample by Industry

	Technology based Industry				Non-technology based Industry			
Variable	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
ROA	0.09493	0.08419	-0.12399	0.36015	0.09287	0.09004	-0.12892	0.37425
ROIC	11.19471	10.70766	-14.2000	53.8400	10.67583	11.52904	-15.9300	40.39000
R&D intensity	0.01640	0.02939	0.00000	0.17322	0.00559	0.01392	0.00000	0.06317
Firm Size	5.53466	0.83705	3.93788	7.72246	5.64137	0.84379	3.03654	7.36283
Sales growth	0.13175	0.26433	-0.49473	1.11030	0.10939	0.23768	-0.40952	1.11524
Leverage	0.25169	0.16834	0.00155	0.67026	0.29406	0.18221	0.00125	0.69098
Tangibility	0.46215	0.18541	0.09778	0.89593	0.51247	0.17942	0.10609	0.79534
Financial crisis	0.39278	0.48850	0.00000	1.00000	0.39692	0.48949	0.00000	1.00000

Source: Authors' calculation

Table 5: Sample by Country

Country	Frequency	Composition (%)	R&D Intensity	Disclosure	Liability	Investor Suits	Investor Protection	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption	Political Stability	Voice and Accountability	Country Governance
India	171	40.4255	0.0126	6.0000	4.0000	7.3856	5.8157	0.7500	0.6581	0.6700	0.4072	0.5581	0.8300	0.6443
Turkey	68	16.0757	0.0060	8.6597	4.0000	5.0000	5.8979	0.5000	0.5965	0.6621	0.4200	0.5501	0.5480	0.5474
China	52	12.2931	0.0163	10.0000	1.0000	3.9362	4.9553	0.5000	0.5539	0.6616	0.3550	0.7203	0.3768	0.5282
Israel	27	6.3830	0.0482	7.0000	9.0000	9.0000	8.3000	1.0000	0.8200	0.8300	0.5000	0.5017	0.7100	0.7277
South Africa	21	4.9645	0.0027	8.0000	8.0000	8.0000	8.0000	0.5000	0.7919	0.4114	0.4314	0.7027	0.8300	0.6118
Malaysia	19	4.4917	0.0035	10.0000	9.0000	7.0000	8.7000	0.7500	0.7658	0.6700	0.4200	0.7142	0.7751	0.6838
Greece	18	4.2553	0.0102	1.3306	3.6364	5.0000	3.3066	0.7500	0.7079	0.7500	0.3300	0.7256	0.9200	0.6959
Indonesia	12	2.8369	0.0046	9.5294	5.0000	3.0000	5.8588	0.5000	0.6759	0.5000	0.4925	0.6080	0.6300	0.5708
Philippines	10	2.3641	0.0032	2.0000	3.0000	8.0000	4.3000	0.7500	0.7266	0.4200	0.3394	0.6772	0.6885	0.5993
Russia	9	2.1277	0.0048	6.0000	2.0000	6.0000	4.7000	0.2500	0.7421	0.6202	0.3066	0.6333	0.5555	0.5167
Brazil	8	1.8913	0.0230	5.0000	8.0000	3.0000	5.3000	0.5000	0.5947	0.3353	0.4529	0.7098	0.7500	0.5569
Pakistan	8	1.8913	0.0070	6.0000	6.0000	7.0000	6.3000	0.5000	0.5859	0.5357	0.3200	0.4466	0.3166	0.4509
Total	423	100												
Min.			0.0000	1.0000	1.0000	3.0000	3.0000	0.2500	0.5000	0.3300	0.2500	0.4300	0.2500	0.4400
Max.			0.1732	10.0000	9.0000	9.0000	8.7000	1.0000	0.8600	0.8300	0.5000	0.8000	0.9200	0.7300
Mean			0.0125	7.0439	4.4872	6.3946	5.9806	0.6578	0.6621	0.6484	0.4062	0.5993	0.6993	0.6120
Median			0.0035	6.0000	4.0000	7.0000	5.7000	0.7500	0.6800	0.6700	0.4200	0.5700	0.7900	0.6300

Source: Authors' calculation

Table 6 : Results Summary-GMM Estimation

Dependent variables: ROA	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
ROA_{t-1}	0.28725***	0.33982***	0.32789***	0.37666***	0.34191***	0.35780***	0.34498***
	(0.05041)	(0.06250)	(0.06266)	(0.06480)	(0.06223)	(0.06437)	(0.06567)
R&D Intensity	-0.23631**	-0.28181**	-0.26010**	-0.26048**	-0.19324***	-0.25629**	-0.25408**
	(0.08563)	(0.10288)	(0.08913)	(0.09520)	(0.06910)	(0.09413)	(0.08076)
R&D $Intensity_{t-1}$	0.03551	2.31178	1.41112	0.68702	1.18864	1.78262	0.76198
	(0.06217)	(1.26212)	(0.92249)	(0.52561)	(0.40095)	(1.00559)	(0.57232)
R&D $Intensity_{t-1}$*Investor Protection Index		2.27678*				1.48958*	
		(1.26464)				(0.89124)	
R&D $Intensity_{t-1}$*Disclosure Index			-0.26085				-1.16609**
			(0.60801)				(0.45554)
R&D $Intensity_{t-1}$*Liability Index			0.14871*				1.11846*
			(0.33291)				(0.57915)
R&D $Intensity_{t-1}$*Shareholders Suits Index			1.53793**				2.23363**
			(0.74181)				(0.73223)
R&D $Intensity_{t-1}$*Country Governance Index				0.70017		0.29456	
				(0.52652)		(0.43195)	
R&D $Intensity_{t-1}$*Government Effectiveness					0.91409**		1.69225
					(0.40060)		(0.75214)
R&D $Intensity_{t-1}$*Regularity Quality					0.02890		-0.11720
					(0.13017)		(0.13117)
R&D $Intensity_{t-1}$*Rule of Law					0.85031		-0.00968
					(0.42179)		(0.34955)
R&D $Intensity_{t-1}$*Control of Corruption					0.68910**		0.06728
					(0.28092)		(0.32776)
R&D $Intensity_{t-1}$* Political Stability					0.10473		0.23230
					(0.11366)		(0.09131)
R&D $Intensity_{t-1}$* Voice & Accountability					0.49816**		0.34194
					(0.22495)		(0.20112)
Size	0.01129**	0.01374*	0.01519**	0.01347*	0.01586**	0.01469**	0.01846**
	(0.00506)	(0.00803)	(0.00682)	(0.00706)	(0.00570)	(0.00744)	(0.00651)

Sales growth	0.01737**	0.01917**	0.01496*	0.01575**	0.01543*	0.01693**	0.01276
	(0.00711)	(0.00871)	(0.00846)	(0.00771)	(0.00798)	(0.00684)	(0.00813)
Leverage	-0.27350***	-0.27429***	-0.23070***	-0.21407***	-0.22432***	-0.24778***	-0.22146***
	(0.03671)	(0.03333)	(0.02717)	(0.03062)	(0.02689)	(0.03209)	(0.02650)
Tangibility	-0.13697**	-0.19883***	-0.17525***	-0.16131***	-0.14845**	-0.17235***	-0.16238***
	(0.04527)	(0.04981)	(0.04448)	(0.04530)	(0.04283)	(0.04800)	(0.04454)
Financial crisis	-0.00495*	-0.00888**	-0.00839**	-0.01154**	-0.01037**	-0.00981**	-0.01186**
	(0.00405)	(0.00450)	(0.00404)	(0.00426)	(0.00461)	(0.00422)	(0.00471)
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2471	2471	2471	2471	2471	2471	2471
AR(1)	-4.57	-4.53	-4.43	-4.53	-4.48	-4.51	-4.37
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AR(2)	1.42	1.38	1.39	1.61	1.48	1.5	1.36
P-value	0.1560	0.1680	0.1640	0.1080	0.1380	0.1320	0.1750
Z_1	20.84(9)	23.68(10)	21.29(12)	26.85(10)	19.12(15)	23.79(11)	17.56(18)
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Z_2	5.41(3)	3.64(4)	3.53(4)	4.69(4)	5.86(4)	3.34(4)	5.68(4)
P-value	0.0012	0.0063	0.0076	0.0010	0.0001	0.0104	0.0002
Hansen J test	116.92(111)	181(159)	244.96(230)	195.63(178)	294.49(272)	223.81(205)	335.37(326)
P-value	0.3320	0.1120	0.2380	0.1740	0.1670	0.1750	0.3490
Diff-in-Hansen	28.04(34)	47.88(48)	42.84(63)	31.24(49)	75.49(84)	51.17(55)	86.75(105)
P-value	0.7540	0.4780	0.9760	0.9770	0.7350	0.6220	0.9020
Number of groups, n	423	423	423	423	423	423	423
Instruments, i	124	174	247	193	292	221	349
Instruments ratio, r=n/i	3.41	2.43	1.71	2.19	1.45	1.91	1.21

Level of significance: * < .10, ** < .05, ***< .01; Standard errors in parenthesis

Table 7: Robustness Test

Dependent variables: ROIC	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
$ROIC_{t-1}$	0.30781***	0.30329***	0.29673***	0.33743***	0.29815***	0.31159***	0.30368***
	(0.07341)	(0.07038)	(0.06940)	(0.07122)	(0.07156)	(0.06987)	(0.06922)
R&D Intensity	-34.72517**	-31.32344**	-32.92282**	-33.94852***	-22.13875**	-40.78708***	-30.10935**
	(13.52455)	(9.45126)	(9.77934)	(9.99837)	(8.61178)	(11.91322)	(9.85959)
R&D $Intensity_{t-1}$	7.738035	187.3532	179.1013	150.4718	202.6503	306.1532	43.34213
	(10.0003)	(113.3602)	(132.7653)	(111.1707)	(58.09552)	(124.7232)	(78.81748)
R&D $Intensity_{t-1}$*Investor Protection Index		187.0076*				175.7646*	
		(112.9088)				(105.1655)	
R&D $Intensity_{t-1}$*Disclosure Index			-63.90225*				-207.7785**
			(100.4663)				(82.83071)
R&D $Intensity_{t-1}$*Liability Index			88.48748**				86.95191*
			(38.79364)				(77.86633)
R&D $Intensity_{t-1}$*Shareholders Suits Index			157.8912*				283.0295**
			(93.23767)				(92.54274)
R&D $Intensity_{t-1}$*Country Governance Index				152.5826		128.6508**	
				(112.0404)		(62.52894)	
R&D $Intensity_{t-1}$*Government Effectiveness					116.264*		-172.8742
					(69.94237)		(76.92155)
R&D $Intensity_{t-1}$*Regularity Quality					16.29706		-0.41779
					(19.48905)		(16.75824)
R&D $Intensity_{t-1}$*Rule of Law					-45.0065		6.77353
					(58.47662)		(47.4051)
R&D $Intensity_{t-1}$*Control of Corruption					63.99298*		4.35866
					(36.69681)		(35.58158)
R&D $Intensity_{t-1}$* Political Stability					-12.15754*		3.82349
					(12.21251)		(10.62251)
R&D $Intensity_{t-1}$* Voice & Accountability					71.66351**		56.32703
					(34.01092)		(29.14889)
Size	2.60975*	2.92561**	3.04885***	3.22232**	2.98814**	3.33154**	3.11889***
	(1.36229)	(1.03429)	(0.95066)	(1.07526)	(1.00343)	(1.22702)	(0.96103)

Sales growth	2.65864**	2.64986**	2.40234*	2.73714**	2.51304**	2.57614**	1.91812
	(1.26558)	(1.20983)	(1.25724)	(1.28444)	(1.23564)	(1.14597)	(1.17522)
Leverage	-36.69806***	-30.08341***	-29.3741***	-30.50507***	-31.47455***	-36.33074***	-29.77768***
	(5.84827)	(4.98402)	(4.52403)	(4.75495)	(4.39568)	(5.03920)	(3.78119)
Tangibility	-34.06267***	-28.89963***	-32.59003***	-31.0271***	-32.40406***	-29.01143***	-30.60816***
	(7.58122)	(6.60811)	(8.24477)	(7.44983)	(7.80353)	(6.27389)	(7.37271)
Financial crisis	-0.51039*	-0.34854**	-0.20393**	-0.03938*	-0.33697*	-0.55098*	-0.35168*
	(0.62735)	(0.72709)	(0.71194)	(0.65956)	(0.79329)	(0.68871)	(0.83559)
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	2471	2471	2471	2471	2471	2471	2471
AR(1)	-3.05	-3.02	-3.03	-3.19	-3.04	-3.08	-3.01
P-value	0.0020	0.0030	0.0020	0.0010	0.0020	0.0020	0.0030
AR(2)	1.40	1.36	1.31	1.51	1.30	1.41	1.29
P-value	0.1610	0.1740	0.1900	0.1300	0.1950	0.1580	0.1990
Z_1	15.13(9)	16.61(10)	15.45(12)	16.76(10)	12.83(15)	16.5(11)	17.8(18)
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Z_2	2.37(4)	2.41(4)	2.17(4)	2.56(4)	3.18(4)	2.19(4)	2.85(4)
P-value	0.0519	0.0483	0.0716	0.0381	0.0136	0.0691	0.0237
Hansen J test	177.64(156)	222.82(183)	245.72(220)	177.97(160)	279.36(256)	191.2(157)	341.17(344)
P-value	0.1130	0.1240	0.1130	0.1570	0.1510	0.133	0.5330
Diff-in-Hansen	42.8(43)	48.65(50)	57.25(64)	41.03(50)	78.07(85)	77.65(57)	75.36(105)
P-value	0.4800	0.5280	0.7120	0.8130	0.6900	0.0330	0.9870
Number of groups, n	423	423	423	423	423	423	423
Instruments, i	170	198	237	175	276	173	367
Instruments ratio, r=n/i	2.49	2.14	1.78	2.42	1.53	2.45	1.15

Level of significance: * < .10, ** < .05, ***< .01; Standard errors in parenthesis

Table 8: Elasticity Test

Variables	Elasticity
ROA	0.37730
R&D Intensity	-0.03796
R&D Intensity$_{t-1}$	0.02552
R&D Intensity*Investor Protection	0.16911
R&D Intensity*Governance	0.03036
Size	0.88125
Sales growth	0.02463
Leverage	-0.71381
Tangibility	-0.88949
Financial crisis	-0.03972

Source: Authors' calculation