

The Effect of Investor Protection on Cross-Country Differences in R&D Investments

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Abstract

This study examines international differences in firms' R&D investments across 31 countries between 2006 to 2014. We analyze whether the level of investor protection, defined as the extent of minority shareholder rights and the quality of legal enforcement, is associated with cross-country differences in R&D investments. We find that strong investor protection reduces the conflicts of interest and information asymmetry between insiders and outsiders associated with R&D investments and, therefore, encourages value-enhancing R&D investments. In addition, we find that strong investor protection mitigates the dependency of firms' R&D investments on their internal resources and reduces R&D investment–cash flow sensitivity.

JEL classification numbers: G15, G31, G32, O31

Keywords: Investor protection, R&D investments, R&D investment–cash flow sensitivity.

1 Introduction

Since La Porta et al. (1998) first made the argument, the literature has supported the notion that strong investor protection encourages good corporate governance, where corporate governance is defined as the set of mechanisms designed to protect minority shareholders from expropriation by insiders (La Porta et al., 2000). In addition, prior literature suggests that level of investor protection,

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which varies widely around the world, can explain both conceptually and empirically a number of important differences in financial markets and corporate investment behavior among countries (Chen et al., 2009; Dargenidou et al., 2007; Johnson et al., 2000; La Porta et al., 2000; La Porta et al., 2002; Wurgler, 2000). This study focuses on a particular type of investment behavior, namely research and development (R&D) investments, and their association with the level of investor protection.

Corporate R&D investments are relevant for two reasons. First, research suggests that innovation activities are critical for developing and maintaining a competitive advantage for many international and domestic markets (Porter, 1990). Because corporate R&D investments are a central component of innovation activities, investigating the determinants of R&D investments can, in turn, shed light on the determinants of corporate competitive advantage and economic growth around the world. Second, prior research suggests that R&D investments can create conflicts of interest between managers and stockholders due to divergent incentives (Francis and Smith, 1995; Holmstrom, 1989). Strong investor protection fosters good corporate governance, and an essential role of good corporate governance is to align the conflicts of interest between managers and shareholders. Hence, we argue that R&D is a potentially rich setting for examining the role of investor protection because of the need to align the interest of shareholders and insiders as well as limit insiders' acquisition of private control benefits.

R&D is attractive to stockholders because it is crucial for both the survival and growth of a firm and stockholders can reduce the inherent risk of innovation activities by keeping diversified investment portfolios (Baysinger et al., 1991; Hay and Morris, 1979; Lee and O'Neill, 2003). However, managers may be reluctant to invest in R&D because outcomes are neither immediate nor certain. That is, R&D investments may not yield short-term returns and are risky because R&D expenditures are typically expensed and have high failure rates (Dechow et al., 1994; Kothari et al., 2002; Shi, 2003). Managers may, in fact, act opportunistically to boost short-term performance at the expense of long-term growth by cutting R&D expenditures (Bushee, 1998; Cao and Laksmana, 2009; Cheng, 2004; Yu, 2007). We conjecture that the level of investor protection may influence managers' discretion to choose to avoid risky R&D investments.

We first examine whether the level of investor protection is positively related with firms' R&D investments. We anticipate that strong investor protection promotes R&D investments in three ways. First, strong investor protection encourages outsider investors to participate in capital markets. In turn, active investor participation leads to better developed capital markets and, consequently, fewer financing constraints on R&D investments. Second, following La Porta et al. (1997), we posit that countries with better shareholder protection laws can more easily inhibit managerial actions that destroy shareholder value, such as managerial decisions to forego R&D investments to opportunistically boost short-term performance. Third, strong legal protections limit insiders' acquisition

of private benefits by making the expropriation technology less efficient (La Porta et al., 2000). Thus, managers in countries with strong investor protection have less incentive to avoid R&D investments to boost short-term performance and conceal private benefits.

We also examine whether strong investor protection reduces firms' dependence on internally generated funds for R&D investments. Prior literature shows that a shortage of internally generated funds leads to corporate underinvestment due to asymmetric information (Mayers and Majluf, 1984). We posit that strong investor protection improves firms' ability to raise external finance for R&D investments by encouraging outside investors, thereby reducing their dependence on internally generated funds. Hence, we expect a negative relation between R&D investment–cash flow sensitivity and investor protection.

Our sample consists of 55,166 firm-year observations in 31 countries from 2006 through 2014. We perform firm-level analysis to test our hypotheses. In the descriptive analysis, we find significant differences in both R&D investments and the level of investor protection across countries. Our regression analyses show that R&D investments are positively related to the two investor protection measures. In addition, we also find both investor protection variables are negatively related to R&D investment–cash flows sensitivity. These results suggest that strong investor protection fosters good corporate governance, which, in turn, mitigates the agency conflicts and asymmetry information between managers and outside investors arising from R&D investments. Finally, we find that investor protection positively moderates the impact of R&D investments in firm performance. This result suggests that strong investor protection enhances both R&D investments and the efficiency of R&D investments. Thus, managers in countries with strong investor protection are less likely to undertake R&D investments to promote their personal interests at the expense of shareholders' interests. We conducted several sensitivity tests by: (a) using country-level regression model; (b) using alternative legal protection indexes; (c) controlling for the potential endogeneity of investor protection; and (d) excluding countries with large numbers of observations (i.e. United States and Japan, etc). In all cases, our results hold.

This study contributes to the literature in three ways. First, our study adds to a strand of literature that examine the role of investor protection on the development of capital markets and the allocation of real resources (La Porta et al., 2000) by highlighting the role that investor protection plays in reducing the conflict of interests and the asymmetry information between outsiders and insiders associated with R&D investments. Our finding that strong investor protection encourages firms' R&D investment suggests that strong investor protection can accelerate economy growth by improving the efficiency of resource allocation. In addition, our finding that strong investor protection reduces firms' R&D investment–cash flow sensitivity corroborates the results of La Porta et al. (1997, 2006) that strong investor protection instills investor confidence, which, in turn, improves firms' ability to raise external finance. Second, we contribute the literature that examines the link between agency cost and R&D. Prior literature

shows that stock concentration and institutional ownership are positively linked to R&D investments because large shareholders (or blockholders) have more at stake and thus a greater incentive to gather information about firm R&D investments. However, these studies primarily focus on the United States (or another single country). This study adds to this literature by comparing R&D investments for a large number of countries with various institutional features, specifically by examining whether the extent of investor protection affects R&D investments. Our study allows us to identify factors associated with the differences in R&D investments around the world that vary greatly across countries. Finally, although the investment–cash flow sensitivity of physical investment has been widely explored, the literature has largely ignored the relation between R&D and cash flow. Our study expands on this line of literature by focusing on R&D investments. Compared to physical investment, R&D investments are more likely to create conflicts of interest and information asymmetry between managers and stockholders due to divergent incentives (Holmstrom, 1989). Accordingly, compared to physical investment, R&D provides a potentially rich setting for examining the role of corporate governance (investor protection) in reducing a firm’s financial constraints on investment.

2 Hypothesis

2.1 Investor protection and R&D investments

We posit that strong investor protection encourages investments in R&D in three ways. First, as suggested by La Porta et al. (2000), better investor protection encourages good corporate governance and limits managerial expropriation. Accordingly, strong investor protection increases investors’ confidence and willingness to invest in capital markets, which, in turn, raises the price of securities in the marketplace. Thus, strong market activity improves firms’ ability to raise capital and to exploit potential growth opportunities through increased R&D expenditures (Hail and Leuz, 2006). Due to less constrained and less costly to access to capital, we expect that firms in countries with strong investor protection will exhibit higher R&D levels than firms in countries with weak investor protection.

Second, we argue that extensive shareholder protection laws favor outsiders over insiders in the corporate decision-making process, including decisions related to R&D investments. Strong shareholder protection laws allow minority shareholders to mail their vote directly, vote cumulatively for directors, and easily call an extraordinary meeting (La Porta et al., 1998). We argue that these mechanisms provide minority shareholders with tools to monitor and discipline directors and managers and to ensure that managers invest in R&D to maximize long-run firm value rather than focus solely on short-term earnings goals. In addition, extensive shareholder protection laws give outsiders the right to legally challenge directors’ decisions or force the company to repurchase their shares if

they object to certain managerial decisions. The very threat of litigation may induce the management to promote strategic orientations that benefit shareholders' wealth, including investments in R&D.

Third, expropriation of minority shareholders by the controlling shareholders is extensive in many countries (La Porta et al., 2000). Insiders have incentives to conceal their private control benefits because if these benefits are detected, the minority shareholders will likely take disciplinary action against them (see, e.g., Shleifer and Vishny, 1997; Zingales, 1994). Because R&D projects have high failure rates and R&D expenditures are immediately written off against earnings, managers and the controlling owners may cut R&D expenditures to opportunistically boost short-term earnings and conceal their private control benefits to avoid disciplinary action. (Leuz et al., 2003; Shleifer and Vishny, 1997; Zingales, 1994). However, strong investor protection laws limit insiders' acquisition of private control benefits because they make the expropriation technology less efficient (La Porta et al., 2000). Accordingly, insiders are less likely to engage in earnings management by cutting R&D investments to mark performance because they are unable to conceal these activities from outsiders.

Thus, due to less constrained and less costly to access to capital, strong monitoring tools and the threat of litigation, and lack of access to expropriation technology, we expect that firms in countries with strong investor protection will exhibit higher R&D levels than firms in countries with weak investor protection. This reasoning This line of reasoning suggests that insiders in countries with strong investor protection are more likely to invest in R&D projects and leads to our first hypothesis:

H1: The level of investor protection is positively related to investments in R&D.

2.2 Investor protection and R&D investment–cash flow sensitivity

In perfect and complete markets, the investment decisions of firms are independent from their financial situation; capital is not rationed and firms can always obtain external financing at a cost equal to their cost of capital (Modigliani and Miller, 1958). However, in imperfect or incomplete markets, firms' ability to undertake profitable investments may be limited by available internal capital due to asymmetric information between corporate insiders and the capital market, which works to limit externally available capital. Under asymmetric information, market participants have less information about the true net present value of firms' investment projects, and they may therefore demand a risk premium on the capital provided that is equal to the premium charged to the median firms. The premium can raise the cost of new equity financing for some investment projects above the opportunity cost of internal finance faced by existing shareholders. Consequently, asymmetric information between insiders and capital market participants may lead to the rejection of good investment opportunities. Extensive literature confirms the existence of positive investment–cash flow sensitivity, which can be explained by liquidity constraints arising from asymmetric information between insiders and

outsiders (Fazzari et al., 1988, 1993, 2000).

We argue that strong investor protection mitigates firms' dependence on internal resources—arising from asymmetric information between insiders and market participants—to fund R&D investments. Because strong investor protection limits expropriation by insiders and better protects outside investors' rights, outside investors in countries with strong investor protection are willing to pay more for finance assets (La Porta et al., 2002). In addition, countries with strong investor protection should have more external finance in the form of broader markets (La Porta et al., 1997) and lower costs of capital (Hail and Leuz, 2006). Consequently, we posit that when firms in countries with strong investor protection attempt to fund R&D investments, they will more easily obtain adequate financing and they will be required to depend less on internal resources. These arguments lead to our second hypothesis:

H2: The level of investor protection is negatively related to R&D investment–cash flow sensitivity.

3 Research design

We employ firm-level regression models to test our hypotheses, in which the dependent variable is measured for each firm, and the control variables are measured either for each firm or as the average within each country. Specifically, firm-level analysis captures both the influence of internally generated funds and investor protection on R&D investments.

We use the following regression specification to test Hypothesis 1:

$$R\&D_{i,t} = \alpha_0 + \alpha_1 IP_{c,t} + \alpha_2 CF_{i,t} + \alpha_3 \text{Tobin's } q_{i,t-1} + \alpha_4 LEV_{i,t} + \alpha_5 SIZE_{i,t} + \alpha_6 HC_{c,t} + \alpha_7 GDP_{c,t} + \alpha_8 POP_{c,t} + \alpha_n D_Year_t + \alpha_n D_Industry_j + \varepsilon_{i,t} \quad (1)$$

We use the following regression specification to test Hypothesis 2:

$$R\&D_{i,t} = \beta_0 + \beta_1 IP_{c,t} + \beta_2 CF_{i,t} + \beta_3 CF_{i,t} \times IP_{c,t} + \beta_4 \text{Tobin's } q_{i,t-1} + \beta_5 LEV_{i,t} + \beta_6 SIZE_{i,t} + \beta_7 CF_{i,t} \times \text{Tobin's } q_{i,t-1} + \beta_8 CF_{i,t} \times LEV_{i,t} + \beta_9 CF_{i,t} \times SIZE_{i,t} + \beta_{10} HC_{c,t} + \beta_{11} GDP_{c,t} + \beta_{12} POP_{c,t} + \beta_n D_Year_t + \beta_n D_Industry_j + \varepsilon_{i,t} \quad (2)$$

where $R\&D$ is the ratio of R&D expenditures to total assets at the beginning of the year $t \times 100\%$; IP is the various measures of the extent of investor protection; CF is operating cash flow divided by total assets at the beginning of year t ; $\text{Tobin's } q$ is the market value of equity plus the book value of debt, divided by the book value of total assets; LEV is the ratio of total debt to total assets; $SIZE$ is the logarithmic transformation of total assets; HC is a combination of the average years of schooling and literacy rate; GDP is the gross domestic product per capita; POP is the total population; D_Year is the dummy variable for year; and

D_Industry is a dummy variable indicating a firm's industry membership based on 2-digit SIC code.

Because patent data are not available for all globally listed companies, we use R&D expenditures (*R&D*) to measure innovation, which are scaled by total assets at the beginning of the year. Expensed R&D expenditures (i.e., item WS01201 in Worldscope database) over total assets at the beginning of year serves as the dependent variable. We focus on expensed R&D expenditures (rather than capitalized R&D expenditures) for three reasons. First, for firms expensing R&D expenditures, annual earnings are decreased by the amount of the year's R&D expenditures. Thus, the expensing of R&D expenditures may lead managers to sacrifice R&D to maintain short-term earnings growth (Bushee, 1998; Cao and Laksmana, 2009; Cheng, 2004; Oswald and Zarowin, 2007; Yu, 2007). However, R&D capitalization appears to mitigate such myopic R&D investment behavior (Oswald and Zarowin, 2007). Accordingly, expensing R&D expenditures can create conflicts of interest between managers and stockholders due to divergent incentives (Francis and Smith, 1995; Holmstrom, 1989), and capitalizing R&D may mitigate such conflicts. Strong investor protection fosters good corporate governance, and an essential role of good corporate governance is to align the conflicts of interest between managers and shareholders. Hence, we argue that relative to capitalized R&D, expensed R&D provides a potentially rich setting for examining the role of investor protection because it exhibits a stronger need to align the interest of shareholders and insiders as well as limits insiders' acquisition of private control benefits. Second, relative to expensed R&D, capitalized R&D provide more information for financial information users because capitalization enables managers to better match R&D costs with their benefits (Lev and Zarowin, 1999) and to better communicate information about the success of the projects and their probable future benefits (Healy et al., 2002). Accordingly, capitalizing R&D is less subject to the information asymmetry between managers and shareholders, relative to expensing R&D. As suggested by La Porta et al. (2000), better investor protection encourages good corporate governance and thus reduces information asymmetry between managers and shareholders, which, in turn, increases investors' confidence and willingness to invest in capital markets and improves firms' ability to raise capital and to exploit potential growth opportunities through increased R&D expenditures (Hail and Leuz, 2006). Because expensed R&D is more subject to information asymmetry and thus more likely to have constrained access to capital, investor protection plays a stronger role in encouraging expensed R&D expenditures and reducing its dependency on operation cash flows as compared to its role relative to capitalized R&D. Finally, as illustrated in Appendix A, we show the cross-country differences in accounting for R&D over the period from 2006 to 2014. We find that during our sample period, in addition to the immediate write-off method for R&D, most countries permit capitalizing and amortizing development costs only. The most commonly specified circumstances to capitalize R&D costs include the need to have a clearly identifiable project and related expenditures as well as the satisfaction of criteria concerning the technical

feasibility and commercial and financial viability of the project. However, in practice, only a minority of firms capitalize research or development costs for the countries permitting capitalizing R&D expenditures in view of the difficult judgments for specified circumstances involved (Radebaugh and Gray, 2002; Radebaugh et al., 2006). Thus, expensed R&D is more relevant for our study.

We measure the level of investor protection as both the extent of minority shareholder rights (*SR*) and the strength of law enforcement institutions (*LE*). We also use a combined index (*SR_LE*), which equals the sum of 50 percent of *SR* plus 50 percent of *LE*.³ This index takes into account both the quality of rules and regulations that protect investors and the degree of enforcement of these rules. Finally, to classify countries as characterized by a strong or a weak legal environment, we use the dummy variable *SR_LE_D*, which equals 1 if the sample country's *SR_LE* is higher than the country-median value, indicating a strong legal environment, and zero otherwise, indicating a weak legal environment.

The proxy for shareholder rights (*SR*) is World Bank database's strength of investor protection index, which measures the strength of minority shareholder protections against directors' misuse of corporate assets for personal gain. The indicators distinguish three dimensions of investor protections: (a) transparency of related-party transactions, (b) extent of liability for self-dealing, (c) shareholders' ability to sue officers and directors for misconduct. The index ranges from zero to 10, with higher scores denoting stronger shareholders' rights. We measure legal enforcement (*LE*) by the strength of legal rights index as computed by the World Bank. The index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and, thus, facilitate lending. The index ranges from 0 to 10, with higher scores indicating a greater legal protection and thus a set of laws that are better designed to expand access to credit.

We include several variables to control for firm-specific factors that may be correlated with our variables of interest. We include growth opportunities (*Tobin's q*), because a number of studies find a positive relation between growth and R&D investment (Connolly and Hirschey, 2005; Lang et al., 1996; Kaplan and Zingales, 1997; Shortridge, 2004). We also control for leverage (*LEV*) because prior literature indicates that firms with high leverage are less willing to invest in R&D (Bah and Dumontier, 2002; Lang et al., 1996; Kang, 1995). We also control for firm size (*SIZE*) because younger firms are more active in innovation activities than older firms (Holmstrom, 1989). Finally, we include dummy variables for year and industry to control for time and industry fixed effects. In equation (2), we also include the intersection terms of these firm-specific factors, year and industry dummies, with cash flow to control their influence on R&D investment–cash flow sensitivity.

We also include a number of control variables to control for country-specific

³ We use 50 percent of *SR* and 50 percent of *LE* because both of them have a range from 0 to 10 in World Bank database.

factors that may be correlated with our variables of interest. We include country-level human capital (*HC*), measured by citizens' educational attainment (i.e., a combination of the average years of schooling and literacy rate). Prior studies show that the higher the level of human capital within a country, the higher the country's level of innovation will be (Dakhli and Clercq, 2004). Felisberto (2008) indicates that the general level of investment in innovation tends to be higher in the most developed economies and countries. Thus, we control for gross domestic product per capita (*GDP*). We also include country size in terms of total population (*POP*) because larger countries may be involved in more R&D expenditures compared to smaller countries (Dakhli and Clercq, 2004).

To take advantage of the panel data feature of our sample data, we estimate all regressions using country random effects. The natural alternative specification is fixed effects. However, fixed effects are not feasible in our setup given that no within-country variation exists in various investor protection measures. Specifically, we use the appropriate models based strictly on the results of the Hausman specification test and Breusch and Pagan Lagrangian multiplier test for random effects. The Lagrangian multiplier test is used to discriminate between a pooled ordinary least squares and a random effects model, and the Hausman test is applied to examine the appropriateness of the estimated specification to be used, namely, either the fixed effects or random effects model. Both tests indicate that a generalized least squares random effects model is appropriate for our analysis.

Our first hypothesis predicts that α_1 and β_1 will be positive. Our second hypothesis predicts that α_2 and β_2 will be positive and that the intersection term of cash flow and the various investor protection measures (β_3) will be negative.

4 Sample and empirical results

4.1 Sample selection and descriptive statistics

Our firm-level data are drawn from Worldscope database, a database that contains financial information and general profiles on publicly traded companies worldwide. Utility firms and financial institutions are excluded from the sample because these firms operate in a different business environment than those in other industries. To be included in the sample, a country must have more than 100 firm-year observations and at least one observation each year for a number of all financial variables needed for analysis, and necessary data to compute each of the country-level variables in our analysis. These restrictions result in a total sample of 55,166 firm-year observations, across 31 countries and 11,450 non-financial and non-utility firms over the period from 2006 to 2014.

Panel A of Table 1 presents various investor protection measures and the mean of our country-level independent variables for each country in our sample as well as sample-wide means, median, and standard deviations. The panel shows considerable variation in the various investor protection measures across countries. We find that New Zealand has the strongest legal environments with the most

outside investor rights and the strongest law enforcement institutions (i.e., the highest *SR_LE*), and Brazil and Philippines have the weakest legal environments with limited outside investor rights and weak law enforcement institutions (i.e., the lowest *SR_LE*). The last three columns report our measures of country-specific factors that have been shown to be associated with R&D investments in prior literature, include gross domestic product per capita (*GDP*), total population (*POP*), and the measure of human capital (*HC*). We also find considerable variation in these three country-level controlled variables across countries. We therefore control these country factors in our firm-level regression analyses.

Panel B of Table 1 reports the number of firm-year observations used available for our analyses and the mean of each of our firm-level variables by country as well as sample-wide means, medians, and standard deviations. We find significant variation in the number of firm-year observations across countries, with the total number of firm-year observations per country ranging from 110 for Pakistan to 16,086 for the Japan, with the United States and Japan having an unusually large number of firm-year observations compared to the rest of the countries. The mean R&D/total assets varies widely across countries, with a high of 3.229 percent in United States and a low of 0.285 percent for Mexico. Panel B also reports statistics for our firm-level control variables. These statistics indicate a relatively low variation in mean leverage but a relatively high variation in mean firm size and mean growth opportunity.

4.2 Empirical results

4.2.1 Investor protection and R&D investments

Table 2 presents four regressions that test our first hypothesis that the level of investor protection is positively related to investment in R&D. We use different investor protection measures in Model 1 through Model 4 and include in each our set of control variables and year and industry effects. The coefficients of various investor protection measures on these four regression allow us to test whether the various investor protection measures are important in R&D investments alone (Models 1 and 2), in combination with one another (Model 3), or in dummy variable for relative strong legal environments (Model 4).

Table 1: Descriptive statistics

Panel A: Country-level variables ($N = 279$ country-years)						
Country	Investor protection measures (IP)			HC	GDP (in \$ billion)	POP (in million)
	SR	LE	SR_LE			
Australia	5.700	9.222	7.461	1.039	1,185	22
Austria	5.000	7.000	6.000	0.616	404	8
Belgium	7.000	5.000	6.000	0.864	494	11
Brazil	5.300	3.000	4.150	-0.216	2,010	199
Canada	8.389	7.000	7.694	0.639	1,618	34
Finland	5.700	8.000	6.850	1.063	259	5
Germany	5.000	7.333	6.167	0.752	3,551	81
Hong Kong	9.000	10.000	9.500	0.232	238	7
India	5.833	7.667	6.750	-2.417	1,540	1,230
Indonesia	5.867	5.000	5.433	-0.879	691	242
Ireland	8.700	9.000	8.850	0.661	244	5
Israel	8.300	9.000	8.650	0.496	235	8
Italy	6.000	3.000	4.500	0.587	2,164	59
Japan	7.000	6.000	6.500	0.532	5,264	128
Korea	6.156	6.000	6.078	0.596	1,142	49
Malaysia	8.700	10.000	9.350	-0.630	258	28
Mexico	5.433	5.333	5.383	-0.483	1,108	118
Netherlands	4.389	5.889	5.139	0.886	852	17
New Zealand	9.700	10.000	9.850	0.953	154	4
Norway	6.700	6.000	6.350	1.108	450	5
Pakistan	6.300	6.000	6.150	-3.682	191	170
Peru	6.222	6.556	6.389	-0.475	150	29
Philippines	4.300	4.000	4.150	-0.501	205	93
Singapore	9.300	10.000	9.650	-0.560	236	5
South Africa	8.000	7.000	7.500	-0.386	340	51
Sweden	5.811	7.556	6.683	0.908	511	9
Switzerland	3.000	8.000	5.500	0.681	592	8
Thailand	7.133	5.000	6.067	-0.585	332	67
Turkey	5.678	5.000	5.339	-1.145	716	73
UK	8.000	10.000	9.000	0.997	2,710	63
US	8.300	9.000	8.650	0.725	15,355	309
Mean	6.642	7.018	6.830	0.077	1,458	101
Median	6.222	7.000	6.389	0.587	511	34
Std.	1.646	2.082	1.656	1.080	2,822	223

Table 1 (Continued)

Panel B: Firm-level variables ($N = 55,166$ firm-years)						
Country	Firm-Years	<i>R&D</i>	<i>CF</i>	<i>Growth</i>	<i>LEV</i>	<i>SIZE</i>
Australia	709	2.670	0.069	1.491	0.204	5.553
Austria	246	2.295	0.096	1.163	0.226	5.857
Belgium	244	2.943	0.130	1.471	0.210	5.612
Brazil	169	1.509	0.060	1.166	0.242	7.024
Canada	3,118	3.173	0.067	1.532	0.169	5.915
Finland	557	3.147	0.111	1.308	0.171	6.258
Germany	2,002	2.672	0.096	1.463	0.227	5.868
Hong Kong	1,557	1.671	0.062	1.277	0.152	5.773
India	4,515	1.660	0.106	1.628	0.183	6.420
Indonesia	168	0.630	0.042	1.253	0.192	5.360
Ireland	145	3.002	0.078	1.520	0.200	6.347
Israel	409	2.839	0.102	1.196	0.178	5.285
Italy	357	2.560	0.102	1.308	0.216	6.621
Japan	16,086	2.097	0.033	1.222	0.201	6.328
Korea	4,640	1.835	0.086	1.153	0.218	5.689
Malaysia	620	1.269	0.111	1.440	0.190	5.128
Mexico	152	0.285	0.125	1.176	0.161	7.374
Netherlands	308	2.395	0.119	1.712	0.231	6.255
New Zealand	304	2.825	0.116	1.559	0.177	5.515
Norway	262	2.184	0.073	1.419	0.189	5.949
Pakistan	110	1.152	0.105	1.088	0.236	5.330
Peru	170	0.328	0.119	1.012	0.159	5.206
Philippines	217	1.069	0.069	1.081	0.172	5.329
Singapore	714	1.667	0.057	1.304	0.168	5.364
South Africa	466	1.540	0.136	1.489	0.200	6.587
Sweden	677	2.716	0.118	1.324	0.193	6.279
Switzerland	853	2.968	0.106	1.466	0.202	6.489
Thailand	182	3.062	0.066	1.082	0.193	4.997
Turkey	802	1.277	0.136	2.104	0.192	5.880
UK	3,931	3.128	0.088	1.637	0.200	5.497
US	10,476	3.229	0.074	1.862	0.214	6.267
Mean	1,780	2.123	0.092	1.384	0.196	5.883
Median	466	2.295	0.096	1.324	0.193	5.863
Std.	3,408	0.884	0.028	0.246	0.024	0.597

Note: *R&D* is the ratio of R&D expenditures to total assets at the beginning of the year $t \times 100\%$. *IP* is the various measures of the extent of investor protection. *SR* is the strength of investor protection index as computed by the World Bank. *LE* is the strength of legal rights index as computed by the World Bank. *SR_LE* is a combined index, which equals the sum of 50 percent of *SR* plus 50 percent of *LE*. *SR_LE_D* is a dummy variable, which equals 1 if the sample country's *SR_LE* is higher than the country-median value. *CF* is operating cash flow divided by total assets at the beginning of year t . *Tobin's q* is the market value of equity plus the book value of debt, divided by the book value of total assets. *LEV* is the ratio of total debt to total assets. *SIZE* is the logarithmic transformation of total assets. *HC* is a combination of the average years of schooling and literacy rate. *GDP* is the gross domestic product per capita. *POP* is the total population. *D_Year* is the dummy variable for year. *D_Industry* is a dummy variable indicating a firm's industry membership based on 2-digit SIC code. ***, **, * represent significance at the 1%, 5%, and 10% levels (two-tailed tests).

Table 2 shows that the coefficients on (a) the extent of outside investor rights (SR), (b) the strength of law enforcement institutions (LE), (c) the combined index of the extent of the investor protection laws and the strength of the law enforcement institutions (SR_LE), and (d) the binary version of the combined index (SR_LE_D) are significantly greater than zero, $p < 0.01$ (two tailed). In particular, we report a 16.0 percent increase in R&D/total assets for each 1 point increase of the outsider rights index (SR) and a 6.5 percent increase in R&D/total assets for each 1 point increase of the law enforcement index (LE). Also, the coefficient of *SR_LE_D* is 0.570, which suggests that strong legal environments (i.e., countries with *SR_LE* > country-median value) increase 31.81 percent in R&D/total assets relative to weak legal environments (i.e., countries with *SR_LE* \leq country-median value).⁴ Overall, our results suggest that both extensive outside investor rights and strong law enforcement institutions help promoting investments in R&D.

Table 2: Regression analysis – H1

Independent	Dependent variable: <i>R&D</i>			
	(1) <i>IP = SR</i>	(2) <i>IP = LE</i>	(3) <i>IP = SR_LE</i>	(4) <i>IP = SR_LE_D</i>
α_0 Con.	0.958 (7.76)***	1.717 (16.70)***	1.242 (10.58)***	1.792 (20.63)***
α_1 <i>IP</i>	0.160 (13.16)***	0.065 (7.34)***	0.128 (11.09)***	0.570 (15.68)***
α_2 <i>CF</i>	5.542 (20.58)***	4.812 (17.51)***	4.940 (18.31)***	6.318 (22.82)***
α_3 <i>Tobin's q</i>	0.341 (17.34)***	0.346 (17.47)***	0.334 (16.88)***	0.353 (18.08)***
α_4 <i>LEV</i>	-2.129 (-16.94)***	-2.232 (-17.76)***	-2.148 (-17.06)***	-2.131 (-17.01)***
α_5 <i>SIZE</i>	-0.142 (-13.06)***	-0.145 (-13.24)***	-0.140 (-12.83)***	-0.164 (-15.10)***
α_6 <i>HC</i>	0.885 (26.06)***	0.789 (22.99)***	0.810 (23.95)***	0.786 (23.21)***
α_7 <i>GDP</i>	0.000 (2.52)**	0.000 (7.70)***	0.000 (5.15)***	0.000 (5.62)***
α_8 <i>POP</i>	0.002 (18.10)***	0.001 (13.99)***	0.001 (15.39)***	0.001 (13.10)***
<i>D_Year</i>	Included	Included	Included	Included
<i>D_Industry</i>	Included	Included	Included	Included
Adj. R^2	0.056	0.054	0.055	0.057

Note: See Table 1 for variable definition. ***, **, * represent significance at the 1%, 5%, and 10% levels. Two-tailed t-values are reported in parentheses.

⁴ We calculate this as Increase = (coefficient estimate / average country-level R&D across 31 countries) \times 100% = (0.570 / 1.792) \times 100% = 31.81%.

4.2.2 Investor protection and R&D investment–cash flow sensitivity

Table 3 presents a set of regressions to test our second hypothesis that the level of investor protection is negatively related to R&D investment–cash flow sensitivity. We estimate equation (2) in Model 1 through Model 4 using *SR*, *LE*, *SR_LE*, and *SR_LE_D* to measure the extent of investor protection. Consistent with the results of Table 2, the coefficients on various investor protection measures are still positive and significant, $p < 0.01$, after controlling for the interaction of cash flows and various control variables. The coefficients on cash flows are positive and significant at the 1% level, confirming the stylized facts of investment–cash flow sensitivity literature; namely, cash flow has a large amount of explanatory power beyond Q for (R&D) investment. The coefficients on the interactive terms between various investor protection measures and cash flows are positive and statistically significant (p -values are all < 0.10). These results strongly support smaller R&D investment–cash flow sensitivity for firms in countries with strong investor protection. These findings are consistent the hypothesis that firms in countries with strong investor protection face lower cost of external capital, thus their R&D investment spending is less sensitive to the changes in internally generated capital (i.e., cash flows). In addition, we find that the coefficient on the interactive term of the extent of outside investor rights and cash flows (-1.289) is much less than the coefficient on the interactive term of the strength of law enforcement institutions and cash flows (-0.454), suggesting that extensive minority shareholder rights are more effective in reducing R&D investment–cash flow insensitivity than the increased quality of law enforcement institutions. Finally, Model 4 shows that the coefficient on cash flow (*CF*) is 4.737, whereas the coefficient on the interactive term between *SR_LE_D* and cash flow is -1.675 . This result indicates that a shift from weak legal environments (with investment–cash flow sensitivity of 4.737) to strong legal environments (with investment–cash flow sensitivity of 3.062; $\beta_2 + \beta_3$), while holding all other variables at sample mean, will reduce a firm's R&D investment–cash flow by 35.4 percent (β_3 / β_2).

Table 3: Regression analysis – H2

Independent	Dependent variable: <i>R&D</i>			
	(1) <i>IP = SR</i>	(2) <i>IP = LE</i>	(3) <i>IP = SR_LE</i>	(4) <i>IP = SR_LE_D</i>
β_0 Con.	0.250 (1.19)	1.898 (11.10)***	1.095 (5.53)***	1.863 (13.45)***
β_1 <i>IP</i>	0.279 (12.40)***	0.060 (4.07)***	0.167 (8.25)***	0.704 (9.52)***
β_2 <i>CF</i>	12.139 (6.29)***	8.022 (6.34)***	5.412 (2.75)***	4.737 (3.60)***
β_3 <i>CF</i> \times <i>IP</i>	-1.289 (-6.18)***	-0.454 (-2.78)***	-0.376 (-1.80)*	-1.675 (-2.35)**
β_4 <i>Tobin's q</i>	0.070 (2.04)**	0.089 (2.52)**	0.088 (2.67)***	0.143 (4.20)***
β_5 <i>LEV</i>	-2.177 (-10.23)***	-2.311 (-10.79)***	-2.176 (-10.17)***	-2.403 (-11.34)***
β_6 <i>SIZE</i>	-0.102 (-5.40)***	-0.102 (-5.35)***	-0.095 (-5.01)***	-0.137 (-7.20)***
β_7 <i>CF</i> \times <i>Tobin's q</i>	3.363 (9.32)***	3.276 (8.95)***	3.463 (9.50)***	2.685 (7.47)***
β_8 <i>CF</i> \times <i>LEV</i>	2.605 (1.07)	2.406 (0.98)	1.935 (0.79)	4.927 (2.02)**
β_9 <i>CF</i> \times <i>SIZE</i>	-0.517 (-2.69)***	-0.547 (-2.84)***	-0.570 (-2.96)***	-0.355 (-1.83)*
β_{10} <i>HC</i>	0.907 (26.65)***	0.784 (22.54)***	0.823 (24.18)***	0.800 (23.51)***
β_{11} <i>GDP</i>	0.000 (1.96)**	0.000 (7.44)***	0.000 (4.69)***	0.000 (5.35)***
β_{12} <i>POP</i>	0.002 (18.79)***	0.001 (13.91)***	0.001 (15.88)***	0.001 (13.68)***
<i>D_Year</i>	Included	Included	Included	Included
<i>D_Industry</i>	Included	Included	Included	Included
Adj. R^2	0.059	0.056	0.057	0.059

Note: See Table 1 for variable definition. ***, **, * represent significance at the 1%, 5%, and 10% levels. Two-tailed t-values are reported in parentheses.

5 Additional test: investor protection and R&D investment efficiency

Our results show that, consistent with our first hypothesis, strong investor protection enhances R&D investments. However, researchers have reported that managers may undertake R&D investments to promote their personal interests at the expense of shareholders' interests (Jensen, 1993; Jensen and Smith, 1985;

Hirshleifer, 1993).⁵ Thus, R&D expenditures per se do not automatically lead to greater firm values. Thus, we further examine whether strong investor protection helps controlling managerial opportunism in R&D investments, thereby improving the efficiency of R&D investments. If so, we expect outside shareholders to positively value the monitoring role of strong investor protection in managerial R&D investments. Accordingly, we expect that the association between *Tobin's q* and *R&D* for firms in countries with strong investor protection should be greater than that of firms in countries with weak investor protection.

We employ the following regression model to test our conjecture:

$$\begin{aligned} \text{Tobin's } q_{i,t} = & \gamma_0 + \gamma_1 IP_{c,t} + \gamma_2 R\&D_{i,t} + \gamma_3 R\&D_{i,t} \times IP_{c,t} + \gamma_4 \text{Tobin's } q_{i,t-1} + \gamma_5 LEV_{i,t} \\ & + \gamma_6 SIZE_{i,t} + \gamma_7 PPE_{c,t} + \gamma_8 GDP_{c,t} + \gamma_n D_Year_t + \gamma_n D_Industry_j + \varepsilon_{i,t} \end{aligned} \quad (3)$$

where *Controls* is a set of control variables.⁶ The interaction term between the extent of investor protection and *R&D* capture the moderating impact of investor protection on the relation between *R&D* and *Tobin's q*.

To account for the potential simultaneity/endogeneity between R&D and *Tobin's q*, we introduce lagged *Tobin's q* as a control variable (Klein 1998; Wintoki et al. 2012). The inclusion of the firm's historic *Tobin's q* allows for the likelihood that past performance affects current R&D investments. In addition, the inclusion of historical performance controls for potential reverse causality between *Tobin's q* and R&D investments (Hayashi and Inoue, 1991). Table 4 shows that R&D investments have a significant and positive effect on market values of firms ($p < 0.01$), which is consistent with the findings of previous studies (see, e.g., Chan et al., 1990; Chauvin and Hirschey, 1993; Connolly and Hirschey, 2005; Doukas and Switzer, 1992; Szewczyk et al., 1996). In addition, we find that the coefficient of the interaction term between *R&D* and the various investor protection measures are positive and significant (p -values are all < 0.01), indicating that outside investors place additional valuation premium on firms in countries with stronger investor protection. In sum, the results of Table 2 and Table 4 show that strong investor protection enhances R&D investments and that these investments are value-enhancing (i.e., not undertaken to fulfill managerial private benefits).

⁵ For instance, executives may engage in excessive R&D spending as part of their short-term reputation building efforts to enhance their visibility in the job market (Hirshleifer, 1993). Additionally, they may undertake R&D investments to create sale-enhancing products that boost firm size and, in turn, executives' status and compensation (Brush et al., 2000; Jensen and Smith, 1985).

⁶ We include controls for several variables known to affect corporate performance: the ratio of total debt to total assets (*LEV*), the logarithmic transformation of total assets (*SIZE*), and the ratio of property, plant and equipment to beginning-of-period total assets of year t (*PPE*). Also, we include gross domestic product per capita (*GDP*) to control for country's overall economic development.

Table 4: Additional Test: Investor protection and R&D investment efficiency

Independent	Dependent variable: <i>Tobin's q</i>			
	(1) <i>IP = SR</i>	(2) <i>IP = LE</i>	(3) <i>IP = SR_LE</i>	(4) <i>IP = SR_LE_D</i>
γ_0 Con.	0.628 (19.82)***	0.777 (20.32)***	0.550 (15.43)***	0.658 (21.54)***
γ_1 <i>IP</i>	0.046 (11.55)***	0.004 (5.19)***	0.043 (12.68)***	0.126 (10.04)***
γ_2 <i>R&D</i>	0.035 (8.03)***	0.025 (3.43)***	0.022 (3.59)***	0.041 (13.18)***
γ_3 <i>R&D</i> \times <i>IP</i>	0.004 (4.33)***	0.003 (4.12)***	0.004 (5.07)***	0.015 (4.40)***
γ_4 Lagged <i>Tobin's</i>	0.253 (22.55)***	0.272 (23.31)***	0.251 (22.24)***	0.261 (23.17)***
γ_5 <i>LEV</i>	-0.013 (-1.78)*	-0.089 (-11.50)***	0.011 (1.44)	-0.009 (-1.25)
γ_6 <i>SIZE</i>	-0.003 (-4.39)***	-0.001 (-2.19)**	-0.003 (-4.97)***	-0.003 (-5.02)***
γ_7 <i>PPE</i>	0.119 (13.33)***	0.060 (6.31)***	0.153 (17.09)***	0.240 (25.62)***
γ_8 <i>GDP</i>	0.000 (17.07)***	0.000 (8.53)***	0.000 (5.99)***	0.000 (17.40)***
<i>D_Year</i>	Included	Included	Included	Included
<i>D_Industry</i>	Included	Included	Included	Included
Adj. R^2	0.371	0.355	0.370	0.367

Note: *PPE* is the ratio of property, plant and equipment to beginning-of-period total assets of year t . See Table 1 for other variables definition. ***, **, * represent significance at the 1%, 5%, and 10% levels. Two-tailed t-values are reported in parentheses.

6 Robustness tests

6.1 Country-level regression model to test the relation between investor protection and R&D investments.

We also perform country-level regressions to test our first hypothesis. The country-level regression is specified as follows:

$$R\&D_{c,t} = \delta_0 + \delta_1 IP_{c,t} + \delta_2 HC_{c,t} + \delta_3 GDP_{c,t} + \delta_4 POP_{c,t} + \delta_n D_Year_t + \varepsilon_{i,t} \quad (4)$$

where *R&D* is the country-level R&D investment, which is computed as country-year mean of R&D expenditures to total assets. Our test variable is the various country-level measurements of investor protection (*IP*), which includes the extent of minority shareholders rights, the quality of legal enforcement, and their combined index. We include a number of control variables to control for country-specific factors that may be correlated with our variables of interest (i.e.,

HC, GDP, and POP).⁷

Table 5 indicates that the extent of the outside investor rights (*SR*), the strength of the law enforcement institutions (*LE*), the combined index (*SR_LE*), and the binary version of the combined index (*SR_LE_D*) exhibit positive coefficients (*p*-values are all < 0.05). Thus, our country-level analyses also support the positive relation between the extent of investor protection and investments in R&D.⁸ In particular, we report a 13.1 percent increase in R&D/total assets for each additional 1 point increase on the outsider rights index (*SR*) and a 11.5 percent increase in R&D/total assets for each additional 1 point increase on the law enforcement index (*LE*) imposed on countries. Moreover, the coefficient of *SR_LE_D* is 0.233, which suggests that strong legal environments (countries with *SR_LE* > country-median value) increase 17.94 percent relative to weak legal environments (countries with *SR_LE* ≤ country-median value) based on the average R&D/assets in country-level sample.⁹

Table 5: Country-level regression model to test the relation between investor protection and R&D investment

Independent variable:	Dependent variable: <i>R&D</i>			
	(1) <i>IP = SR</i>	(2) <i>IP = LE</i>	(3) <i>IP = SR_LE</i>	(4) <i>IP = SR_LE_D</i>
δ_0 Con.	0.465 (1.59)	0.642 (2.66)***	0.910 (3.24)***	1.299 (7.28)***
δ_1 <i>IP</i>	0.131 (3.92)***	0.115 (4.34)***	0.076 (2.20)**	0.233 (2.01)**
δ_2 <i>HC</i>	0.637 (9.62)***	0.609 (9.13)***	0.653 (9.70)***	0.645 (9.49)***
δ_3 <i>GDP</i>	0.000 (1.83)*	0.000 (2.51)**	0.000 (2.38)**	0.000 (2.36)**
δ_4 <i>POP</i>	0.001 (1.97)**	0.000 (1.24)	0.001 (1.56)	0.000 (1.28)
<i>D_Year</i>	Included	Included	Included	Included
Adj. <i>R</i> ²	0.372	0.380	0.349	0.347

Note: See Table 1 for variable definition. ***, **, * represent significance at the 1%, 5%, and 10% levels. Two-tailed t-values are reported in parentheses.

6.2 Alternative legal protection indexes

We also use La Porta et al.'s (1998) anti-director rights index and Djankov et al.'s (2008) anti-self-dealing index to measure the legal protection of minority shareholders against expropriation by corporate insiders. The anti-director rights index measures how strongly the legal system favors minority shareholders against managers or dominant shareholders in the corporate decision making

⁷ See discussion in Section 3.

⁸ In addition, we model the market capitalization following Belloc (2013) and jointly estimate the country-level R&D investment and market capitalization using a three-stage least squares (3SLS) approach. In untabulated results, our conclusions remain qualitatively the same.

⁹ We calculate this as Increase = (coefficient estimate/average country-level R&D across 31 countries) × 100% = (0.233 / 1.299) × 100% = 17.94%.

process. The anti-self-dealing index is based on legal rules prevailing in 2003 and focuses on private enforcement mechanisms (e.g., disclosure, approval, litigation) that govern a specific self-dealing transaction. Next, we use the rule of law index from La Porta et al. (1998) as an alternative proxy for legal enforcement. The index assesses the law and order tradition in the country. Lastly, we introduce the patent rights index constructed by Ginarte and Park (1997) and updated by Park (2008). This index focuses more specially on the protection of patents. Table 6 shows that the coefficients on the indexes (in Panel A and B) and the interaction of the indexes and cash flow (in Panel B) are positively significant, $p < 0.05$. Thus, our overall results are not sensitive to alternative measures of the legal protection.

Table 6: Alternative legal protection measures

Panel A: H1				
Dependent variable: <i>R&D</i>				
Independent variable:	(1) <i>IP = ADRI</i>	(2) <i>IP = ASDI</i>	(3) <i>IP = RLI</i>	(4) <i>IP = PRI</i>
α_0 Con.	1.233 (12.76)***	1.544 (14.67)***	0.682 (6.01)***	-0.248 (-0.88)
α_1 <i>IP</i>	0.243 (19.01)***	1.135 (12.26)***	0.209 (19.14)***	0.588 (8.91)***
α_2 <i>CF</i>	6.154 (22.61)***	5.117 (17.61)***	5.980 (22.10)***	5.620 (20.67)***
<i>D_Year</i>	Included	Included	Included	Included
<i>D_Industry</i>	Included	Included	Included	Included
Firms-level control variables	Included	Included	Included	Included
Countries-level control	Included	Included	Included	Included
Adj. R^2	0.059	0.051	0.059	0.054
Panel B: H2				
Dependent variable: <i>R&D</i>				
Independent variable:	(1) <i>IP = ADRI</i>	(2) <i>IP = ASDI</i>	(3) <i>IP = RLI</i>	(4) <i>IP = PRI</i>
β_0 Con.	0.989 (6.25)***	1.390 (8.12)***	0.521 (2.92)***	-0.127 (-0.36)
β_1 <i>IP</i>	0.357 (14.33)***	1.723 (9.50)***	0.248 (15.56)***	0.593 (7.53)***
β_2 <i>CF</i>	7.791 (5.29)***	6.039 (3.64)***	7.344 (4.52)***	6.715 (2.16)**
β_3 <i>CF</i> \times <i>IP</i>	-1.233 (-5.44)***	-6.301 (-3.76)***	-0.495 (-3.77)***	-1.472 (-2.29)**
<i>D_Year</i>	Included	Included	Included	Included
<i>D_Industry</i>	Included	Included	Included	Included
Firms-level control variables	Included	Included	Included	Included
Countries-level control	Included	Included	Included	Included
Adj. R^2	0.061	0.054	0.061	0.056

Note: *ADRI* is the anti-director rights index from La Porta et al. (1998). *ASDI* is the anti-self-dealing index from Djankov et al. (2008). *RLI* is the rule of law index from La Porta et al. (1998). *PRI* is the 2005 patent rights index from Park (2008). See Table 1 for other variables definition. ***, **, * represent significance at the 1%, 5%, and 10% levels. Two-tailed t-values are reported in parentheses.

6.3 Controlling for the potential endogeneity of investor protection

If our investor protection measures and R&D investments are simultaneous, then our results suffer from an endogeneity bias. To account for any endogeneity bias, we use the instrumental variable method, whereby instrument variables are chosen to substitute for the various investor protection measures that may be correlated with the residual. A successful instrument is one that is correlated with the substitute explanatory variable, yet is uncorrelated with the residual. We use countries' legal origins and average per capital GDP as instruments for the investor protection measures as suggested by Levine (1999). A country's legal origin is appealing because they are predetermined and uncorrelated with residuals and are related to the level of investor protection. In addition, a country's per capital GDP may influence the level of legal enforcement because an effective legal infrastructure is costly to create and maintain. Table 7 reports results of our two-stage least squares regression. The results for Panel A and B are similar to those of Table 2 and Table 3, indicating that our results are not driven by the potential endogeneity of investor protection.

6.4 Excluding U.S. and Japanese firms

Table 1 shows that the United States and Japan have an unusually large number of firm-year observations compared to the rest of the countries. To test whether these two countries influence our firm-level tests, we rerun our regressions from Table 2 and Table 3 excluding U.S. and Japanese firms. The analysis (not tabulated) yields results consistent with the results of Table 2 and Table 3, indicating that our overall results are not sensitive to excluding U.S. and Japan firms.

7 Conclusion

R&D investments are attractive to stockholders because R&D is crucial for both survival and growth. As compared with capital expenditures, however, R&D investments are more difficult for outsiders to monitor and, hence, more likely to depend on managerial discretion. Taking into consideration that R&D investments may not yield short-term returns and that divergent interests exist between shareholders and managers, managers may reduce R&D spending to opportunistically boost short-term performance (Bushee, 1998; Cao and Laksmana, 2009; Cheng, 2004; Yu, 2007). Based on prior research that identifies a key institutional factor affecting corporate governance and limiting managerial discretion (see Shleifer and Vishny, 1997; La Porta et al., 2000), we focus on investor protection as a significant determinant of corporate R&D investments around the world.

Table 7: Controlling for the potential endogeneity of investor protection

Panel A: H1				
Dependent variable: <i>R&D</i>				
Independent variable:	(1) <i>IP = SR</i>	(2) <i>IP = LE</i>	(3) <i>IP = SR_LE</i>	(4) <i>IP = SR_LE_D</i>
α_0 Con.	0.498 (3.67)***	1.990 (20.24)***	1.071 (8.73)***	1.265 (13.81)***
α_1 Predicted <i>IP</i>	0.221 (15.49)***	0.055 (6.74)***	0.153 (12.08)***	1.403 (24.49)***
α_2 <i>CF</i>	5.659 (20.98)***	4.866 (17.72)***	4.884 (18.09)***	7.900 (27.20)***
<i>D_Year</i>	Included	Included	Included	Included
<i>D_Industry</i>	Included	Included	Included	Included
Firms-level control variables	Included	Included	Included	Included
Countries-level control	Included	Included	Included	Included
Adj. R^2	0.056	0.054	0.055	0.048

Panel B: H2				
Dependent variable: <i>R&D</i>				
Independent variable:	(1) <i>IP = SR</i>	(2) <i>IP = LE</i>	(3) <i>IP = SR_LE</i>	(4) <i>IP = SR_LE_D</i>
β_0 Con.	2.025 (7.42)***	0.930 (12.37)***	0.479 (2.13)**	2.183 (15.68)***
β_1 Predicted <i>IP</i>	0.590 (17.99)***	0.175 (19.59)***	0.251 (10.10)***	0.954 (12.95)***
β_2 <i>CF</i>	29.395 (12.56)***	5.039 (3.98)***	10.516 (4.88)***	4.237 (3.18)***
β_3 <i>CF</i> \times Predicted <i>IP</i>	-3.713 (-13.29)***	-0.430 (-12.51)***	-1.079 (-4.48)***	-1.314 (-1.83)*
<i>D_Year</i>	Included	Included	Included	Included
<i>D_Industry</i>	Included	Included	Included	Included
Firms-level control variables	Included	Included	Included	Included
Countries-level control	Included	Included	Included	Included
Adj. R^2	0.055	0.056	0.057	0.059

Note: See Table 1 for variable definition. ***, **, * represent significance at the 1%, 5%, and 10% levels. Two-tailed t-values are reported in parentheses.

We posit and find that R&D investments are positively associated with the extent of minority shareholder rights and the quality of legal enforcement. This result is consistent with the conjectures that strong investor protection encourages outsider investors to participate in capital markets and leads to fewer financing constraints on R&D investments, inhibits managerial myopic actions that may forego R&D investment to opportunistically boost short-term performance, and reduces insiders' need to avoid R&D investment to obfuscate firm performance due to smaller private control benefits. We also find that the extent of investor protection is negatively associated with R&D investment–cash flow sensitivity. This result suggests that strong investor protection mitigates the dependence of a firm's R&D investments on its internal resource and strengthens the relation with its investment opportunities. Finally, we find that investor protection positively

moderates the relation between R&D investments and firm performance, indicating that the increased R&D investments arising from strong investor protection is generally value enhancing.

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Appendix A: Cross-country differences in accounting for research and development costs during the sample period (2006-2014)

Country	Is R&D expenditures permitted as capitalization?
Australia	Yes
Austria	Development costs only
Belgium	Development costs only
Brazil	Yes
Canada	Development costs only
Finland	Development costs only
Germany	Development costs only
Hong Kong	Yes
India	Development costs only
Indonesia	Yes
Ireland	Development costs only
Israel	Development costs only
Italy	Development costs only

Appendix A (*Continued*)

Country	Is R&D expenditures permitted as capitalization?
Japan	No
Korea	Development costs only
Malaysia	Development costs only
Mexico	Development costs only
Netherlands	Development costs only
New Zealand	Development costs only
Norway	Development costs only
Pakistan	Development costs only
Peru	Development costs only
Philippines	Development costs only
Singapore	Development costs only
South Africa	Development costs only
Sweden	Development costs only
Switzerland	Development costs only
Thailand	Yes
Turkey	Yes
UK	Development costs only
US	No

Note: We obtain access to the information on cross-country differences in R&D accounting for the countries included in our analysis by contacting their GAAP regulators and searching their Web sites.