The Effect of Labor Union on Innovation Process and Its Firm Valuation in Business Group Affiliation: New Evidence from South Korea

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Abstract

This paper examines the effect of labor union on firm innovation process (i.e., research, development and patenting) in business group affiliation. Using labor union data unique to Korea from 2001 to 2009, we find that firms' innovation activities, measured by R&D expenditures, are negatively related to unionization. The result indicates that unionized firms tend to reduce innovation activities to maintain good relationships with employees. This is more pronounced for large business groups, suggesting that chaebol management is more concerned with non-cooperative labor. Also, equity market shows a negative valuation for non-chaebol firms' R&D reduction under union pressure, but not for chaebol firms, indicating a positive capital market valuation for co-insurance effect of chaebol business groups. Lastly, our results are robust to an alternative measure of labor union and two-stage regression to mitigate the endogeneity issue. These findings fill the void in the literature by providing new evidence on the effects of labor unions on firms' innovation activities and the differential market valuation of labor's influence on each stage of firm innovation process. Moreover, we add new evidence to the literature on the effect of internal captive market on R&D investment decision in business group affiliation by showing differential managerial reaction to labor pressure depending on chaebol affiliation.

Keywords: Labor Union, Firm Innovation, R&D Expenditures, Business Group Affiliation, Chaebol

JEL Classification Codes: M40, G02

I. Introduction

Technological innovation is crucial for a firm's sustainable performance and economic growth (Schumpeter, 1934). Innovation activity aims to develop original products or technologies by using a firm's productive resources that are combined with knowledge in a new object or method. As innovation is a collective and cumulative learning process, it requires the commitment of a firm's resources for long time period (Belloc, 2012). For such a process, R&D investment is the primary driving force.

Moreover, corporate investment decisions directly affect resource allocation that will ultimately determine a firm's current and future profits. Due to its importance, organization-level agreement should precede the investments. Since R&D investment is highly uncertain about the outcome, it is especially difficult to reach an agreement. Prior literature has explored how a firm's R&D activities are affected by various dimensions of corporate governance. Thus far, most studies have examined the role of managers, shareholders and debtholders in R&D investment decision making process. However, our knowledge of the effect of labors on R&D activities is very limited. This research question is especially important in Korea where labor unions exert great influence upon corporate decisions.

Labor unions are the primary way through which employees can increase their bargaining power over distribution of the firm's surplus obtained from successful innovation (Belloc, 2012). It is widely documented that labor unions are central to corporate governance and performance (Blair, 1999). Since employees and their human capital are important assets to create innovations (and practically, innovations take up much of their efforts and time), the employer-employee relationship could affect the incentives of employees to invest in innovation processes (Laursen and Foss, 2003; Michie and Sheehan, 2003; Shipton et al., 2005).

This paper investigates the relationship between labor unions and the firm's R&D activities by utilizing the publicly available union data unique to Korea. Prior to 2009, Korean listed companies were required to disclose whether they had a union, their unions' affiliation, the number of employees belonging to unions, and the number of full-time union administrators. This unique firm-level data allows us to overcome the limitations of many prior studies that are based on the *estimated* unionization or labor intensity data at the *industry* level in the U.S. and U.K. (e.g., Hilary, 2006; Matsa, 2010; Chen et al., 2011; Farber et al., 2013).

Using a sample of publicly listed companies on Korea Stock Exchange between 2001 and 2009, we find the following empirical results. First, unionization is significantly and negatively related to firms' R&D activities, suggesting that managers of unionized firms tend to reduce discretionary R&D expenditures to maintain more cooperative labor unions. Second, the positive effect of R&D expenditures on firm's valuation is reduced in unionized firms. This result is related to negative market valuation resulting from the labor-related costs. Next, we further examine the relation between labor union and R&D activities in business group affiliation ("chaebols"). The negative relation between these two variables is more pronounced for chaebol-affiliated firms, indicating that chaebols' management is more concerned with non-cooperative labor unions. However, market valuation of such R&D reduction is negative for only non-chaebols, but not for chaebols. Collectively, these results imply that business group affiliations have a tendency to reduce innovative activities when there is a pressure from labor unions because of the co-insurance effect, and capital market participants do not have a negative perception of such relation between labor union and firm innovation.

These findings of the paper add new evidence to innovation literature by using the unique Korean data. There is mixed evidence on how unions affect the R&D activities of the U.K. and

U.S. firms. This seems to be due to the limitations in data on labor union. The existing studies based on U.S. and U.K. firms have used industry-level measures or *estimated* unionization data. On the contrary, this paper utilizes the individual firm-level union measure and documents that unionism may have a negative effect on firms' innovation activities. Moreover, the paper fills the gap in the literature by providing new evidence for Korea since the effect of labor union on innovation is likely to depend on unobservable country-specific and political variables, as argued in Drago and Wooden (1994).

Further contribution of this paper is to document how market valuation is affected by labor's influence on each stage of firm innovation process (i.e., research or development phase of internal project). This paper also adds to the literature by showing differential managerial reaction to labor pressure depending on chaebol affiliation. This provides new evidence on the effect of internal captive market on R&D investment decision in business group affiliation.

The rest of the paper is organized as follows. Section II reviews prior studies and develops our hypotheses. Section III presents our research methods and sample selection. Section IV shows the results of empirical analyses and Section V concludes this study.

II. Related Literature and Hypothesis Development

This paper is closely related to two streams of literature. First, the paper adds new evidence to the literature on corporate innovation. The traditional economics literature focused on how market structure (such as industry competition) affects the innovation. According to Schumpeter (1934), the key innovative actors are individual entrepreneurs with the flexibility to lead the 'creative destruction.' However, later, Schumpeter (1942) argues that established firms with monopolistic power are the key innovative actors. Also, the agency theory has been used to

explain what affects corporate innovation. Holmstrom (1989) posits that, because incentivizing both innovation and routine activities is costly and measuring the integrated performance of these activities is difficult, firms' innovation may be restricted despite its contribution to sustainable economic growth. Moreover, managers tend to be myopic and hesitant in taking risk due to a concern for job security and reputation in capital markets. As a means of reducing such agency problem, prior studies (e.g., Francis and Smith, 1995; Manso, 2011) suggest that concentrated ownership and long-term compensation plan are effective at mitigating high agency costs and contracting costs associated with innovation. Extensive studies are devoted to the determinants of firm innovation based on the U.S. and U.K. markets, which are mostly comprised of widely-held corporations. However, there is little known about innovation activities in emerging markets like South Korea, where family-controlled companies play a dominant role. Hence, this paper contributes to this line of research by filling in this gap.

Second, the paper extends the line of academic research on labor unions, specifically the effect of labor unions on managerial decisions/behaviors. Many studies document a significant relationship between labor unions and leverage (Matsa, 2010), cash holdings (Klasa et al., 2009), CEO compensation (Banning and Chiles, 2007; Gomez and Tzioumis, 2011), information asymmetry (Hilary, 2006), accounting conservatism (Farber et al., 2012), and the likelihood of meeting earnings thresholds (Bova, 2012). Moreover, labor unions are considered as rent-seekers and thus incentivized to extract quasi-rent as much as possible through collective bargaining and strike threats (Grout, 1984; Connolly et al., 1986; Hirsch, 1992; Klasa et al., 2009; Matsa, 2010). Prior research (e.g., Blanchflower et al., 1996) find that labor unions tend to demand a wage raise when their firms are performing well, while they consent to current wage levels when the performance is poor. Although the literature on the role of labor unions in capital markets is

growing, there is little research on how labor unions affect firms' innovation activities. Therefore, this paper attempts to fill this void by examining the relationship between labor unions and innovations.

There are two opposing predictions on how labor unions could affect the firm innovations. On one hand, strong labor unions may act as a corporate governance mechanism that monitors the agency problems, thereby mitigating managerial myopia. This may eventually encourage risk taking and innovative behaviors. According to Chen et al. (2011), labor unions can effectively monitor managerial actions based on their advantageous position to acquire their firms' information compared to outside stakeholders. Also, unions exert their power on management using their bargaining power to enhance the corporate transparency. For instance, affiliated labor unions in Korea have requested management to share information and to allow their participation in decision making process so as to monitor whether managers harm the transparency and betray the trust of stakeholders.[1]

The Union Social Responsibility (USR) declared by LG Electronics is one of examples that show such a role of labor unions. The USR describes the four major guidelines: (1) to protect eco-system, (2) to help the disadvantaged, (3) to enhance the transparency of union and company, and (4) to lead innovations in the field. Hence, these arguments support the prediction that labor unions enhance the innovating activities via enhanced transparency and mitigated managerial myopia.

On the other hand, strong labor unions may impede the innovations. Prior research (e.g., Faleye et al., 2006; Hamm et al., 2013) documents that labor unions are the fixed claimants of

[1] Labor unions in Korea are affiliated with one of the following three groups: (1) Minju Korean Confederation of Trade Unions, (2) Hanguk Federation of Korean Trade Unions, and (3) unaffiliated unions. Minju is considered the most aggressive and unaffiliated unions the least aggressive.

companies since their contractual wages and benefits are similar to payoffs on risky debt. This suggests that downside risk is more important to union workers than upside potential. Thus, they would be mainly concerned about corporate failures such as deteriorating performance in order to secure their jobs and wages. If union workers perceive long-term investments or innovations to be so risky that may increase the possibility of unemployment, they will demand monetary and non-monetary compensation, for example, higher wages, additional benefits, and improved working conditions (Agrawal and Matsa, 2012; Chemmanur et al., 2012). Moreover, since non-cooperative labors could lead to strikes, inefficient production, or poor reputations in the labor market (Banning and Chiles, 2007), managers have incentives to have a good relationship with union workers. Then, managers of unionized firms may reduce discretionary R&D expenditures to minimize the costs due to non-cooperative labor unions. These arguments lead to the alternative prediction that labor unions are negatively associated with firms' R&D investments. Considering these opposing predictions, the relationship between labor unions and firm innovations is an open empirical question.[2]

Also, we further examine the market valuation of the firm's innovation activities that are affected by labor unions. If managers change their firms' R&D activities due to labor unions' monitoring (or security) *and* capital market perceives such relationship positively (negatively), market valuation will be positively (negatively) associated with the interaction between labor

[2] Theoretical economics literature provides the explanation for the former prediction based on "strategic" R&D model. In this model, a firm determines its R&D investments strategically as a means of responding to threats from competitors According to Ulph and Ulph (1994, 1998, 2001), when management and labor union negotiate their wages and employment and labor union has relatively low bargaining power, there may be a positive relationship between labor union's bargaining power and R&D investment. By contrast, the latter prediction is supported by the "hold-up" model (Grout, 1984) in economics. A firm's R&D investment precedes the wage bargaining between management and labor union. Then, rents that are created by innovations will be claimed by labor union, resulting in higher level of wages for union members. Therefore, under the assumption that management and labor union cannot enter into efficient contracts on R&D investments and wages, unionized firms will reduce investments in technology innovations.

union and R&D expenditures. Hence, we state the hypotheses in a null form as below:

H1-1: There is no significant association between labor unions and firms' R&D activities.

H1-2: Firm valuation is not significantly affected by the association between labor unions and firms' R&D activities.

More importantly, the paper attempts to shed light on the relation between labor unions and firm innovations in business group affiliations. In Korea, large business groups, so called 'chaebols,' are mostly controlled by founder members or their families. Prior literature has defined family firm as "one in which a family has enough ownership to determine the composition of the board, where the CEO and at least one other executive is a family member, and where the intent is to pass the firm on to the next generation" (Miller and Le Breton-Miller, 2003). Specifically, chaebol is defined as "a collection of both public and private companies in a pyramidal and circular ownership structure and typically controlled by founding family members" (Kim and Yi, 2006).

It is widely documented that business group affiliations have different corporate governance issues compared to others. Due to their pyramidal and circular ownership structure, controlling shareholders exert significant influence on the rest of the affiliated firms within the business group. Hence, chaebol-affiliated companies are likely to maximize the wealth of controlling shareholders via mutual-cooperation, which is known as "propping" (although they

are legally independent entities).[3] This indicates that chaebol business groups have a stable source of revenue from internal transactions with other affiliated companies. Then, chaebol firms may have less incentive for innovation but rather tend to settle for the present, thereby exhibiting a greater tendency to reduce R&D investments to secure the firm resources for labor union members than non-chaebols. In addition, since chaebol business groups have greater media coverage and political costs, their costs related to non-cooperative labor unions (e.g., strikes) are expected to be greater than non-chaebols. These arguments lead us to predict that labor unions of chaebol firms will exert greater influence on their firms' innovations than those of non-chaebols. Therefore, we hypothesize the differential effects of chaebol governance on the relation between labor unions and innovations.

Also, prior research has documented the positive capital market valuation for co-insurance effect of chaebol business groups. Such fact is reflected in higher credit rating and lower cost of capital for chaebols than non-chaebols. Moreover, market valuation is less sensitive to changes in chaebol firms' R&D investments. If managers reduce their firms' R&D activities due to labor unions' monitoring (or security) *and* capital market perceives such relationship positively, market valuation will be positively associated with the interaction between labor union and R&D expenditure for chaebols. Hence, we posit that there will be differential market valuation of chaebol firms' innovation activities compared to non-chaebol firms. Taken together, we state the hypotheses in a null form as below:

[3] For example, Mr. Kunhee Lee, the chairperson of Samsung Electronics Co., had a complete control over affiliated firms within Samsung Business Group via circular ownership. Mr. Lee had a significant ownership of Everland Co. which had a significant ownership of Samsung Life Insurance Co., which again had a significant ownership of Samsung Electronics Co., while Samsung Electronics Co. had a significant ownership of Samsung Card Co. with a significant ownership of Everland Co. ("An External Director's Perspective on a Difficulty in Samsung," Monthly Shin-DongA, 2007 (Dec. 1), p. 118)

H2-1: The relation between labor unions and firms' R&D activities is not significantly different between chaebol firms and non-chaebol firms.

H2-2: Firm valuation on the association between labor unions and firms' R&D activities is not significantly different between chaebol firms and non-chaebol firms.

III. Research Methodologies

3.1. Data Collection

This study is based on a sample of publicly companies listed on Korea Stock Exchange between 2001 and 2009. We match the labor union data, which is available up to 2008, with the next year's R&D expenditure in order to mitigate the endogeneity problem.

We collect financial data that is required to calculate test variables from the TS2000 database, provided by NICE Information Service Co. The labor union data is manually collected from the sample firms' annual reports. We exclude financial firms, non-December year-end firms, delisted firms and firms with impaired capital in order to ensure the homogeneity of the sample firms. As a result, the final sample consists of 4,989 firm-year observations over 9-year study period.

3.2. Model Specification for H1-1 & H1-2

We estimate the following multivariate regression models to examine our hypotheses:

$$\mathrm{RD_{it}} = \beta_0 + \beta_1 UNION_{it} + \beta_2 SIZE_{it} + \beta_3 ROA_{it} + \beta_4 LEV_{it} + \beta_5 HERF_{it} + \beta_6 CAPEX_{it} + \beta_7 LNAGE_{it} + \Sigma\mathrm{Industry} + \Sigma\mathrm{Year} + \varepsilon_{it} \quad (1)$$

$$\text{Tobin Q}_{it} = \beta_0 + \beta_1 UNION_{it} + \beta_2 RD_{it} + \beta_3 Union_{it} \times RD_{it} + \beta_4 SIZE_{it} + \beta_5 ROA_{it} + \beta_6 LEV_{it} + \beta_7 CAPEX_{it} + \beta_8 LNAGE_{it} + \beta_9 SGROW_{it} + \beta_{10}\mathrm{BOD_{it}} + \beta_{11}\mathrm{FOR_{it}} + \Sigma\mathrm{Industry} + \Sigma\mathrm{Year} + \varepsilon_{it} \quad (2)$$

where,

RD = Research and development expenditures divided by the beginning total assets, either *RD_TOT* (total R&D expenditures), *RD_Research* (research expenses), or *RD_Development* (development expenditures);

UNION = 1 if a firm is unionized, 0 otherwise;

SIZE = The natural logarithm of total sales at the beginning of year *t*;

ROA = Return on assets, calculated as the income before extraordinary items during year *t*-1, divided by total assets at the beginning of year *t*;

LEV = Leverage ratio, measured as the sum of long-term debts and short-term debts scaled by total assets at the beginning of year *t*;

HERF = Herfindahl index of three-digit SIC industry *j* to which firm *i* belongs, measured at the end of fiscal year *t*;

CAPEX = Capital expenditures scaled by book value of total assets at the end of fiscal year *t*;

LNAGE = Natural logarithm of (1 + a firm's age);

Tobin Q = Total market value divided by total assets at the end of year *t*;

SGROW = Sales growth, measured by sales in year *t* minus sales in year *t-1* (divided by prior year sales);

BOD = The number of outside directors divided by the number of total directors in board of directors; and

FOR = The ratio of foreign market value to total market value at the end of fiscal year t.

The dependent variable of equation (1), RD_{it}, captures the extent of firms' innovation activities. R&D expenditure is considered the useful innovation measure because R&D projects are crucial inputs into innovation activities and directly under managerial discretion. For our empirical analyses, we use the total R&D expenditure (*RD_TOT*) as well as its components, which are development expenditure (*RD_Development*) and research expenditure

(*RD_Research*).[4]

$UNION_{it}$ is a dummy variable, which is set to 1 if at least one employee belongs to a union and 0 elsewhere. This captures the influence of unionization on wage bargaining process as well as managerial attitude towards employees. The labor union data is publicly available in Korea at the firm level since publicly traded companies were required to disclose whether they had a union, their unions' affiliation, the number of employees belonging to unions, and the number of full-time union administrators until 2008.

We control for various firm and industry characteristics that may affect firm innovations: firm size, *SIZE*, measured by the natural logarithm of total sales; profitability, *ROA*, measured by return on assets; leverage, *LEV*, measured by ratio of total debt to total assets; product market competition, *HERF*, measured by the Herfindahl index based on annual sales; investment in fixed assets, *CAPEX*, measured by capital expenditures scaled by total assets; firm age, *LNAGE*, measured by the natural logarithm of a firm's age since its IPO.

The dependent variable of equation (2) is Tobin's Q ratio, which is measured by total market capitalization divided by total assets. This regression model contains additional control variables that are shown to affect the firm value, such as sakes growth rate (*SGROW*), board independence (*BOD*), and foreign investor ownership (*FOR*). Lastly, industry and year fixed effects are included in the regression models and standard errors are corrected for heteroscedasticity.

[4] Expenditure on research (or on research phase of an internal project) shall be recognized as an expense when it is incurred, whereas an intangible assets arising from development (or from the development phase of an internal project) shall be recognized if, and only if, an entity can demonstrate all of the following: (a) the technical feasibility of completing the intangible asset so that it will be available for use or sale, (b) its intention to complete the intangible asset and use or sell it, (c) its ability to use or sell the intangible asset, (d) how the intangible asset will generate probable future economic benefits, (e) the availability of adequate technical, financial, and other resources to complete the development and to use or sell the intangible asset, (f) its ability to measure reliably the expenditure attributable to the intangible asset during its development. (IAS 38)

3.3. Chaebols vs. Non-chaebols: H2-1& H2-2

The role of large business conglomerate groups (chaebols) is significant in Korean capital markets. In many chaebol firms, controlling shareholders or founder family members also serve as top executives or board chairmen (Jeong and Bae, 2007). Thus, chaebol firms have different governance system and employer-employee relations compared to non-chaebol firms. Interestingly, these companies can be characterized by significant portions of related party transactions among subsidiaries. The Korean Fair Trade Committee (KFTC) specifies the list of companies that are restricted on such mutual contribution based on the size of total assets: the 'designated' business groups have total assets of at least five trillion won (two trillion won before 2009).[5] In order to examine how the relationship between labor unions and firm innovations is affected by chaebol ownership structure, we partition the full sample into chaebol and non-chaebol firms based on the list of designated business groups.

3.4. Descriptive Statistics

Table 1 Panel A presents the descriptive statistics of test variables based on the full sample. The main test variable (*UNION*) represents whether a firm is unionized or not. Mean $UNION_{it\text{-}1}$ is 0.5334 with the standard deviation of 0.4989, indicating about half of sample firms are unionized. RD_TOT_{it} has the mean 0.0123, median 0.0042 with the standard deviation of 0.0188, indicating that R&D intensity is highly skewed to the right. Sample firms, on average, have logged market value of equity of 19.2470, ROA of 0.0374, debt ratio of 0.4534, and tangible asset intensity of 0.2429. Lastly, roughly 20% of sample firms are affiliated with

[5] See Fair Trade Act Decree 17 Article 9, amended 2008. This particular list is updated in April every year.

chaebols.

Table 1 Panel B provides descriptive statistics for chaebols and non-chaebols. Means of most test variables are significantly different for two subsamples. While R&D expenditures are marginally different between two groups, unionization of chaebol firms is significantly higher than non-chaebols. Also, chaebol-affiliated companies are larger, more profitable and highly levered and have more independent board of directors and foreign ownership, in general.

<Insert Table 1 about here>

Table 2 exhibits the correlation matrix of test variables in full sample. The raw correlation between RD_TOT_{it} and $UNION_{it}$ is negative (-0.041) and statistically significant (*p-value*=0.004). $RD\_Development_{it}$ is also negatively correlated with *UNIONit* (-0.047, p-value=0.001). In addition, RD_TOT_{it} is positively associated with $SIZE_{it}$, $ROA_{it,}$ $HERF_{it}$, $CAPEX_{it}$ and $TOBIN\_Q_{it}$. By contrast, RD_{it} is negatively with $LEVERAGE_{it}$ and $LNAGE_{it}$.

<Insert Table 2 about here>

IV. Empirical Results

4.1. Main Test Results: H1-1 & H1-2

Table 3 exhibits the main test results on the relationship between labor unions and R&D activities (H1). Test results in Panel A are based on the ordinary least squares (OLS) regression analysis. When the dependent variable is *RD_TOT*, we find a negative and statistically significant coefficient of $Union_t$ (-0.0039, *p-value*<0.01). These results hold when the dependent variable is specified as research expenditures (*RD_Research;* coef=-0.0013, *p-value*<0.01) or

development expenditures (*RD_Development;* coef=-0.0026, *p-value*<0.01). Such a negative relationship between unionization and firm innovation suggests that managers of unionized firms may reduce discretionary R&D expenditures in order to have more cooperative labor unions. In regards to control variables, bigger firms ($Size_t$) and firms with higher profitability (ROA_t) tend to have greater amount of R&D expenditures. By contrast, a firm's leverage (Lev_t) and age ($LNAGE_t$) are negatively associated with R&D investments.

Unionization is not exogenously determined; rather it may be affected by various firm characteristics and industry nature. We perform two-stage least squares (2SLS) regression analysis to address the endogenous issue of unionization. Following Chen et al. (2012), the ratio of female employees to total employees ($Female\_Ratio_{it-1}$) is used as an instrumental variable of unionization in the first-stage model, as it is correlated with unionization but not with R&D expenditures.[6]

Table 3 Panel B-1 reports the first-stage regression results. We find that the coefficient of $Female\_ratio_{it-1}$ is negative and statistically significant (-0.4160, *p-value*<0.01), confirming that $Union_t$ is highly related to the instrumental variable $Female\_ratio_{it-1.}$ Next, second-stage model employs the predicted value of first-stage regression ($Union\_hat_t$) instead of $Union_t$ itself as the main independent variable. Panel B-2 exhibits the second-stage regression results for H1-1 based on R&D expenditures as the dependent variable. R&D activities (*RD_TOT*, *RD_Research* or *RD_Development*) are negatively related to the exogenized union variable (*Union_hat*), which is consistent with previously documented OLS results.

<Insert Table 3 about here>

[6] The sample size for 2SLS analysis is smaller than the one used in previous tests since *Female_ratio* data is available only after 2001 and lagged variables are used as independent variables in our regression models.

Table 4 Panel A presents the OLS test results on the market valuation of the firm's innovation activities that are affected by labor unions (H1-2). The estimated coefficient of the interaction term *Union*RD_TOT* is negative (-2.8091) and statistically significant at 1% level, whereas the coefficient of *RD_TOT* is significantly positive (6.7009, p-value<0.01). The results imply that the positive effect of R&D expenditures on firm's valuation is reduced in unionized firms, which may be related to labor-related costs. This is consistent with prior evidence on the rent-seeking of labor unions; for instance, R&D investments add less to the market value of firm in more unionized industries since labor union reduces the returns to R&D (Connolly et al. 1986).

Our further tests show that such negative market perception is only limited to reduced development expenditures but not research expenses. The coefficient of *Union*RD_Development* is significantly negative (-5.8191, *p-value*<0.01) whereas the one of *Union*RD_Research* is not statistically significant (0.1828, *p-value*=0.9052). These results suggest that capital market is more sensitive to reduced development expenditures than research expenditures since development projects are more likely to be successful to be new products and to be realized as future economic benefits so that they are highly linked to a firm's future performance. In addition, Tobin's Q is positively related to R&D expenditures (*RD_TOT, RD_Research, RD_Development*) and most of control variables except for *SIZE* and *LNAGE*.

Table 4 Panel B provides the second-stage regression results for H1-2 when the dependent variable is Tobin's Q. The estimated coefficient of the interaction term *Union_hat*RD_TOT* is negative (-5.7431) and statistically significant at 1% level. When *RD_TOT* is decomposed into *RD_Development* and *RD_Research*, the coefficient of

*Union_hat*RD_Development* is significantly negative (-7.0568, *p-value*<0.01) whereas the one of *Union_hat*RD_Research* is not statistically significant (-4.5842, *p-value*=0.1106). Hence, the positive capital market valuation of R&D activities (specifically, development phase) is mitigated in unionized firms, indicating that the overall results are consistent with main OLS regression analysis.

<Insert Table 4 about here>

4.2. Chaebol vs. Non-chaebol Firms: H2-1 & H2-2

Table 5 Panel A exhibits the test results on the relation between labor union and R&D activities in two subgroups: chaebol firms and non-chaebol firms. In all specifications of dependent variable (*RD_TOT*, *RD_Research*, *RD_Development*), the regression coefficient of $Union_t$ is more negative for chaebol firms than for non-chaebol firms. Moreover, their differences are statistically significant, suggesting that labor unions of chaebols have a greater influence on their firms' innovation activities than those of non-chaebols. Hence, these findings suggest that chaebol firms' management is more likely to be concerned with non-cooperative labor unions.

Table 5 Panel B presents the results on differential market valuation of the firm's innovation activities that are affected by labor unions in two subgroups: chaebol firms and non-chaebol firms. For chaebol firms, the estimated coefficient of the interaction term *Union*RD_TOT* (*Union*RD_Research, Union*RD_Development*) is positive but statistically insignificant. On the contrary, for non-chaebol firms, the coefficients of *Union*RD_TOT* and *Union*RD_Development* are significantly negative, -4.0324 (p-value<0.01) and -7.7358 (p-

value<0.01), respectively.

In sum, while the positive market valuation of R&D investments is mitigated in unionized non-chaebol firms, it is not mitigated by unionization of chaebol-affiliated firms. This provides supporting evidence that capital market participants are aware of the co-insurance effect of chaebol business groups. Since chaebol business groups have secure revenue sources from internal transactions among affiliated companies, capital market valuation of R&D activity is not negatively affected by the existence of labor unions. Moreover, the difference between chaebols and non-chaebols is more pronounced for development expenditures that are highly likely to be realized as future economic benefits.

<Insert Table 5 about here>

4.3. Additional Tests: Chaebol Governance

In this section, we further examine how different characteristics of chaebol governance affect the relation between labor union and R&D activities. First set of additional tests is based on the measure of agency problem of chaebols: a group owner's divergence between ownership (cash flow rights) and control (voting rights) over a firm. Korean corporations are characterized by pyramidal and cross-holding structures, which allow controlling owners to have low equity investment while maintaining tight control of the firm. According to prior research (e.g., Fan and Wong, 2002), due to such divergence between voting and cash flow rights, controlling owners may become entrenched with high level of control but their low equity ownership results in low incentive alignment between controlling owner and minority shareholders. This means that entrenched owners could extract wealth from the firm, whereas they are exposed to low risk.

Following prior research (e.g., Kang et al., 2014), we calculate the "wedge" by subtracting cash flow right from voting right, where voting right is the sum of the stakes held by the group owner and all the affiliates of the firm. Table 6 presents the results when the regression model (1) includes *Wedge* and *Union*Wedge*. The regression coefficient of *Union*Wedge* is negative and statistically significant at 10% and 1% level when the dependent variable is *RD_TOT* and *RD_Research*, respectively (-0.0092, *p-value*=0.0666; -0.0116, *p-value*<0.01). As the disparity between cash flow and voting rights gets bigger, the managerial tendency to reduce R&D to respond to labor union's pressure also increases. This suggests that while minority shareholders prefer innovations that will maximize firm value, entrenched owners are not aligned with minority shareholders' interest and consequently do not pursue innovative activities in order to minimize political costs due to labor unions.

<Insert Table 6 about here>

Second set of tests is based on a dummy of top 5 chaebol groups, which have greater captive market within groups. Table 7 shows the results of the regression model (1) that includes a dummy for *Top5_Chaebol* and *Union*Top5_Chaebol*. The regression coefficient of *Union* Top5_Chaebol* is negative and statistically significant at 5% level when the dependent variable is *RD_Research* (-0.0033, *p-value*=0.0346). The results indicate that because top 5 business groups have larger internal captive markets than others, they tend to reduce discretionary expenditures in research projects to a greater extent when there is a pressure from labor unions.

<Insert Table 7 about here>

4.4. Robustness Check: Alternative Measure of Labor Union

For robustness check, we use an alternative measure of labor union in addition to the dummy variable of whether a firm is unionized or not: union membership ratio (*Union_MEM*) which is the number of union member employees divided by the number of total employees. This membership ratio will be higher for firms with a greater number of employees who support the union. Hence, union membership ratio will represent the strength of labor unions.

As shown in Table 7 Panel A, the estimated coefficients of *Union_MEM* are negative and statistically significant at 1% level when dependent variable is *RD_TOT* and *RD_Research* (-0.0067, *p-value*<0.01; -0.0062, *p-value*<0.01, respectively). This indicates that firms with greater union membership are more likely to reduce discretionary R&D expenditures in order to have more cooperative labor unions.

Table 7 Panel B presents the regression results on the market valuation of the firm's innovation activities that are affected by labor unions. Using Tobin's Q as the dependent variable, the estimated coefficient of the interaction term *Union_MEM*RD_TOT* (*RD_Research* or *RD_Development*) is negative (-16.2201, -12.1863, -15.5102) and statistically significant at 1% level. This implies that capital market valuation tends to be negative when managers reduce their firms' R&D activities to minimize the labor-related costs. Therefore, our main results are robust to alternative definition of firms' unionization.

<Insert Table 8 about here>

4.5. Robustness Check: Alternative Measure of Firm Innovation

Finally, we perform robustness tests using alternative measure of innovation: patenting activity. Patent data has been frequently used in recent research as a proxy for innovation output, in addition to R&D expenditures (e.g., He and Tian, 2013; Fang et al., 2014; Bena et al., 2017). We manually collect the data on the number of patent registration during the period between 2001 and 2007 from the patent database Kipris (www.kipris.or.kr).

The test results on the relation between labor union and patent are reported in Table 8, Panel A. When the dependent variable is one-year and two-year ahead patent registration, the coefficient of $Union_t$ is negative and significant at 1% and 5% level, respectively (-0.0160, *p-value*<0.01; -0.0138, *p-value*=0.0213). Firms' patent registration count is significantly smaller in unionized firms than non-unionized firms. Taken together with main test results, we find that unionization decreases firms' investment in each phase of innovation process (i.e., research and development phases of internal projects) and its output (i.e., patent registration count).

However, as shown in Table 8 Panel B, test results on firm valuation of patenting activities and labor union are different than the main results based on R&D investments. When Tobin's Q is used as the dependent variable, the estimated coefficient of the interaction term *Union*Patent* is not statistically significant. This indicates that firm valuation is not negatively affected when a firm's patenting activity is decreased because of labor pressure. We interpret such result in relation to firm valuation effect of development expenditures. Firm valuation is already negatively affected by the decline in a firm's investment in development phase, which in turn will decrease its patenting activity, therefore firm valuation does not incrementally decrease due to a decline in patenting activity.

<Insert Table 9 about here>

V. Conclusions

This paper investigates the relationship between labor unions and firm innovations in business group affiliation. Using the publicly available union data unique to Korea, we find that labor union is negatively related to firms' R&D expenditures. Moreover, the negative relation between unionization and innovation is more pronounced for large business groups, suggesting that chaebol management is more concerned with the cost related to non-cooperative labor unions. Also, while equity market exhibits negative valuation of non-chaebol firms' R&D reduction due to labor union pressure, it does not for chaebol firms. Furthermore, the negative valuation appears to be due to reduction in development expenditures which are likely to be realized as future economic benefits.

This paper extends prior research showing that managers have incentives to maintain a good relationship with their employees so as to minimize costs imposed by non-cooperative labor; such as strike costs, inefficient production, or a damaged reputation in the labor market (e.g., Hamm et al., 2013). Our study provides new evidence by documenting that non-cooperative labor unions may result in less innovation activities. To summarize, our study sheds a new insight on the importance of cooperative labor unions for firm innovations.

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Appendix: Variable Definitions

Variable	Description
RD_TOT	Research and development expenditures divided by the beginning total assets.
RD_Research	Research expenditures, divided by the beginning total assets.
RD_Development	Development expenditures, divided by the beginning total assets.
Union	1 if a firm is unionized, 0 otherwise.
Union_MEM	Union membership ratio, which is computed as the number of union member employees divided by the number of total employees for each firm.
Tobin's Q	Total market value divided by total assets at the end of year *t*;
TANG	Ratio of net property, plant, and equipment to the beginning total assets
SIZE	The natural log of the total sales.
ROA	Return-to-assets ratio, calculated as the income before extraordinary items divided by the beginning total assets.
LEVERAGE	Leverage ratio, calculated as the sum of long-term and short-term debts divided by total assets.
HERF	Herfindahl index of three-digit SIC industry j to which firm i belongs, measured at the end of fiscal year t.
LNAGE	Natural logarithm of one plus firm's age.
CHAEBOL	Dummy variable indicating a Chaebol (Korean business group) affiliated firm.
CAPEX	Capital expenditures scaled by book value of total assets at the end of fiscal year *t.*
SGROW	Sales growth, measured by sales in year *t* minus sales in year *t-1* (divided by prior year sales).
PATENT	The count of patent registration (divided by 100) during fiscal year t.
FOR	The ratio of foreign market value to total market value at the end of fiscal year t.
BOD_INDEPENDENCE	The number of outside directors, divided by the total number of directors on board of directors.

TABLE 1: Descriptive statistics

Panel A: Full Sample

Variable	N	Mean	Standard deviation	Median	25%	75%
RD_TOT	4,989	0.0123	0.0188	0.0042	0.0005	17.6635
RD_Research	4,989	0.0052	0.0108	0.0003	0.0000	0.6701
RD_Development	4,989	0.0073	0.0134	0.0011	0.0000	0.5847
CHAEBOL	4,989	0.2171	0.4123	0.0000	0.0000	0.5728
Union	4,989	0.5334	0.4989	1.0000	0.0000	0.4792
Union_MEM	2,658	0.4697	0.2263	0.5033	0.2973	27.3319
SIZE	4,989	19.2470	1.5572	19.0035	18.2358	20.6929
ROA	4,989	0.0374	0.0895	0.0398	0.0087	1.2870
LEVERAGE	4,989	0.4534	0.2020	0.4552	0.3006	0.6499
HERF	4,989	0.1297	0.1347	0.0866	0.0427	17.5917
CAPEX	4,989	0.2429	0.3237	0.1353	0.0654	0.1631
LNAGE	4,989	3.3750	0.7288	3.5553	3.2581	0.0000
TOBIN_Q	4,989	0.9750	0.4918	0.8451	0.6889	0.1659
BOD_INDEPENDENCE	4,989	0.2541	0.1548	0.2222	0.2000	0.0734
FOR	4,989	0.0984	0.1478	0.0231	0.0013	0.5808
PATENT	1,875	4.4485	14.4421	0.0000	0.0000	3.3895

Panel B: Chaebol vs. Non-Chaebol Firms

Variable	Chaebol			Non-chaebol			Mean Diff. p-value
	N	Mean	Median	N	Mean	Median	
RD_TOT	1,083	0.0136	0.0046	3,906	0.0120	0.0041	0.0263
RD_Research	1,083	0.0056	0.0009	3,906	0.0050	0.0002	0.0949
RD_Development	1,083	0.0079	0.0013	3,906	0.0071	0.0011	0.1053
Union	1,083	0.6214	1.0000	3,906	0.5090	1.0000	<0.01
Union_MEM	673	0.4478	0.4600	1,985	0.4771	0.5225	<0.01
SIZE	1,083	20.9607	20.9544	3,906	18.7718	18.7500	<0.01
ROA	1,083	0.0443	0.0468	3,906	0.0355	0.0379	<0.01
LEVERAGE	1,083	0.5113	0.5368	3,906	0.4373	0.4366	<0.01
HERF	1,083	0.1861	0.1395	3,906	0.1140	0.0731	<0.01
CAPEX	1,083	0.2257	0.1260	3,906	0.2476	0.1383	0.0482
LNAGE	1,083	3.3024	3.5264	3,906	3.3951	3.5553	<0.01
TOBIN_Q	1,083	1.1221	0.9736	3,906	0.9342	0.8148	<0.01
BOD_INDEPENDENCE	1,083	0.3636	0.3750	3,906	0.2238	0.2222	<0.01
FOR	1,083	0.1779	0.1289	3,906	0.0763	0.0098	<0.01
PATENT	416	15.7740	2.0000	1,459	1.2193	0.0000	<0.01

Notes: All variables are defined in the appendix. All *p*-values are based on two-tailed t-tests.

TABLE 2: Correlations Matrix

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16) *PATENT*
RD_TOT$_{it}$ (1)	0.636	0.818	-0.041	-0.100	0.102	0.116	-0.051	0.039	0.043	-0.063	0.272	0.035	0.092	0.186	0.255
	<.0001	<.0001	0.004	<.0001	<.0001	<.0001	0.000	0.006	0.002	<.0001	<.0001	0.015	<.0001	<.0001	<.0001
RD_Research (2)		0.124	-0.019	-0.126	0.069	0.074	-0.064	0.042	0.017	-0.046	0.249	0.024	0.088	0.098	0.269
		<.0001	0.170	<.0001	<.0001	<.0001	<.0001	0.003	0.219	0.001	<.0001	0.095	<.0001	<.0001	<.0001
RD_Development (3)			-0.047	-0.028	0.077	0.102	-0.034	0.009	0.036	-0.066	0.176	0.024	0.055	0.178	0.162
			0.001	0.147	<.0001	<.0001	0.017	0.522	0.011	<.0001	<.0001	0.084	0.000	<.0001	<.0001
Union (4)				.	0.247	0.025	0.107	0.020	-0.051	0.134	-0.074	0.093	0.050	0.111	0.121
				.	<.0001	0.075	<.0001	0.154	0.000	<.0001	<.0001	<.0001	0.001	<.0001	<.0001
Union_MEM (5)					0.018	-0.054	0.054	0.100	-0.012	-0.010	-0.126	-0.054	0.018	-0.037	0.038
					0.355	0.006	0.006	<.0001	0.552	0.612	<.0001	0.005	0.351	0.057	0.307
SIZE (6)						0.200	0.244	0.259	-0.036	0.033	0.162	0.580	0.474	0.462	0.492
						<.0001	<.0001	<.0001	0.011	0.020	<.0001	<.0001	<.0001	<.0001	<.0001
ROA (7)							-0.339	0.020	0.080	-0.097	0.130	0.041	0.034	0.250	0.064
							<.0001	0.149	<.0001	<.0001	<.0001	0.004	0.015	<.0001	0.006
LEVERAGE (8)								0.014	-0.055	0.026	0.152	0.151	0.067	-0.120	0.059
								0.316	0.000	0.062	<.0001	<.0001	<.0001	<.0001	0.010
HERF (9)									0.016	-0.042	0.045	0.221	0.227	0.163	0.173
									0.249	0.003	0.002	<.0001	<.0001	<.0001	<.0001
CAPEX (10)										-0.031	0.117	-0.028	-0.030	0.033	-0.030
										0.029	<.0001	0.048	0.035	0.019	0.200
LNAGE (11)											-0.185	-0.052	-0.052	-0.052	-0.041
											<.0001	0.000	0.000	0.000	0.075
TOBIN_Q (12)												0.158	0.166	0.286	0.247
												<.0001	<.0001	<.0001	<.0001
CHAEBOL (13)													0.373	0.283	0.419
													<.0001	<.0001	<.0001
BOD_INDEPENDENCE (14)														0.281	0.384
														<.0001	<.0001
FOR (15)															0.302
															<.0001

Notes: All variables are defined in the appendix. All *p*-values are based on two-tailed tests.

TABLE 3: Labor Unions and Firm Innovations

Panel A: OLS Regression

Variable	Dependent variable = *RD_TOT*		Dependent variable = *RD_Research*		Dependent variable = *RD_Development*	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	-0.0186	<0.01	-0.0093	<0.01	-0.0067	0.0101
Union $_{it}$	**-0.0039**	**<0.01**	**-0.0013**	**<0.01**	**-0.0026**	**<0.01**
$SIZE_{it}$	0.0017	<0.01	0.0008	<0.01	0.0008	<0.01
ROA_{it}	0.0144	<0.01	0.0038	0.0449	0.0093	<0.01
$LEVERAGE_{it}$	-0.0057	<0.01	-0.0033	<0.01	-0.0033	<0.01
Herfindal Index$_{it}$	0.0054	0.0120	0.0026	0.0658	0.0012	0.4348
$CAPEX_{it}$	0.0014	0.0766	0.0001	0.8435	0.0008	0.1751
$LNAGE_{it}$	-0.0015	<0.01	-0.0006	<0.01	-0.0011	<0.01
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	
Adj. R^2	0.268		0.1437		0.1818	
N	4,989		4,989		4,989	

Panel B: 2SLS Regressions

Panel B-1: First-Stage Regression

Variable	Dependent Variable = $Union_t$	
	Coef.	p-value
Intercept	-1.4645	<0.01
Female_Ratio $_{it-1}$ ***[Instrument]***	**-0.4160**	**<0.01**
$SIZE_{it-1}$	0.0659	<0.01
ROA_{it-1}	0.0777	0.3212
$LEVERAGE_{it-1}$	0.0497	0.1611
Herfindal Index$_{it-1}$	-0.0763	0.1092
$CAPEX_{it-1}$	-0.0703	<0.01
$LNAGE_{it-1}$	0.0728	<0.01
Industry fixed effect	YES	
Year fixed effect	YES	
Adj. R^2	0.2682	
N	4,838	

Panel B-2: Second-Stage Regression

Variable	Dependent variable = *RD_TOT*		Dependent variable = *RD_Research*		Dependent variable = *RD_Development*	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	-0.0290	<0.01	-0.0169	<0.01	-0.0134	0.0351
Union_Hat $_{it}$ ***[Predicted]***	**-0.0118**	**<0.01**	**-0.0067**	**0.0231**	**-0.0089**	**0.0123**
$SIZE_{it}$	0.0022	<0.01	0.0014	<0.01	0.0012	<0.01
ROA_{it}	0.0148	<0.01	0.0038	0.1099	0.0147	<0.01
$LEVERAGE_{it}$	-0.0061	<0.01	-0.0051	<0.01	-0.0027	0.0153
Herfindal Index$_{it}$	0.0038	0.0944	0.0015	0.3703	0.0013	0.4873
$CAPEX_{it}$	0.0011	0.2452	0.0000	0.9632	0.0017	0.0880
$LNAGE_{it}$	-0.0007	0.1820	-0.0008	0.0606	-0.0010	0.0303
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	

Adj. R^2	0.2553	0.0968	0.1403
N	4,838	4,838	4,838

Notes: All *p*-values are based on two-tailed tests and standard errors are corrected for heteroscedasticity. Variable definitions are provided in the Appendix.

TABLE 4: The Effect of Labor Unions on the Relation between R&D Activities and Firm Valuation

Panel A: OLS Regression

Variable	Dependent variable = *Tobin's Q*					
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	1.2276	<0.01	1.2485	<0.01	1.1677	<0.01
Union $_{it}$	-0.0162	0.3085	-0.0615	<0.01	-0.0212	0.1639
RD_TOT $_{it}$	6.7009	<0.01				
RD_Research $_{it}$			9.3337	<0.01		
RD_Development $_{it}$					5.7009	<0.01
***Union*$_{it}$*RD_TOT* $_{it}$**	**-2.8091**	**<0.01**				
***Union*$_{it}$*RD_Research*$_{it}$**			**0.1828**	**0.9052**		
***Union*$_{it}$*RD_Development* $_{it}$**					**-5.8191**	**<0.01**
$SIZE_{it}$	-0.0199	<0.01	-0.0196	<0.01	-0.0149	0.0157
ROA_{it}	0.6013	<0.01	0.6321	<0.01	0.6411	<0.01
$LEVERAGE_{it}$	0.7117	<0.01	0.7099	<0.01	0.6956	<0.01
$CAPEX_{it}$	0.1265	<0.01	0.1343	<0.01	0.1307	<0.01
$LNAGE_{it}$	-0.0683	<0.01	-0.0693	<0.01	-0.0720	<0.01
$SGROW_{it}$	0.0987	<0.01	0.1067	<0.01	0.1074	<0.01
$BOD\_INDEPENDENCE_{it}$	0.1696	<0.01	0.1531	<0.01	0.1699	<0.01
FOR_{it}	0.7737	<0.01	0.8251	<0.01	0.8132	<0.01
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	
Adj. R^2	0.3297		0.3294		0.3059	
N	4,989		4,989		4,989	

Panel B: 2SLS Regressions

Variable	Dependent variable = *Tobin's Q*					
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	0.1158	0.6386	0.1364	0.5740	0.0177	0.9430
Union_Hat*$_{it}$*[Predicted]	-0.6590	<0.01	-0.7185	<0.01	-0.7101	<0.01
RD_TOT $_{it}$	8.6534	<0.01				
RD_Research $_{it}$			9.6432	<0.01		
RD_Development $_{it}$					7.2665	<0.01
***Union*$_{it}$*[Predicted]*RD_TOT* $_{it}$**	**-5.7431**	**<0.01**				
***Union*$_{it}$*[Predicted]*RD_Research*$_{it}$**			**-4.5842**	**0.1106**		
***Union*$_{it}$*[Predicted]*RD_Development* $_{it}$**					**-7.0568**	**<0.01**
$SIZE_{it}$	0.0314	0.0103	0.0312	<0.01	0.0387	<0.01
ROA_{it}	0.6005	<0.01	0.6507	<0.01	0.6247	<0.01
$LEVERAGE_{it}$	0.6837	<0.01	0.6987	<0.01	0.6630	<0.01
$CAPEX_{it}$	0.0843	<0.01	0.0923	<0.01	0.0829	<0.01
$LNAGE_{it}$	-0.0189	0.1353	-0.0138	0.2752	-0.0187	0.1462
$SGROW_{it}$	0.1010	<0.01	0.1019	<0.01	0.1076	<0.01

BOD_INDEPENDENCE$_{it}$	0.1533	<0.01	0.1487	<0.01	0.1485	<0.01
FOR$_{it}$	0.7131	<0.01	0.7509	<0.01	0.7285	<0.01
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	
Adj. R^2	0.3352		0.3398		0.3124	
N	4,838		4,838		4,838	

Notes: All *p*-values are based on two-tailed tests and standard errors are corrected for heteroscedasticity. Variable definitions are provided in the Appendix.

TABLE 5: The Relation between Labor Unions and Firm Innovations - Chaebol vs. Non-Chaebol Firms

Panel A: Firm Innovations

Panel A-1: Dependent Variable = *RD_TOT*

	Chaebol Firms		Non-Chaebol Firms		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	-0.0148	0.1153	-0.0199	<0.01	
Union $_{it-1}$	**-0.0095**	**<0.01**	**-0.0028**	**<0.01**	**<0.01**
$SIZE_{it-1}$	0.0016	<0.01	0.0017	<0.01	
ROA_{it-1}	0.0044	0.5435	0.0154	<0.01	
$LEVERAGE_{it-1}$	-0.0145	<0.01	-0.0039	<0.01	
Herfindal Index$_{it-1}$	0.0203	<0.01	-0.0005	0.8204	
$CAPEX_{it-1}$	0.0000	0.9995	0.0020	0.0337	
$LNAGE_{it-1}$	-0.0035	<0.01	-0.0009	0.0288	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.3863		0.2422		
N	1,083		3,906		

Panel A-2: Dependent Variable = *RD_Research*

	Chaebol Firms		Non-Chaebol Firms		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	-0.0102	0.0590	-0.0072	0.0123	
Union $_{it-1}$	**-0.0033**	**<0.01**	**-0.0010**	**<0.01**	**0.4488**
$SIZE_{it-1}$	0.0007	<0.01	0.0008	<0.01	
ROA_{it-1}	-0.0016	0.7317	0.0049	0.0185	
$LEVERAGE_{it-1}$	-0.0087	<0.01	-0.0021	<0.01	
Herfindal Index$_{it-1}$	0.0143	<0.01	-0.0026	0.0967	
$CAPEX_{it-1}$	0.0007	0.4161	-0.0002	0.6718	
$LNAGE_{it-1}$	0.0000	0.9499	-0.0009	<0.01	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.2851		0.1211		
N	1,083		3,906		

Panel A-3: Dependent Variable = *RD_Development*

	Chaebol Firms		Non-Chaebol Firms		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	-0.0052	0.4513	-0.0094	<0.01	
Union $_{it-1}$	**-0.0063**	**<0.01**	**-0.0019**	**<0.01**	**<0.01**
$SIZE_{it-1}$	0.0009	<0.01	0.0009	<0.01	
ROA_{it-1}	0.0053	0.3634	0.0093	<0.01	
$LEVERAGE_{it-1}$	-0.0065	<0.01	-0.0027	<0.01	
Herfindal Index$_{it-1}$	0.0055	0.0640	0.0000	0.9938	

$CAPEX_{it-1}$	-0.0008	0.4543	0.0014	0.0357	
$LNAGE_{it-1}$	-0.0033	<0.01	-0.0004	0.1755	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.2823		0.1607		
N	1,083		3,906		

Panel B: Firm Valuation

Panel B-1: The Effect of Labor Unions on the Relation between Total R&D Expenditures and Firm Valuation

Variable	Dependent Variable = *Tobin's Q*				Difference Test
	Chaebol Firms		Non-Chaebol Firms		
	Coef.	p-value	Coef.	p-value	
Intercept	1.8637	<0.01	1.2368	<0.01	
Union $_{it}$	-0.0349	0.3994	-0.0037	0.8315	
RD_TOT $_{it}$	3.4118	<0.01	7.6331	<0.01	
$\boldsymbol{Union_{it}*RD\_TOT_{it}}$	**1.1744**	**0.4392**	**-4.0324**	**<0.01**	**0.0132**
$SIZE_{it}$	-0.0487	<0.01	-0.0225	<0.01	
ROA_{it}	1.5868	<0.01	0.4510	<0.01	
$LEVERAGE_{it}$	0.6128	<0.01	0.7467	<0.01	
$CAPEX_{it}$	0.0474	0.1123	0.1562	<0.01	
$LNAGE_{it}$	-0.0348	0.1084	-0.0683	<0.01	
$SGROW_{it}$	0.0499	0.3062	0.1106	<0.01	
$BOD\_INDEPENDENCE_{it}$	0.0848	0.3092	0.1494	<0.01	
FOR_{it}	0.9382	<0.01	0.6924	<.0	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.4046		0.3080		
N	1,083		3,906		

Panel B-2: The Effect of Labor Unions on the Relation between Research Expenditures and Firm Valuation

Variable	Dependent Variable = *Tobin's Q*				Difference Test
	Chaebol Firms		Non-Chaebol Firms		
	Coef.	p-value	Coef.	p-value	
Intercept	1.8739	<0.01	1.2552	<0.01	
Union $_{it}$	-0.0440	0.2337	-0.0556	<0.01	
RD_ Research $_{it}$	9.8304	<0.01	9.1738	<0.01	
$\boldsymbol{Union_{it}*RD\_\ Research_{it}}$	**4.6458**	**0.1230**	**-0.8850**	**0.6183**	**0.0284**
$SIZE_{it}$	-0.0469	<0.01	-0.0220	0.0102	
ROA_{it}	1.6664	<0.01	0.4800	<0.01	
$LEVERAGE_{it}$	0.6679	<0.01	0.7416	<0.01	
$CAPEX_{it}$	0.0369	0.2518	0.1705	<0.01	

$LNAGE_{it}$	-0.0532	<0.01	-0.0666	<0.01	
$SGROW_{it}$	0.0179	0.7107	0.1309	<0.01	
$BOD\_INDEPENDENCE_{it}$	0.0141	0.8615	0.1414	0.0100	
FOR_{it}	0.9285	<.	0.7626	<.00	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.4361		0.2954		
N	1,083		3,906		

Panel B-3: The Effect of Labor Unions on the Relation between Development Expenditures and Firm Valuation

Variable	Dependent Variable = *Tobin's Q*				Difference Test
	Chaebol Firms		Non-Chaebol Firms		
	Coef.	p-value	Coef.	p-value	
Intercept	1.8213	<0.01	1.1867	<0.01	
$Union_{it}$	-0.0649	0.0995	-0.0060	0.7158	
$RD\_Development_{it}$	-0.2105	0.8758	7.0146	<0.01	
$Union_{it}$*RD_ $Development_{it}$	**1.6269**	**0.3537**	**-7.7358**	**<0.01**	**<0.01**
$SIZE_{it}$	-0.0437	<0.01	-0.0182	0.0333	
ROA_{it}	1.5785	<0.01	0.5013	<0.01	
$LEVERAGE_{it}$	0.5630	<0.01	0.7370	<0.01	
$CAPEX_{it}$	0.0500	0.0880	0.1610	<0.01	
$LNAGE_{it}$	-0.0449	0.0424	-0.0687	<0.01	
$SGROW_{it}$	0.0463	0.3568	0.1216	<0.01	
$BOD\_INDEPENDENCE_{it}$	0.0913	0.2701	0.1397	0.0112	
FOR_{it}	0.9751	<0.01	0.7377	<0.01	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.3883		0.2827		
N	1,083		3,906		

Notes: All *p*-values are based on two-tailed tests and standard errors are corrected for heteroscedasticity. Variable definitions are provided in the Appendix.

TABLE 6: Agency Problem in Chaebols and Firm Innovations

Panel A: Dependent Variable = *RD_TOT*

Variable	Firms with high control-ownership disparity		Firms with low control-ownership disparity		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	0.0123	0.4611	-0.0233	0.0718	
Union $_{it-1}$	**-0.0098**	**<0.01**	**-0.0023**	**0.1892**	**0.0119**
$SIZE_{it-1}$	0.0015	0.0279	0.0013	0.0433	
ROA_{it-1}	-0.0039	0.7093	0.0218	0.0403	
$LEVERAGE_{it-1}$	-0.0229	<0.01	-0.0097	0.0222	
Herfindal Index$_{it-1}$	0.0090	0.1331	0.0274	<0.01	
$CAPEX_{it-1}$	-0.0004	0.8454	0.0038	0.0516	
$LNAGE_{it-1}$	-0.0093	<0.01	-0.0005	0.6400	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.451		0.3179		
N	542		541		

Panel B: Dependent Variable = *RD_ Research*

Variable	Firms with high control-ownership disparity		Firms with low control-ownership disparity		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	0.0129	0.0659	-0.0160	0.0486	
Union $_{it-1}$	**-0.0022**	**0.0529**	**-0.0005**	**0.6885**	**0.0212**
$SIZE_{it-1}$	0.0002	0.5806	0.0006	0.1360	
ROA_{it-1}	-0.0080	0.2056	0.0115	0.2154	
$LEVERAGE_{it-1}$	-0.0113	<0.01	-0.0025	0.4655	
Herfindal Index$_{it-1}$	0.0084	<0.01	0.0244	<0.01	
$CAPEX_{it-1}$	-0.0001	0.9677	0.0048	<0.01	
$LNAGE_{it-1}$	-0.0024	<0.01	0.0004	0.4589	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.2679		0.1211		
N	542		541		

Panel C: Dependent Variable = *RD_Development*

Variable	Firms with high control-ownership disparity		Firms with low control-ownership disparity		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	-0.0054	0.6075	-0.0021	0.8329	
Union $_{it-1}$	**-0.0080**	**<0.01**	**-0.0022**	**0.0592**	**0.6505**
$SIZE_{it-1}$	0.0014	<0.01	0.0006	0.2565	
ROA_{it-1}	0.0029	0.7296	0.0086	0.2491	

LEVERAGE$_{it-1}$	-0.0102	<0.01	-0.0056	0.0202	
Herfindal Index$_{it-1}$	-0.0002	0.9596	0.0121	<0.01	
CAPEX$_{it-1}$	-0.0007	0.6241	0.0013	0.3813	
LNAGE$_{it-1}$	0.0000	<0.01	-0.0022	<0.01	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.3719		0.137		
N	1,083		3,906		

Notes: All *p*-values are based on two-tailed tests and standard errors are corrected for heteroscedasticity. Variable definitions are provided in the Appendix.

TABLE 7: The Relation between Labor Unions and Firm Innovations - Top 5 Chaebols vs. Non Top 5 Chaebols

Panel A: Dependent Variable = *RD_TOT*

Variable	Top 5 Chaebols		Non Top 5 Chaebols		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	-0.0076	0.6481	0.0250	<0.01	
Union $_{it-1}$	**-0.0083**	**<0.01**	**-0.0045**	**0.0134**	**0.8631**
$SIZE_{it-1}$	0.0034	<0.01	-0.0013	<0.01	
ROA_{it-1}	-0.0094	0.5373	0.0129	0.1108	
$LEVERAGE_{it-1}$	-0.0490	<0.01	0.0074	0.0147	
Herfindal Index$_{it-1}$	-0.0086	0.3134	0.0149	<0.01	
$CAPEX_{it-1}$	0.0085	0.0122	0.0009	0.5515	
$LNAGE_{it-1}$	-0.0109	<0.01	-0.0005	0.5842	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.6539		0.2216		
N	330		753		

Panel B: Dependent Variable = *RD_Research*

Variable	Top 5 Chaebols		Non Top 5 Chaebols		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	0.0168	0.2725	-0.0064	0.1677	
Union $_{it-1}$	**-0.0038**	**0.0453**	**-0.0010**	**0.2439**	**0.0346**
$SIZE_{it-1}$	0.0002	0.6827	0.0002	0.4988	
ROA_{it-1}	0.0041	0.6775	-0.0020	0.7187	
$LEVERAGE_{it-1}$	-0.0246	<0.01	0.0007	0.6838	
Herfindal Index$_{it-1}$	0.0067	0.2786	0.0099	<0.01	
$CAPEX_{it-1}$	0.0076	<0.01	0.0002	0.8770	
$LNAGE_{it-1}$	-0.0026	0.0379	0.0008	0.0638	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.3762		0.1747		
N	330		753		

Panel C: Dependent Variable = *RD_Development*

Variable	Top 5 Chaebols		Non Top 5 Chaebols		Difference Test
	Coef.	p-value	Coef.	p-value	
Intercept	-0.0310	<0.01	0.0309	<0.01	
Union $_{it-1}$	**-0.0049**	**<0.01**	**-0.0028**	**0.0832**	**0.2171**
$SIZE_{it-1}$	0.0032	<0.01	-0.0013	<0.01	
ROA_{it-1}	-0.0101	0.2593	0.0133	0.0386	
$LEVERAGE_{it-1}$	-0.0250	<0.01	0.0067	<0.01	
Herfindal Index$_{it-1}$	-0.0156	<0.01	0.0022	0.4440	

$CAPEX_{it-1}$	0.0009	0.6181	0.0006	0.5925	
$LNAGE_{it-1}$	-0.0069	<0.01	-0.0014	0.0680	
Industry fixed effect	YES		YES		
Year fixed effect	YES		YES		
Adj. R^2	0.652		0.1879		
N	330		753		

Notes: All *p*-values are based on two-tailed tests and standard errors are corrected for heteroscedasticity. Variable definitions are provided in the Appendix.

TABLE 8: Robustness Check—Alternative Measure of Labor Union

Panel A: Firm Innovations

Variable	Dependent variable = *RD_TOT*		Dependent variable = *RD_Research*		Dependent variable = *RD_Development*	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	-0.0118	<0.01	-0.0029	0.2875	-0.0056	0.0963
Union_MEM $_{it}$	**-0.0067**	**<0.01**	**-0.0062**	**<0.01**	**-0.0003**	**0.7414**
$SIZE_{it}$	0.0013	<0.01	0.0006	<0.01	0.0007	<0.01
ROA_{it}	0.0125	<0.01	0.0008	0.8124	0.0104	<0.01
$LEVERAGE_{it}$	-0.0024	<0.01	-0.0019	0.0374	-0.0014	0.1750
Herfindal Index$_{it}$	0.0016	<0.01	0.0056	<0.01	-0.0039	0.0417
$CAPEX_{it}$	0.0005	0.0106	0.0000	0.9671	0.0004	0.5091
$LNAGE_{it}$	-0.0014	0.6959	-0.0009	0.0171	-0.0009	0.0399
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	
Adj. R^2	0.2827		0.1558		0.1775	
N	2,658		2,658		2,658	

Panel B: Firm Valuation

Variable	Dependent variable = *Tobin's Q*					
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	0.9419	<0.01	0.9918	<0.01	1.0285	<0.01
Union $_{it}$	0.0685	0.1094	-0.0656	0.0735	-0.0532	0.2118
RD_TOT $_{it}$	10.0726	<0.01				
RD_Research $_{it}$			13.6267	<0.01		
RD_Development $_{it}$					7.0891	<0.01
Union_MEM*$_{it}$***RD_TOT*** $_{it}$	**-16.2201**	**<0.01**				
Union_MEM*$_{it}$***RD_Research***$_{it}$			**-12.1863**	**<0.01**		
Union_MEM*$_{it}$***RD_Development*** $_{it}$					**-15.5102**	**<0.01**
$SIZE_{it}$	-0.0030	0.6572	-0.0083	0.2031	-0.0034	0.6179
ROA_{it}	1.0859	<0.01	1.1367	<0.01	1.1589	<0.01
$LEVERAGE_{it}$	0.5206	<0.01	0.5261	<0.01	0.5297	<0.01
$CAPEX_{it}$	0.0418	0.0552	0.0463	0.0391	0.0408	0.0590
$LNAGE_{it}$	-0.0923	<0.01	-0.1010	<0.01	-0.0954	<0.01
$SGROW_{it}$	-0.0035	<0.01	-0.0052	<0.01	-0.0039	<0.01
$BOD\_INDEPENDENCE_{it}$	0.2562	<0.01	0.2534	<0.01	0.2550	<0.01
FOR_{it}	0.4999	<0.01	0.5368	<0.01	0.5296	<0.01
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	
Adj. R^2	0.3888		0.3865		0.3654	
N	2,658		2,658		2,658	

Notes: All *p*-values are based on two-tailed tests and standard errors are corrected for heteroscedasticity. Variable definitions are provided in the Appendix.

TABLE 9: Robustness Check—Alternative Measure of Firm Innovation: Innovation Output

Panel A: Firm Innovations

Variable	Dependent variable = $PATENT_{it}$		Dependent variable = $PATENT_{it+1}$		Dependent variable = $PATENT_{it+2}$	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	-0.8969	<0.01	-0.9514	<0.01	-0.9648	<0.01
Union $_{it}$	**-0.0087**	**0.2176**	**-0.0160**	**<0.01**	**-0.0138**	**0.0213**
$SIZE_{it}$	0.0518	<0.01	0.0548	<0.01	0.0561	<0.01
ROA_{it}	-0.2141	<0.01	-0.2269	<0.01	-0.1905	<0.01
$LEVERAGE_{it}$	-0.0993	<0.01	-0.0888	<0.01	-0.0789	<0.01
$CAPEX_{it}$	0.1007	<0.01	0.0879	<0.01	0.0792	<0.01
Herfindal Index$_{it}$	-0.0057	0.4225	-0.0086	0.1397	-0.0096	0.1204
$LNAGE_{it}$	-0.0117	<0.01	-0.0125	<0.01	-0.0153	<0.01
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	
Adj. R^2	0.3201		0.3314		0.3377	
N	1,875		1,846		1,817	

Panel B: Firm Valuation

Variable	Dependent variable = $Tobin\_Q_{it}$		Dependent variable = $Tobin\_Q_{it+1}$		Dependent variable = $Tobin\_Q_{it+2}$	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Intercept	0.9181	<0.01	0.8524	<0.01	1.1148	<0.01
Union $_{it}$	-0.0053	0.8504	-0.0427	0.0980	-0.0403	0.2967
$PATENT_{it}$	0.5644	<0.01	0.7952	<0.01	1.2520	<0.01
Union$_{it}$****PATENT*** $_{it}$	**0.0400**	**0.8515**	**-0.0933**	**0.7650**	**-0.1734**	**0.6524**
$SIZE_{it}$	-0.0016	0.8888	0.0053	0.6890	-0.0067	0.7433
ROA_{it}	1.1800	<0.01	0.9036	<0.01	1.2204	<0.01
$LEVERAGE_{it}$	0.6611	<0.01	0.5854	<0.01	0.6874	<0.01
$CAPEX_{it}$	0.1188	<0.01	0.0404	0.2912	-0.0305	0.4598
$LNAGE_{it}$	-0.0504	<0.01	-0.0481	<0.01	-0.0692	<0.01
$SGROW_{it}$	0.0616	0.1593	-0.0207	0.6803	0.1143	0.1802
$BOD\_INDEPENDENCE_{it}$	0.0311	0.7285	-0.1276	0.2375	-0.3748	0.0316
FOR_{it}	0.5177	<0.01	0.4112	<0.01	0.3889	0.0170
Industry fixed effect	YES		YES		YES	
Year fixed effect	YES		YES		YES	
Adj. R^2	0.2523		0.2193		0.2535	
N	1,875		1,277		689	

Notes: All *p*-values are based on two-tailed tests and standard errors are corrected for heteroscedasticity. Variable definitions are provided in the Appendix.