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National Culture and Corporate R&D Investment

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Abstract: This paper examines the relationship between national culture and corporate R&D investment behavior. Based on Hofstede's work and the cushion hypothesis, we predict that firms in East Asian countries are more likely to engage in R&D investment than are firms in Western countries because East Asian cultures are collectivistic and long-term oriented while Western cultures are individualistic and short-term oriented. We use firm-level panel data for seven countries and apply dynamic GMM methods. The regression analysis shows that R&D investment is positively sensitive to internal funds for firms in East Asian countries, but not sensitive for firms in the Western countries. The result is robust to model specification and sample splitting. Moreover, the level of financial development and the legal environment do not systemically affect the relationship between R&D investment and internal funds. We suggest that this evidence supports the hypothesis that national culture affects corporate decisions.

Keywords: National culture, R&D investment, Cushion hypothesis.

1 Introduction

Does national culture matter for economic behavior and performance? Kahn (1979) argued that the East Asian countries and regions such as Singapore, Taiwan, South Korea (Korea, hereafter), Hong Kong, and Japan had common culture roots of Confucian tradition, and this cultural inheritance provided a competitive advantage for economic growth. The seminal paper by Hofstede and Bond (1988) examined the relationship between Confucian teachings and economic development in Asia by using the IBM employee attitude surveys and found evidence supporting Kahn's hypothesis. Thus, we can infer that national culture is a significant explanatory factor for cross-country differences in economic behavior and performance.

Given that national culture matters for economic activity, another question arises: Does national culture matter for firm behavior? Indeed, several studies have explored the effect of the dimensions of national culture proposed by Hofstede and Bond (1988) on business practices and performance. In addition to Confucianism, which is called later as the long-term orientation, Hofstede and Bond (1988) proposed four more dimensions of cross-cultural variation such as power distance, individualism, masculinity, and uncertainty avoidance, and they provided scores on the five dimensions for 50 countries. Straub et al. (1997) compared knowledge worker perceptions and use of the same technology in three countries--Japan, Switzerland, and the United States--and found that Hofstede's indices were useful for explaining cross-cultural differences. Steensma et al. (2000) focused on the effect of national culture on the propensity of small, independent manufacturing enterprises (SMEs) to cooperate with other firms for technological innovation. They showed that SMEs in uncertainty avoiding or low masculinity or low individualistic countries were more likely to engage in technology alliances. Png et al. (2001) examined the adoption of a type of IT infrastructure (frame relay) and demonstrated that businesses from higher uncertainty avoidance countries

were less likely to adopt frame relay. These studies have confirmed the effect of national culture on firm behavior and strategy.

In this context, this study addresses a more specific question: Does national culture affect corporate R&D investment decisions? The question of the effect of national culture on corporate R&D investment has not been studied extensively in previous research. It has been accepted that technological innovation based on R&D investment is important to economic development (see Guellec and Potterie, 2001 for an extensive empirical study). Thus, it is worthwhile determining whether cultural differences affect R&D decisions.

In order to test the effect of cultural factors on corporate R&D decisions, the current study investigates firm-level panel data from seven OECD countries: Japan, Korea, Canada, France, Italy, UK, and US. These countries can be divided into two groups: East Asian countries (Japan and Korea) and Western countries (Canada, France, Italy, UK, and US). According to the scores on cultural dimensions Hofstede (2001), whereas the East Asian countries represent collectivistic culture, the Western countries represent individualistic culture. Moreover, the former countries have a long-term orientation, and the latter countries have a short-term orientation. The scores on cultural dimensions of the selected countries are summarized in Table 1.

Table 1: Scores on Cultural Dimensions

		Individualism		Long-term Orientation	
Group	Country	Rank	Index Value	Rank	Index Value
I	Japan	22-23	46	4	80
	Korea	43	18	5	75
II	Canada	4-5	80	20	23
	France	10-11	71	NA	NA
	Italy	7	76	NA	NA
	UK	3	89	18	25
	US	1	91	17	29

Notes: The table shows the scores on cultural dimensions for the selected countries reported by Hofstede (2001, p.215 & p.356).

The present study uses regression analysis to estimate the effect of internal funds such as cash flow on corporate R&D investment in the two groups of countries, and compares the two groups to determine whether the two groups differ significantly in terms of the sensitivity of investment to internal funds. The basic idea behind this analysis is that, if national culture can influence corporate R&D decision making, then the empirical results of the sensitivity of investment to cash flow will be significantly different across the two groups of countries.

2 Hypothesis Development

R&D investment has several characteristics that differentiate it from other investments. This study focuses on two key features: first, R&D outcomes are uncertain and thus R&D projects are usually risky; second, since it takes time for R&D inputs to generate outputs, R&D investment requires patience and a long-term view. Given these two features, risk-averseness and time horizon are highly relevant to R&D decision making. We discuss these two factors in turn, and develop a hypothesis for subsequent testing.

First, we relate risk aversion to individualism, the first category by which to classify the countries. R&D is risky in that R&D outcomes are inherently uncertain. Thus, it is expected that risk-averse managers would underinvest in R&D. This naturally leads to the prediction that managers in risk-averse cultures are more hesitant to invest in R&D. Then, how are risk-averseness and individualism related? Is risk-taking encouraged in individualistic cultures? or in collectivistic cultures?

An interesting finding relevant to the question of the relation between individualism and risk-taking was reported by Hsee and Weber (1999) which investigated cross-national differences in risk preferences between Americans and Chinese (see Weber and Hsee, 2000 for a literature review). The study used questionnaire data to assign a risk preference index to each respondent. Participants in their study were from the University of Chicago and from Shanghai Chengjian University in China. The study

found, surprisingly, that the Chinese respondents were more risk-seeking than the American respondents, although participants predicted that the Americans would be more risk-seeking than the Chinese. Hsee and Weber (1999) explained their results in terms of a 'cushion hypothesis', which suggests that, because people in collectivist cultures are likely to receive financial help if they are in need, they are less risk averse than those in individualistic cultures. Many Chinese people live in extended families with a large number of relatives, and they can rely on this social network for support. Therefore, financial risk is not a big issue for them. This hypothesis is called the cushion hypothesis because the social network serves as a cushion that would hold individuals in case they fell. Other studies by the authors (Weber and Hsee, 1998; Weber and Hsee, 1999) supported the cushion hypothesis.

Also relevant in this respect is the work of Mandel (2003), which investigated the moderating role of risk domain in the effects of priming the interdependent self versus the independent self on risk-taking. The study distinguished between two types of individual risk: financial risk and social risk. Social risk refers to embarrassment or esteem among one's family or peers. It is reasonable to expect that individuals with the interdependent self will care more than individuals with the independent self to avoid social risks. It is known that Asian cultures foster an interdependent perspective on the self, while American culture emphasizes an independent perspective on the self (Markus and Kitayama, 1991). Combining this expectation with the cushion hypothesis, Mandel (2003) predicted that interdependent individuals would be less likely to take social risks but more likely to take financial risks than would independent individuals. The study found experimental evidence that interdependent individuals were more risk-seeking in their financial choices and less risk-seeking in their social choices than were independent individuals.

From this, it appears to be clear that individuals from collectivist cultures are more likely to take financial risks than are individuals from individualistic cultures. If this is

the case, then a question may arise: What about organizations such as firms? Are organizations in collectivistic cultures more likely to take risks? More specifically, are firms in collectivist cultures more likely to be risk seeking? We argue that the answer to the question is yes. Decisions in an organization are made by individuals or groups in the organization, and when making decisions, the individuals or the groups are influenced by the cultural context in which the organization operates. Thus, if individuals from collectivist cultures are risk takers, then so are organizations in collectivistic cultures. Obviously, risk takers are more likely to engage in risky activities such as R&D. Thus, firms in collectivistic cultures are more likely to be active in R&D than firms in individualistic cultures.

Business groups such as Japanese *keiretsu* and Korean *chaebol* may be thought of examples of the cushion hypothesis at the organizational level. It is widely suggested that business groups facilitate mutual insurance and risk sharing among affiliated firms. In Japan, the group's main bank often assists distressed firms within the group with the help of other group members, which acts as a kind of risk sharing within *keiretsu* firms (Khanna and Yafeh, 2005, p.302). In Korea, firms in a *chaebol* are usually controlled by the founding family, which exercises control through interlocking ownership among the firms. The firms can obtain much of their financing within their own group. *Chaebol*s redistribute funds within the group and thus reduce the affiliated firms' risk of financial distress (Shin and Park, 1999, pp.172-173). Using the internal capital markets, managers in *chaebol* firms can be more risk seeking.

Second, since it takes time for R&D to have an effect on earnings, R&D requires a long-term perspective. This leads to the prediction that firms in long-term orientation cultures are more likely to be active in R&D than firms in short-term orientation cultures. According to Hofstede (2001, p.361), businesses in long-term oriented cultures do not expect immediate results, while the immediate result is a major concern in short-term oriented cultures. Similarly, Chen et al. (2005) showed that people from Western

cultures are less patient and discount the future to a greater degree than do people from Eastern cultures.

Putting the issues of risk-taking and time horizon, we expect that collectivistic and long-term oriented cultures encourage R&D investment, and individualistic and short-term oriented cultures discourage R&D investment. As shown by Table 1, Japan and Korea are collectivistic and long-term oriented countries, and Canada, France, Italy, UK and US are individualistic and short-term oriented countries. Therefore, we hypothesize that firms in the East Asian countries are more active in R&D investment decisions than are firms in the Western countries.

The extent to which firms are active in R&D is relevant with investment-cash flow sensitivity, which is one of the most debated topics in the literature on corporate finance (see Hubbard, 1998 for a review). The seminal paper by Modigliani and Miller (1958) proposed that a firm's financial status does not influence investment decisions. However, it has been observed that firms prefer internal finance when making investment decisions. According to the pecking order theory of Myers and Majluf (1984), firms prefer internal sources for financing investment to external sources because internal finance is cheaper than external finance as a result of asymmetric information. If a firm has better information about its investment projects than outside investors, the firm prefers to finance such projects with internal sources of fund since outside investors will demand a premium for bearing risk. This leads to the prediction that investment is sensitive to internal funds.

We expect that corporate R&D investments are more sensitive to internal cash flow for firms that are more active in R&D, *ceteris paribus*. Cash flow is more important for firms when they are willing to make investments. R&D-active firms are more sensitive to the availability of internal funds. Thus, the extent to which firms are willing to make R&D investments can be measured by the sensitivity of investment in R&D to internal funds. Therefore, the hypothesis to be tested in this study would be: R&D investment is more

sensitive to internal funds for firms in Japan and Korea than for firms in the Western countries.

3 Research Design

3.1 Sample

We use firm-level panel data from Japan, Korea, Canada, France, Italy, UK, and US for the period 1998-2012. The data set used in this study contains corporate financial data from Thomson Reuters Datastream. We split the countries into two groups according to their individualism and long-term orientation scores. Group I includes the countries with collectivistic and long-term oriented cultures such as Japan and Korea and Group II includes the countries with individualistic and short-term oriented cultures such as Canada, France, Italy, UK and US. The panel data from Japan (n=1057) and Korea (n=247) include 1304 firms, and the data from Canada (n=71), France (n=78), Italy (n=35), UK (n=124), and US (n=810) include 1118 firms.

As a preliminary check, we first examined GDP growth rates across the sample countries. Table 2 shows the values of GDP growth (annual %) from 1998 to 2011 for the selected countries, which is graphically illustrated in Figure 1, which did not reveal any significant differences with respect to the macroeconomic conditions for the countries over the period.

Table 2: GDP growth (annual %)

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Japan	-2.00	-0.19	2.25	0.35	0.28	1.68	2.36	1.30	1.69	2.19	-1.04	-5.52	4.43	-0.70
Korea	-6.85	9.48	8.48	3.97	7.15	2.80	4.61	3.95	5.17	5.10	2.29	0.31	6.32	3.63
Canada	4.09	5.53	5.23	1.78	2.92	1.88	3.11	3.01	2.82	2.20	0.68	-2.76	3.21	2.45
France	3.37	3.29	3.67	1.83	0.92	0.89	2.54	1.82	2.46	2.28	-0.08	-3.14	1.66	1.69
Italy	1.44	1.45	3.65	1.86	0.45	-0.04	1.73	0.93	2.19	1.68	-1.15	-5.49	1.81	0.43
UK	3.51	3.16	4.23	2.88	2.43	3.81	2.90	2.77	2.60	3.63	-0.96	-3.97	1.79	0.75
US	4.40	4.86	4.17	1.09	1.82	2.55	3.47	3.07	2.65	1.90	-0.35	-3.52	3.02	1.70

Notes: The table shows the values of GDP growth (annual %) from 1998 to 2011 for the selected countries. Source: World Bank.

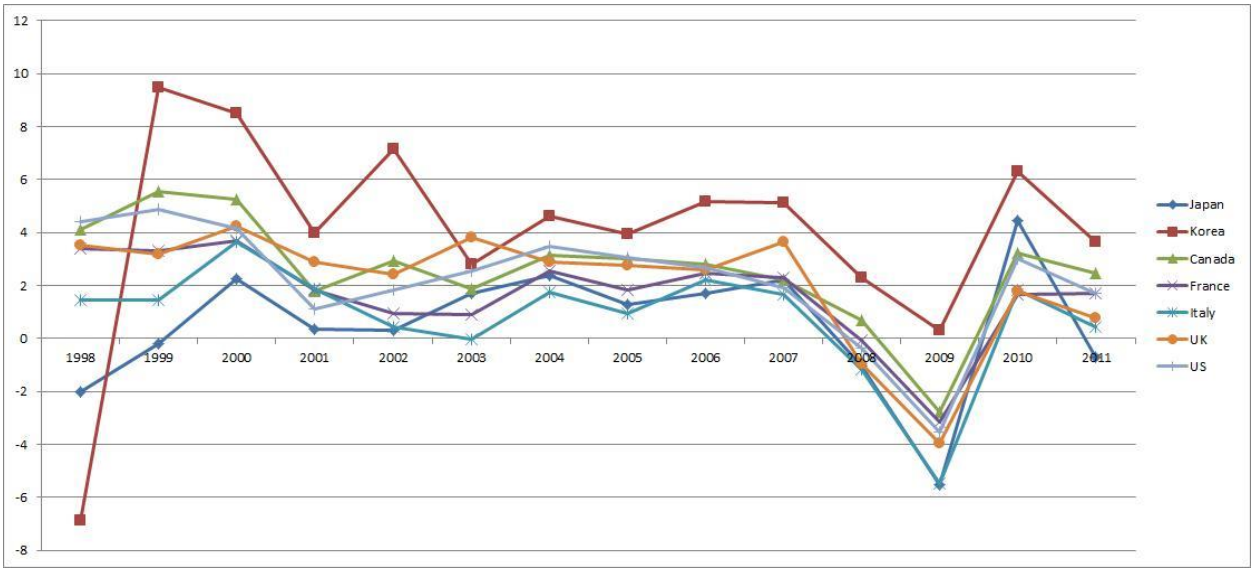

Figure 1: GDP growth (annual %), 1998-2011, Source: World Bank

The variables used in the empirical analysis are selected as follows. R&D investment, a main dependent variable, is measured by R&D spending divided by total assets (*rnd*/*asset*). Main independent variables employed in this study are the ratio of net sales to total assets (*sale*/*asset*) and the ratio of cash flow to total assets (*cash*/*asset*). The sales variable is used to control for investment profitability, which reflects the idea that a firm's investment depends on the firm's recent performance. Tobin's Q is also widely used to control for profitability in empirical studies, but it has been criticized due to its lack of reliability (see Schiantareli, 1996 for a review). In a model using Tobin's Q, marginal Q is supposed to be a proxy for investment profitability, but it cannot be observed, and thus, average Q is used instead of marginal Q. However, average Q is known as a poor proxy for marginal Q. In order to avoid this problem, this study uses the sales variable. Following the investment literature, we use the cash flow variable as a proxy for internal funds.

As control variables, the ratio of total debt to total equity (*debt/equity*) and the natural logarithm of employees (*log(emp)*) are used. The ratio of debt to equity controls for variations in firms' financial structure such as leverage. The variable of employees is included as a proxy for firm size, and a logarithmic transformation is used in order to minimize skewness.

Table 3: Summary Statistics

	Group I			Group II		
full	median	mean	s.d.	median	mean	s.d.
rnd/asset	0.01	0.44	42.66	0.05	0.13	0.53
sale/asset	0.90	1.09	12.23	0.81	0.87	0.65
cash/asset	0.13	0.19	2.68	0.19	0.29	0.27
debt/equity	0.38	1.32	45.21	0.16	0.66	28.37
log(emp)	7.03	7.19	1.49	7.02	7.02	2.27
four industries	median	mean	s.d.	median	mean	s.d.
rnd/asset	0.02	0.08	1.67	0.08	0.17	0.63
sale/asset	0.84	0.92	0.59	0.72	0.77	0.61
cash/asset	0.16	0.21	0.53	0.28	0.35	0.28
debt/equity	0.28	0.63	4.81	0.06	0.66	33.45
log(emp)	6.93	7.10	1.59	6.38	6.50	2.15
the largest 50%	median	mean	s.d.	median	mean	s.d.
rnd/asset	0.00	0.01	0.02	0.02	0.04	0.05
sale/asset	0.89	0.97	0.44	0.87	0.93	0.51
cash/asset	0.12	0.14	0.11	0.10	0.16	0.17
debt/equity	0.48	1.86	60.52	0.47	1.12	41.51
log(emp)	7.87	7.99	1.29	8.80	8.89	1.43
the largest 25%	median	mean	s.d.	median	mean	s.d.
rnd/asset	0.00	0.02	0.02	0.01	0.03	0.04
sale/asset	0.88	0.93	0.40	0.83	0.90	0.49
cash/asset	0.11	0.14	0.11	0.08	0.13	0.13
debt/equity	0.64	2.22	69.38	0.55	0.89	11.96
log(emp)	8.73	8.83	1.28	9.64	9.70	1.16

Notes: The table shows the summary statistics of the variables used in the study. The currency used is US dollars.

Summary statistics are presented in Table 3. In order to check the robustness of our findings, we investigate some subsamples as well as the entire sample. We create the first subsample by selecting four R&D intensive industries only--electronic and electrical equipment, industrial engineering, pharmaceuticals and biotechnology, and

technology hardware and equipment. This study examines the sensitivity of R&D investment to cash flow, which may be important especially in the R&D intensive industries. In addition, using the subsample of the four industries is useful if significant inter-industry differences in R&D activity exist and the composition of industries varies considerably across the sample countries. Second, we construct a subsample of large firms in order to consider the moderating role of firm size. We examined the total sample including both Group I and Group II, and found that the median and the third quartile of total assets are $397,798 and $1,414,452, respectively. The subsample, 'the largest 50%' in Table 3, includes large firms with assets above the median, and 'the largest 25%' includes large firms with assets above the third quartile.

3.2 Method

We undertake panel data regression analysis to test the hypothesis of the relationship between national culture and corporate R&D investment. A dynamic sales accelerator investment model is used as a base model:

$$(rnd/asset)_{i,t} = b_1 (sales/asset)_{i,t-1} + b_2 (cash/asset)_{i,t-1} + b_3(rnd/asset)_{i,t-1} + e_{i,t}, \quad (1)$$

where i refers to firm, t refers to time period, and *e* refers to the error term. The lagged R&D variable $(rnd/asset)_{i,t-1}$ is included as an independent variable because it can be an important determinant of current R&D investment. R&D has high adjustment costs and thus R&D budgets tend to be "set by standard rules of thumb based upon historical precedence" (Hansen and Hill, 1991, p.4). Thus, previous R&D spending can have a significant influence on the current R&D investment.

We also estimate the model with control variables of firm leverage and size:

$$(rnd/asset)_{i,t} = b_1 (sales/asset)_{i,t-1} + b_2 (cash/asset)_{i,t-1} + b_3 (debt/equity)_{i,t-1} + b_4 \log(emp)_{i,t-1} + b_5(rnd/asset)_{i,t-1} + e_{i,t}. \quad (2)$$

Since the lagged R&D term, included as an independent variable, is likely to be endogenous, OLS estimates in such a dynamic model would be inconsistent. Thus, for

consistent estimation of the dynamic model, we conduct the generalized methods of moments (GMM) estimation of the kind introduced by Blundell and Bond (1998), called system GMM. This type of GMM is known to be less biased than other types of GMM such as difference GMM. We include all possible lags from period t-2 as GMM instruments for $(rnd/asset)_{i,t-1}$. The Sargan test and the second order autocorrelation test are used to test the validity of the instruments and the absence of autocorrelation.

4 Main Analysis

We split the selected countries into two groups (Group I and Group II), collect the corporate financial data of the groups of the countries, and use a dynamic GMM technique to obtain the estimation results of the two groups. The focus of the study is on the difference between the two groups with respect to the degree of willingness to invest in R&D, which is represented by the coefficient estimates of the cash flow term.

Table 4: Regression Results

full	Group I		Group II	
(sale/asset) t-1	0.0151**	0.0123*	0.0029	0.0033
	(2.8461)	(1.9694)	(0.3856)	(0.4550)
(cash/asset) t-1	0.0896**	0.0815**	-0.0020	-0.0052
	(2.7778)	(2.8007)	(-0.1539)	(-0.4084)
(debt/equity) t-1		-0.0003		0.0001
		(-0.2911)		(0.6922)
log(emp) t-1		0.0007		-0.0042
		(0.3162)		(-1.8565)
(rnd/asset) t-1	0.6588***	0.6708***	0.9176***	0.8688***
	(7.0129)	(9.8624)	(16.1348)	(14.0704)
Sargan	1.0000	1.0000	1.0000	1.0000
AR(2)	0.1588	0.1598	0.0863	0.1858
four industries	Group I		Group II	
(sale/asset) t-1	0.0093	0.0208*	0.0013	0.0001
	(1.7255)	(2.4956)	(0.1496)	(0.0179)
(cash/asset) t-1	0.0598**	0.0678**	0.0015	0.0069
	(2.6074)	(3.0748)	(0.1157)	(0.4531)
(debt/equity) t-1		0.0003		0.0003
		(0.8163)		(0.4441)
log(emp) t-1		-0.0035		-0.0006
		(-1.4745)		(-0.2226)
(rnd/asset) t-1	0.8941***	0.8405***	0.9319***	0.9126***
	(20.9947)	(15.9755)	(11.7867)	(13.3883)
Sargan	1.0000	1.0000	1.0000	1.0000
AR(2)	0.1597	0.1583	0.0854	0.1877

Notes: The table shows the results of dynamic GMM regressions. Figures are regression coefficient estimates, and *t* values are shown in parentheses below coefficient estimates. ***, **, and *, respectively, indicate significance levels at 0.1%, 1%, and 5% levels. *Sargan* and *AR(2)* refer to *p* values for the Sargan test and the autocorrelation test for AR(2) process, respectively.

Table 4 gives the results of the dynamic GMM regressions for the full sample as well as subsample of the four industries. The Sargan test and the second order autocorrelation test all confirm that the models are correctly specified. The full sample regression shows that the coefficient estimates of the cash flow term are statistically significant and

positive for the East Asian countries, but insignificant for the Western countries. This implies that R&D investment is significantly sensitive to cash flow for firms in Japan and Korea, but is not sensitive for firms in the Western countries. This finding is quite robust, occurring on the cash flow terms both with and without the control variables in the regression. We interpret the result to imply that East Asian cultures encourage firms to invest in R&D more than Western cultures.

In order to take industry effects into account, we also apply the regression analysis to the subsample of four R&D intensive industries. Investigating this subsample yields the same results as in the full sample: the sensitivity of firms' R&D investment to cash flow is positive and significant in Japan and Korea, but insignificant in the remaining Western countries.

Previous empirical studies of investment such as Fazzari et al. (1988) have explained that the investment-cash flow sensitivity would measure the degree of financial constraints faced by firms (see Hubbard, 1998 for a review). Such an interpretation can explain the observed differences between the two groups of countries if firms in Group I suffer more financial constraints than do firms in Group II. In order to check this possibility, we examine the subsample of large firms. Large firms face less severe financial constraints than small firms, and thus the financial problem is not expected to play an important role in this subsample. Moreover, according to Schumpeter, large firms innovate more than small firms, and thus the subsample of large firms is particularly relevant for the investigation of R&D investment.

Table 5: Regression Results (large firms)

the largest 50%	Group I		Group II	
(sale/asset) $_{t-1}$	0.0119***	0.0075	0.0034	0.0032
	(3.5403)	(1.3942)	(0.4479)	(0.4343)
(cash/asset) $_{t-1}$	0.0672***	0.0739**	-0.0011	-0.0032
	(3.3394)	(2.8459)	(-0.0830)	(-0.2507)
(debt/equity) $_{t-1}$		0.0006		0.0000
		(1.0644)		(0.1936)
log(emp) $_{t-1}$		0.0018		-0.0044
		(0.9919)		(-1.8184)
(rnd/asset) $_{t-1}$	0.7555***	0.7326***	0.9074***	0.8588***
	(13.1842)	(11.8452)	(16.0907)	(14.7841)
Sargan	1.0000	1.0000	1.0000	1.0000
AR(2)	0.1608	0.4642	0.0917	0.1020
the largest 25%	Group I		Group II	
(sale/asset) $_{t-1}$	0.0121***	0.0073	0.0042	0.0042
	(3.4695)	(1.3851)	(0.5164)	(0.5634)
(cash/asset) $_{t-1}$	0.0678***	0.0753**	-0.0027	-0.0037
	(3.3004)	(2.9038)	(-0.2102)	(-0.2832)
(debt/equity) $_{t-1}$		0.0006		-0.0000
		(1.1264)		(-0.2001)
log(emp) $_{t-1}$		0.0018		-0.0043
		(0.9370)		(-1.5892)
(rnd/asset) $_{t-1}$	0.7510***	0.7377***	0.9081***	0.8554***
	(13.2390)	(12.2186)	(15.9029)	(14.2763)
Sargan	1.0000	1.0000	1.0000	1.0000
AR(2)	0.4677	0.2523	0.0574	0.0917

Notes: The table shows the results of dynamic GMM regressions. Figures are regression coefficient estimates, and *t* values are shown in parentheses below coefficient estimates. ***, **, and *, respectively, indicate significance levels at 0.1%, 1%, and 5% levels. *Sargan* and *AR(2)* refer to *p* values for the Sargan test and the autocorrelation test for AR(2) process, respectively.

The results of the dynamic GMM regressions using the subsample of large firms are presented in Table 5. We examine the subsample of firms with assets above the median (the largest 50%) and the subsample of firms with assets above the third quartile (the largest 25%). These subsamples do not add anything new to the main findings. Still, the

sensitivity of R&D investment to cash flow is found to be significant and positive in Group I only.

Another interesting point is that, in Group II, the sales variable (in addition to the cash variable) is also insignificant. Corporate R&D investment does not respond to variations in sales as well as cash flow in the Western countries. This observation strongly supports the hypothesis of less active in R&D for firms in the Western cultures.

Overall, we observe that corporate R&D investment responds strongly to movements in internal funds in East Asian cultures, but not in Western cultures. Since the result holds even when we look at large firms only, we argue that the difference between the two groups is likely due to national culture rather than the degree of financial constraints.

5 Extended Analysis

As mentioned above, many studies have interpreted a strong sensitivity of investment to cash flow as a high degree of financial constraints faced by firms. In this regard, we can interpret our results of the difference between the two groups as follows: the strong sensitivity in Group I probably reflects the existence of financial constraints faced by firms in the Group I countries. Although this issue has been examined to some extent in the previous section, we address the issue in other ways, by posing the two separate questions: One is whether the difference between the two groups in terms of the investment-cash flow sensitivity can be explained by a difference in financial development across the groups; Another question is whether the difference can be attributed to a difference in legal environment for sources of finance. We will discuss these two issues in turn.

5.1 Financial Development

First, we consider the possibility that the level of financial system development affects the sensitivity of R&D investment to cash flow. If the Western countries in the sample

are endowed with well-developed financial markets, firms in the countries do not necessarily rely on internal funds for investing. This may explain the insignificant effect of cash flow on R&D investment in Group II.

Some previous studies reported a negative relationship between financial development and financial constraints. Love (2003) utilized firm-level data for 36 countries over the period 1988-1998 and found that financial constraints (or the effect of internal funds on firms' discount factor) decreased with financial development. Love and Zicchino (2006) also observed that the positive effect of internal funds on investment is higher in countries with less developed financial systems. Some other studies of financial constraints have focused on the sensitivity of firms' cash holdings to their cash flows instead of the investment-cash flow sensitivity. Almeida et al. (2004) claimed that financially constrained firms would save cash today for future investment projects while cash holdings would not necessarily be related to cash flows for unconstrained firms, and they found evidence supporting the hypothesis. Especially, there exists research demonstrating the moderating role of financial development on the sensitivity of firms' cash holdings on cash flows. Khurana et al. (2006) examined firm-level data for 35 countries over the years 1994-2002 and found that the sensitivity of cash holdings to cash flows decreased with financial development.

Table 6: Financial Development and Investor Protection

Financial Development					Investor Protection			
Group	Country	FD	FININT	STKMKT	Group	Country	ASR	ADR
I	Japan	1.44	2.71	0.17	I	Japan	65	4
	Korea	1.73	0.90	2.56		Korea	62	2
IIa	Italy	0.56	0.75	0.38	IIc	France	69	3
	France	0.73	0.85	0.61		Italy	62	1
	Canada	0.54	0.59	0.50				
IIb					IId	Canada	74	5
	UK	2.15	2.02	2.27		UK	78	5
	US	2.64	2.01	3.27		US	71	5

Notes: The table shows the index of financial development for each country reported by Khurana et al. (2006, p.795) and the index of investor protection for each country reported by John et al. (2008, p.1698). FD refers to a measure of financial development; FININT refers to the financial intermediary development index; STKMKT refers to the stock market development index; ASR refers to the rating of quality of the accounting disclosure standards; and ADR refers to the anti-director rights index.

Prior studies hold that financial development would mitigate the sensitivity of investment (or cash holdings) to cash flow. In order to take this hypothesis into account, we compare the level of financial development in the countries. Table 6 shows the index of financial development for the selected countries, reported by Khurana et al. (2006, p.795), in which FININT represents a measure of financial intermediary development, measured by the sum of the ratio of liquid liabilities to GDP and the credit going to the private sector per GDP, while STKMKT refers to a measure of stock market development, measured by the sum of market capitalization per GDP, total value traded per GDP, and total value traded per market capitalization. FD is the sum of STKMKT and FININT and indicates a measure of financial development. Khurana et al. (2006) used indices obtained from the World Bank database as of 2002.

According to Table 6, it is clear that UK and US among Group II are financially developed. Their scores of FD, FININT, and STKMKT are much higher than the scores

of the other countries. In contrast, the remaining countries of Group II, that is, Italy, France, and Canada, have much lower scores. The countries in Group I are in between. Thus, we split Group II into two subgroups: IIa refers to the Western countries that are less financially developed and IIb refers to the Western countries that are more financially developed. IIa includes Italy, France, and Canada, and IIb includes UK and US.

Table 7: Regression Results (Group II)

financial development	Group IIa		Group IIb	
(sale/asset) t-1	-0.0119	-0.0128	-0.0013	-0.0017
	(-0.4017)	(-0.1382)	(-0.2489)	(-0.3413)
(cash/asset) t-1	0.0403	0.0414	-0.0079	-0.0061
	(0.5537)	(0.1068)	(-0.8055)	(-0.7211)
(debt/equity) t-1		0.0000		0.0001
		(0.0250)		(0.4594)
log(emp) t-1		0.0014		-0.0025
		(0.0142)		(-1..4809)
(rnd/asset) t-1	0.9930***	1.0204	0.9712***	0.9372***
	(14.4034)	(1.3226)	(21.5854)	(20.5093)
Sargan	1.0000	1.0000	1.0000	1.0000
AR(2)	0.0666	0.0993	0.0737	0.1579
four industries	Group I		Group II	
(sale/asset) t-1	-0.0089	-0.0103	-0.0014	-0.0017
	(-0.4518)	(-0.1247)	(-0.2553)	(-0.3444)
(cash/asset) t-1	0.0169	0.0038	-0.0079	-0.0061
	(0.3048)	(0.0096)	(-0.8026)	(-0.7220)
(debt/equity) t-1		0.0002		0.0001
		(0.1006)		(0.4848)
log(emp) t-1		-0.0080		-0.0025
		(-0.0807)		(-1.5046)
(rnd/asset) t-1	0.9299***	0.9240	0.9714***	0.9373***
	(6.8267)	(0.8814)	(21.6220)	(20.6243)
Sargan	1.0000	1.0000	1.0000	1.0000
AR(2)	0.1697	0.3201	0.0846	0.1900

Notes: The table shows the results of dynamic GMM regressions. Figures are regression coefficient estimates, and *t* values are shown in parentheses below coefficient estimates. ***, **, and *, respectively, indicate significance levels at 0.1%, 1%, and 5% levels. *Sargan* and *AR(2)* refer to *p* values for the Sargan test and the autocorrelation test for AR(2) process, respectively.

We apply the GMM method to the samples of Group IIa and IIb, and compare the results. If the hypothesis of the impact of financial development on the investment-cash flow sensitivity holds for the data, Group IIa is expected to show significant sensitivity while Group IIb is not. The regression results of the subgroups of Group II, shown in Table 7, do not support the hypothesis. We find the insignificant sensitivity of investment to cash flow in both Group IIa and Group IIb. R&D investment is not sensitive to cash flow for firms both in the countries with low financial development and in the countries with high financial development. It indicates that the level of financial development does not influence the relationship between R&D investment and internal funds. This result is consistent with recent evidence reported by Suh (2007) investigating firm-level data of 35 countries, which does not support that firms in financially less developed countries exhibit high investment-cash flow sensitivity.

5.2 Legal Environment

Another issue is the effect of legal environment on the investment-cash flow sensitivity. Recent literature has focused on legal rules regarding investors' rights. According to La Porta et al. (1998), the laws governing investor protection and the quality of enforcement of the laws differ considerably around the world, and the legal environment is closely related to economic and financial development. John et al. (2008) empirically examined a large panel of manufacturing firms from 39 countries over the period 1992-2002 and reported a significant positive relationship between risk-taking and investor protection.

Especially, Demirguc and Maksimovic (1998) used a sample of 30 countries and found that firms in countries with better investor protection were able to obtain external funds. This evidence leads to the conclusion that as investor protection improves, investment is less sensitive to internal funds. If Group II of the sample is composed of countries

with strong investor protection, the insensitivity of R&D investment to cash flow observed in Group II can be explained by the theory of the legal system of investor protection.

First of all, in order to deal with the issue of the legal system of investor protection, we compare the sample countries with regard to investor protection. Following John et al. (2008), we use the indices of the quality of accounting disclosure standards (ASR) and of anti-director rights (ADR) as measures of investor protection. High accounting disclosure standards and high anti-director rights imply better investor protection. The investor protection scores of each country are given in Table 6. We can observe that France and Italy among Group II countries as well as Group I countries have relatively weak investor protection. Thus, it is not likely that the insensitivity of investment in Group II is due to strong investor protection.

It might be claimed that firms in Group I countries show significant sensitivity of investment to cash flow because of weak investor protection. To check this argument further, we split the sample of Group II into two, the countries with weak investor protection (IIc) and the countries with strong investor protection (IId). The former includes France and Italy, while the latter includes Canada, UK, and US. We conduct the GMM estimations both for the subgroups, IIc and IId. From the regression results, presented in Table 7, we do not see any difference between the two subgroups in terms of sensitivity of investment to cash flow. Thus, we conclude that the level of investor protection does not play a role in influencing international differences in R&D investment decisions at the firm level.

6 Conclusion

We argue that national culture accounts for the variation in firms' investment behavior. In order to check this argument, we take the two cultures--East Asian and Western cultures--into account and compare them. Based on Hofstede’s work and the cushion

hypothesis, we predict that firms in the East Asian countries are more likely to engage in R&D investment than are firms in the Western countries because East Asian cultures are collectivistic and long-term oriented while Western cultures are individualistic and short-term oriented.

We use the investment-cash flow sensitivity as a measure of firms' willingness to invest in R&D. Thus, the hypothesis to be tested in this study is that investment is more sensitive to cash flow for firms in the East Asian countries than in the Western countries. We collect firm-level panel data for the East Asian countries (Japan and Korea) and the Western countries (Canada, France, Italy, UK and US), and apply dynamic GMM methods to the sample. The dynamic GMM regression analysis shows that R&D investment is positively sensitive to internal funds for firms in Japan and Korea, but not sensitive for firms in the Western countries. This result is robust to model specification and sample splitting. Moreover, we do not find evidence that the level of financial development and the legal environment systemically affect the relationship between R&D investment and internal funds. Overall, we suggest that this evidence supports the hypothesis that national culture affects corporate decisions.

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