7-2018

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Published in Journal of Accounting, Auditing and Finance, 2016 May, OnlineFirst
http://doi.org/10.1177/0148558X16648032

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Abstract

This paper examines the determinants of allocation of decision rights between the parent company and its subsidiaries, and the economic consequence of suboptimal power structure. Based on China's unique double-disclosure for the parent company and the whole group, we construct a decentralization index to measure how decision rights are allocated within the group companies. We find a more decentralized (centralized) power structure for the groups with more uncertain (certain) external environment and with poorer (better) internal information quality. We also show that the groups with suboptimal power structure have weaker future performance.

Keywords

Decentralization; Power structure; External environmental uncertainty; Internal information quality; Performance

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Introduction

Companies tend to have different organizational structures (in other words, power structures) that prescribe decision rights.[1] In some companies, decision rights are centralized so that top managers (such as the CEO) retain control over almost all important decisions, whereas in other companies rights are decentralized to lower managers (Melumad & Reichelstein, 1987).

Hayek (1945) emphasizes the importance of the collocation of decision rights with specific knowledge for decision-making. However, delegating decision rights to lower-level managers introduces the risk of possible agency problems. When determining their power structure, companies usually make a trade-off between the agency costs arising from conflicts of interest associated with decentralization, and the costs that arise from poor information associated with centralization (Jensen & Meckling, 1992). In this study, we examine the determinants of the allocation of decision rights between a parent company and its subsidiaries, and the economic consequence of a suboptimal power structure.

We use a sample of Chinese listed group companies to study this issue. In China, listed groups are required to provide not only consolidated financial statements for the group, but also separate financial statements for the parent company. Taking advantage of this double disclosure, we construct a decentralization index (*DI*) based on operating activities to measure the allocation of decision rights between the parent company and its subsidiaries. When the parent company executes purchases and sales on behalf of the whole group, the decision rights for major operating activities are more likely to be concentrated in the parent company. In contrast, when the subsidiaries execute purchases and sales independently, the

[1] For ease of exposition, we use power structure and allocation of decision rights interchangeably.

decision rights are more likely to be delegated to the subsidiaries.[2]

Our empirical results show that groups operating in more uncertain business environments tend to be decentralized, i.e., they are more likely to assign decision rights to the subsidiaries due to the demand for specific knowledge for decision-making. Groups with high-quality internal information prefer a centralized structure because the effective communication within the group can facilitate decision-making by the parent company. The evidence strongly supports the prediction that the power structure within a group is significantly affected by both external and internal environments. Moreover, we also examine the economic consequence of power structures and find that groups in which the power structure is mismatched to the environment have weaker future performance. The evidence suggests the important role of an efficient power structure.

Our study makes several contributions to the literature. First, the question of how decision rights should be allocated within the group company is an important matter of corporate policy that has attracted the interest of researchers from the economics, management and finance fields (see, e.g., Graham, Harvey & Puri, 2015; Jensen & Meckling, 1992; Harris & Raviv, 2005; Rantakari, 2013). However, most researchers explore this issue through mathematical modeling (e.g., Harris & Raviv, 2005; Rantakari, 2013) or surveys (e.g., Bloom, Sadun & Van Reenen, 2012; Christie, Joye & Watts, 2003; Graham et al., 2015). By providing empirical evidence based on a large sample of group companies, we shed light on this area.

Second, making use of China's double disclosure, we develop a novel proxy for the allocation of decision rights between a parent company and its subsidiary. Our measure uses unique information obtained from the separately disclosed financial statements of the parent company and the whole group. This measure, though rough, relies on audited financial

[2] As a robustness test, we also construct alternative measures of decentralization based on investing activities.

information and is therefore not affected by the subjective judgments of managers or researchers. In the extant literature, Robinsen and Stocken (2013) construct a measure of power structure in international companies, and Csaszar (2012) does so for mutual funds. Compared with their measures, our measure is more externally generalizable, as it is available for a large sample of companies, including both small and large ones, and covers more industries.

Third, our study is related to the literature on internal information environments. A good internal information environment can provide top management with timely information and improve the efficiency of management decisions (Horngren, Datar, Foster, Rajan & Ittner, 2012). Previous studies have noted the importance of high-quality internal information and documented its effects on a variety of corporate decisions, such as management forecasts (Dorantes, Li, Peters & Richardson, 2013) and tax avoidance (Gallemore & Labro, 2015). Our study extends this line of research and documents the relation between internal information and power structure.

The remainder of this paper proceeds as follows. A "Literature Review and Hypothesis Development" section is followed by the "Decentralization Index" section, which describes our measure of decentralization. This is followed by the "Research Design" section and the "Empirical Results" section. An "Additional Analyses" section reports the robustness tests and additional analyses, and the final section concludes the paper.

Literature Review and Hypothesis Development

Literature Review

As Hayek (1945) notes, the economic problem that a society must solve is how to secure the best use of resources known to members of the society. Hayek emphasizes that the ultimate decision rights must rest with those people who are familiar with the particular

circumstances of time and place, in other words, those who have information relevant to making decisions. Therefore, decision rights should be allocated to different people and a decentralized organization is generally preferable.

Hayek's pioneering view is supported by Jensen and Meckling (1992), whose analysis shows that the delegation of decision rights to those at lower levels of an organization who have relevant information for the decision can reduce the costs arising from poor information. However, they also suggest that lower-level agents may not act in the best interest of top management, and agency costs resulting from conflicts of interest inevitably increase as the company adopts a more decentralized structure. Therefore, companies should trade off the costs associated with poor information and those associated with agency problems when determining their optimal level of decentralization.

Along this line, Stein (2002) argues that when information is "soft" and cannot be credibly transmitted, a decentralized company performs better. His paper highlights the importance of information communication. Harris and Raviv (2005) build a theoretical model and show that the probability of delegation increases with the importance of division managers' private information and decreases with that of CEOs. Furthermore, Rantakari (2013) demonstrates that organizations operating in volatile environments prefer decentralized decision-making. These theoretical models provide a framework for determining the allocation of decision rights.

Besides the theoretical models, several papers have empirically examined power structures within companies. Colombo and Delmastro (2004) analyze a sample of 438 Italian manufacturing plants and their parent companies. They show that the complexity and size of organizations, the urgency of decisions, and the use of advanced communication technologies are positively associated with the degree of decentralization. In addition, companies that are younger, closer to the technological frontier, and in more heterogeneous environments are

more likely to choose a decentralized structure because they have less public information and the benefit of lower-ranking managers' information outweighs agency costs (Daron, Aghion, Lelarge, Reenen & Zilibotti, 2007). Using survey data, Graham et al. (2015) find that depending on the nature of the decisions, CEOs have different preferences for allocating rights; for example, decisions about mergers and acquisitions are less likely to be delegated than those about capital structure. Other studies document that the product market, the company's involvement in international trade, and the social trust in a region also play important roles in determining the power structure within a company (Bloom et al., 2012; Meagher & Wait, 2013).

In summary, the allocation of decision rights is an important issue that has attracted attention from researchers. Nonetheless, due to the difficulty of empirically measuring the power structure in an organization, extant studies mainly use theoretical models, survey data, or small samples to conduct their investigations. An empirical study based on a large sample is thus warranted.

Hypothesis Development

External environment. It has long been argued in the management literature that companies should choose organizational structures that match their environment (e.g., Chandler, 1962; Lawrence & Lorsch, 1986). Companies generally operate in an uncertain business environment. The unpredictable behavior of customers, suppliers, competitors, and regulatory parties contributes to environmental uncertainty (Ghosh & Olsen, 2009). Intuitively, companies should react accordingly to changes in the external environment. For example, a change in customers' preferences may drive a company to adjust its product design, or a change in regulations may push a company to adjust its marketing strategy. When

a company faces great uncertainty, the value of local responsiveness and local information increases. A principal will prefer to delegate decisions to a better informed agent, because the communication between top management and lower management is often noisy (Dessein, 2002) and a decentralized structure can facilitate faster reactions from the company. Similarly, Rantakari (2013) claims theoretically that organizations operating in volatile environments prefer decentralized decision-making.

Based on the above discussion, we expect that a group company within a volatile environment will value the local information of its subsidiaries, and will therefore delegate more decisions to the subsidiaries. Our first hypothesis is as follows.

Hypothesis 1. Group companies with higher environmental uncertainty have a more decentralized power structure.

Internal environment. When companies have a centralized power structure, to facilitate better decision-making, top managers will need low-level managers to provide relevant information. However, barriers always exist in the transfer of information, which makes communication noisy and causes information loss that may prevent top managers from efficient decision-making (Bloom et al., 2012; Dessein, 2002). Timely and accurate communication between top and low-level managers therefore becomes essential for centralization, which can be warranted by high-quality internal information. The quality of internal information determines the accessibility and accuracy of the data and knowledge collected, generated, and consumed within an organization (Gallemore & Labro, 2015). Top managers in a company with high-quality internal information have timely access to accurate information for better decision-making (Hodge, Kennedy & Maines, 2004).

In the context of group companies, because good-quality internal information can ensure better decision-making associated with effective communication between the parent company

and its subsidiaries, it is more likely that a more centralized structure will be adopted by groups with better internal information. The hypothesis is formalized as follows.

Hypothesis 2. Group companies with high-quality internal information have a more centralized power structure.

Suboptimal power structure. According to the discussions above, companies should decide the appropriate level of centralization by trading off the costs arising from poor information against those arising from agency problems (Jensen & Meckling, 1992; Dessein, 2002). Companies with different external environments and different internal information qualities will choose different power structures. A natural question then arises concerning the economic consequences of a suboptimal power structure. Intuitively, deviation from the optimal structure will give the wrong people excessive power and lead to inefficient decisions: top managers may make inefficient decisions due to poor information, or lower-level managers may do this because of conflicts of interest. These inefficient decisions inevitably lead to weaker performance.

For example, Robinson and Stocken (2013) study a group of multinational companies and find that a mismatched power structure between foreign segments and headquarters is associated with weak performance. They also find that multinational companies are more likely to adjust the allocation of decision rights to foreign segments if the extent of the mismatch is large. Furthermore, Csaszar (2012) documents that when there is an overdecentralized structure, mutual funds are more likely to pursue bad projects and miss good ones.

Hypotheses 1 and 2 predict that group companies should decide their power structures according to environmental factors. If the allocation of decision rights does not match well with the companies' environments, future performance will be adversely affected. We

summarize our third hypothesis as follows.

Hypothesis 3. Group companies with a suboptimal power structure are more likely to experience poor future performance.

Decentralization Index

Measuring the power structure within a company is not easy. One instrument that has been used in the literature is the relative proportion of profit and cost centers at the management level. Presumably, managers of profit centers have more decision rights than those of cost centers. Therefore, companies with more profit centers are more decentralized than companies with more cost centers (see, for example, Christie et al., 2003; Daron et al., 2007). Other studies use survey data and directly contact CEOs or managers for related information via questionnaires or interviews (see for example, Colombo & Delmastro, 2004; Graham et al., 2015; Bloom et al., 2012). Robinson and Stocken (2013) rely on the accounting rules for U.S.-based multinational companies to identify their allocation of decision rights to foreign segments. Specifically, when the foreign affiliate's functional currency is the host country's currency, decision rights are regarded as being delegated; when its functional currency is U.S. dollar, decision rights are retained by the parent company. The advantage of this measure is that it is based on public information. However, it is only available for multinational companies and can only be used to measure the power allocation between foreign segments and the domestic headquarters.

Our measure of power structure is also based on publicly available information. In China, listed group companies are required by the regulators to provide not only consolidated financial statements for the group, but also separate financial statements for the parent company. Therefore, we can access information specific to the parent company. Taking advantage of this double disclosure, we construct a decentralization index, denoted as *DI*, to

measure the power structure of the group company, i.e., how a group company allocates decision rights between the parent company and its subsidiaries. The formula for *DI* is stated as follows.

$$DI = -\{\frac{Parent's\ Sales\ Revenue}{Consolidated\ Sales\ Revenue} * 0.5 + \frac{Parent's\ Operating\ Expenses}{Consolidated\ Operating\ Expenses} * 0.5 - \frac{Parent's\ Operating\ Assets}{Consolidated\ Operating\ Assets}\},$$

where operating expenses are the sum of the cost of goods sold, SGA (selling, general, and administrative) expenses, and sales tax; operating assets are the sum of inventories, prepaid expenses, PPE (property, plant, and equipment), and intangible assets.

A company's major profit-maximizing operating activities are producing goods and providing services. When a company has multiple divisions, it usually practices centralized purchasing; i.e., the parent company purchases key supply items for common use by all of its divisions (Corey, 1978). According to Karjalainen (2011), centralized purchasing has synergy benefits including economies of scale, economies of information and learning, and economies of process. Typically, the parent company makes essential purchasing decisions and takes responsibility for ensuring the integrity of the purchasing process, and the subsidiaries "buy" goods (e.g., raw materials) from the parent company at an internal transfer price via the internal market.

When preparing consolidated financial statements, such intra-entity transactions are eliminated because they are not transactions with an outside unrelated party. However, this practice of centralized procurement is reflected in the financial statements of the parent company, which record a large increase in sales and operating expenses.

After the subsidiaries produce goods (i.e., output) using the purchased raw materials (i.e., input), the group companies need to sell their products to outsiders. The parent company may be responsible for selling all of the products produced by individual subsidiaries, which we

denote as centralized sales. This practice, similar to centralized purchasing, does not affect the consolidated financial statements, but greatly increases the sales and operating expenses of the parent company.

Therefore, the underlying rationale of *DI* is that if a group company concentrates its sales activities or procurement in the parent company rather than in its subsidiaries, we can claim that the company concentrates the decision rights for its major operating activities in the parent company. In other words, it has a high (low) level of centralization (decentralization). The *DI* formula is further adjusted by subtracting relative operating assets owned by the parent company of the whole group, because operating assets are the main resources for operating activities. Note that the size of the parent company relative to its subsidiaries may, to a certain degree, correspond to power allocation within the group. For example, if a subsidiary is relatively large, this may imply that more power has been allocated to the subsidiary. We do not study this type of power allocation. By using relative size deducted, *DI* captures the abnormal power allocation relative to the operating resources owned by each group member.[3] For ease of interpretation of the empirical results, we multiply the measure by minus one. Hence, a higher *DI* indicates a more decentralized power structure, and lower *DI* indicates a less decentralized power structure.

Our *DI* measure has several advantages. First, it is constructed using audited financial statements, which are more reliable than data from private sources. Second, compared to survey data, it is less prone to subjective bias. In addition, the measure can be applied to all Chinese listed companies with subsidiaries, and is not limited to large multinational companies. Nonetheless, we acknowledge that *DI* has limitations. Organizations make decisions on various activities, including operating activities, investing activities, financing activities, and many others. An ideal measure of decentralization should cover all of these

[3] In other words, we classify a group whose parent company retains more operating activities relative to operating resources (i.e. assets), as having a more centralized structure.

activities, but our measure only considers purchase and sales decisions (or operating decisions) and does not capture control through funding or other non-operating channels. To address this issue, in the robustness test we construct alternative measures of decentralization based on investing activities and run analyses after deleting the observations with parent companies that only engage in investment activities.

Furthermore, we must note that due to data limitations, we cannot identify whether sales (or purchases) of a parent company are performed in the market or within the group, which also adds some noise to the *DI* measure. However, *DI* can differentiate the degree of concentration if external sales or purchases by the parent company exceed its own processing needs (in other words, if the operating activities are concentrated toward the parent company). We illustrate this in Appendix A.

Research Design

Data and Sample Selection

Our sample includes all Chinese A-share listed companies, excluding those in the financial industry.[4] To ensure the data quality and to calculate certain variables, we use the 2002 to 2013 sample period.[5] After eliminating observations with missing data, the final sample consists of 16,062 firm-year observations.[6]

We obtain consolidated financial statements and parent companies' financial statements from RESSET/DB to calculate the proxy for decentralization, i.e., *DI*. Other required financial information, if not specified, is taken from CSMAR.[7]

[4] A-share listed companies are for domestic investors and traded in RMB; B-share stocks were originally for international investors. B-share stocks are now open to domestic investors, but are settled with U.S. or H.K. dollars. Some listed companies are traded in both A and B markets.
[5] As we need at least five years (ending in the current year) of available data to calculate certain variables, we actually use data starting from 1998.
[6] Our sample only includes groups with both parent company and subsidiaries. Groups with only one entity are excluded.
[7] CSMAR is the major database supporting accounting and finance research on China issues. However, CSMAR does not provide financial information for the parent companies.

Research Design

Hypotheses 1 and 2. To test Hypothesis 1, concerning the relation between external environmental uncertainty (*EU*) and power structure, we use a proxy of *EU* from Ghosh and Olsen (2009). They argue that a volatile sales pattern across time indicates a relatively uncertain operating environment. Following them, we use the coefficient of variation in sales over the five years before current year as the measure of *EU*.[8]

To test Hypothesis 2, concerning the relation between internal information quality (*IQ*) and power structure, we follow Gallemore and Labro (2015) and use the earnings announcement speed calculated as the number of days between the end of the current fiscal year and the group company's earnings announcement date, divided by 365 and multiplied by minus one.[9] A company with high-quality internal information is likely to have a high-quality accounting system that is capable of quickly integrating information from various sources (Jennings, Hojun, & Tanlu, 2014), thus enabling the company to make earlier earnings announcements.

We run the following model to test Hypotheses 1 and 2.

$$DI_{i,t} = \beta_0 + \beta_1 EU_{i,t} + \beta_2 IQ_{i,t} + \beta_3 \text{Controls}_{i,t} + \varepsilon_{i,t} \qquad (1)$$

The variables *DI*, *EU*, and *IQ* are defined above. We include several control variables as in Fan, Wong, and Zhang (2013).[10] Firm size (*Size*) is the natural logarithm of total assets. Large companies tend to have more complex operations, which might affect power allocation. Financial leverage (*Lev*) is total liabilities divided by total assets. The market-to-book ratio (*MB*), is the ratio of market value of common equity divided by the book value of equity.

[8] To avoid survivor bias, we use all of the available data to calculate *EU* if companies have been listed for less than five years.
[9] We also use one-year lagged *IQ*, which does not change the results.
[10] In the main analyses, we use control variables in the concurrent year. We also use one-year lagged control variables, which does not change the results.

Firm age (*Age*) is the natural logarithm of the number of years that the company has been in business. *SOE* is an indicator variable for state-owned companies, which equals 1 for state-owned companies and 0 otherwise.

An indicator variable for diversified companies (*Diversify*) is also included, and equals 1 if companies have sales in two or more industries, and 0 otherwise (Xu, Chan, Jiang & Yi, 2013).[11] Specifically, if the parent company and its subsidiaries operate in the same business, the group is more likely to be centralized; if they are diversified into different lines of operation, the parent company may tend to allocate more power to the subsidiaries.[12] We expect *Diversify* to be positively associated with *DI*.

In addition, in 2007 China adopted a new set of accounting standards that substantially converge with IFRS (Ding & Su, 2008), and may have a positive effect on internal information quality (Liu, Yao, Hu & Liu, 2011). We thus include the variable *After*, which equals 1 for the years after 2007 (inclusive) and 0 otherwise. Finally, we include year and industry fixed effects in the model.

Hypothesis 3. Hypothesis 3 predicts that the mismatch between power structure and environmental factors has an adverse effect on firm performance. Following Robinson and Stocken (2013), we use the absolute value of the residuals from Equation 1, which negatively captures the model fitness, to measure the mismatch, denoted as *AbDI*.

To formally test Hypothesis 3, we estimate the following model.

$$Perf_{i,t+1} = \beta_0 + \beta_1 AbDI_{i,t} + \beta_2 Perf_{i,t} + \beta_3 \text{Controls}_{i,t} + \varepsilon_{i,t} \qquad (2)$$

[11] The data are from the Wind Financial Database (WindDB).

[12] However, we acknowledge that due to data availability, *Diversify* is unable to efficiently differentiate between horizontal diversification and vertical integration. Horizontal diversification implies that the subsidiaries produce products or provide services that are often technologically or commercially unrelated to those of the parent company. Intuitively, within horizontally diversified groups, decisions are made independently for those unrelated products; in other words, the groups are more decentralized. Vertical integration implies that a group owns its upstream suppliers and its downstream buyers. The customer–producer relationship within the group may require centralized decision-making by the parent company. *Diversify* is defined based on whether a company runs business across different industries, and this construct is more relevant to horizontal diversification.

$Perf_{t+1}$ is the company's financial performance in year t+1, measured as return on assets (*ROA*), return on equity (*ROE*), or return on sales (*ROS*), all standardized by subtracting the industry median to isolate industrial effects. We also include one-year lagged performance ($Perf_t$) to control for the time-series correlation in performance. Other control variables are *Size*, *Lev*, *MB*, *Age*, and *SOE*, defined above.

All of the variables in Equations 1 and 2 are defined in Appendix B. To mitigate the potential effect of outliers, we winsorize the continuous variables at the 1% and 99% levels.

Empirical Results

Descriptive Statistics

Panel A of Table 1 presents the descriptive statistics for all variables used in the regressions. The mean (median) of the *DI* is -0.056 (-0.023), which indicates that the sample companies tend to be centralized. This is consistent with the survey conducted by Bloom et al. (2012), which finds that companies incorporated in Asian countries are much more centralized than those incorporated in Europe. The relatively large standard deviation of *DI* shows that there is a wide variation in companies' power structures, which is also consistent with previous research (Bloom et al., 2012). *EU* also varies widely among companies. The statistics for *IQ* show that most companies release their annual earnings within 70 to 110 days after the end of the fiscal year.

Panel B of Table 1 presents the correlations between all variables, with Pearson correlations above the diagonal and Spearman rank correlations below. As predicted by Hypotheses 1 and 2, *EU* is positively correlated with *DI*, and *IQ* is negatively associated with *DI*, which provides preliminary support for the relation between power structure and environmental factors. The correlations among the independent variables do not present a significant multicollinearity problem.

[Insert Table 1 here]

Table 2 presents annual and industrial statistics for *DI*. Panel A shows that *DI* is decreasing over time, suggesting an increasing trend toward centralized decision-making.[13] Panel B shows that the allocation of decision rights from the parent company to the subsidiaries also varies across industries. Similar to previous studies (e.g., Robinson & Stocken, 2013), the transportation and public service industries tend to be more decentralized, whereas the mining and construction industries have a more centralized structure.

[Insert Table 2 here]

Hypothesis Testing

Hypotheses 1 and 2. Table 3 presents the results of estimating Equation 1 to test Hypotheses 1 and 2. Columns 1 and 2 present the results for environmental uncertainty (*EU*, Hypothesis 1) and internal information quality (*IQ*, Hypothesis 2) respectively, and column 3 contains both.

The coefficients of *EU* in columns 1 and 3 are significantly positive (0.053 and 0.055 respectively; p <0.01), consistent with Hypothesis 1. Companies operating in a volatile and uncertain environment tend to allocate more decision rights to their subsidiaries, because local information and knowledge are important in such situations.

The coefficients of *IQ* in columns 2 and 3 are negative and significant (-0.067 and -0.077 respectively; p <0.05 and 0.01 respectively), suggesting that good internal information ensures effective communication between a parent company and its subsidiaries, and allows the parent company to obtain accurate and timely information for decision-making. Therefore,

[13] In untabulated analyses, we explore whether the pattern of *DI* is associated with newly listed companies, market volatility, easier communication within the group, or adoption of the new accounting standards in 2007, and find that the latter two factors appear to have driven the increasing centralization.

a centralized power structure is observed. The evidence supports Hypothesis 2.

The results for the control variables indicate that companies that are larger (*Size*), with a higher leverage ratio (*Lev*), and lower growth opportunity (*MB*) tend to be centralized, whereas older (*Age*),[14] state-owned (*SOE*), and diversified (*Diversify*) companies are more decentralized. We also observe a decrease in *DI* with the implementation of new accounting standards (*After*).

[Insert Table 3 here]

Hypothesis 3. Table 4 reports the results of estimating Equation 2 to test Hypothesis 3.[15] Using one-year-ahead *ROA*, *ROE*, or *ROS* as the dependent variable, the coefficients on *AbDI* are negative and significant, ranging from -0.005 to -0.026, with *p* ranging from slightly less than 0.10 to 0.05. The results suggest that future performance decreases with the extent of the mismatch between the level of decentralization and environmental factors, supporting Hypothesis 3. Specifically, the agency cost of overdecentralization and the communication cost due to overcentralization may both contribute to poor performance (Jensen & Meckling, 1992; Bloom et al., 2012). In the next section, we conduct further analyses to determine whether overdecentralization or overcentralization or both contribute to poor performance.

[Insert Table 4 here]

Additional Analyses

In this section, we conduct several additional analyses to ensure the robustness of the main findings.

[14] We also include the interaction between *EU* and *Age*. Untabulated results show that the main effect of *EU* remains positively significant; and this positive effect decreases when the company grows older (negative coefficient on *EU*Age*). Thanks for the reviewer's suggestion.

[15] As we need one-year-ahead performance variables (*ROA*, etc.) in Equation 2, the sample for this regression includes only 13,770 firm-years.

Further Analyses on *DI*

Relative efficiency of the parent company and its subsidiaries. It is possible that *DI* is driven by the relative efficiency of the parent company and its subsidiaries. If the asset turnover ratio is higher in the parent company, *DI* will point to a more centralized structure.

However, the concern can be mitigated for the following reasons. First, our alternative measures of decentralization, described below in the "Alternative Measures of the Main Variables" section, are based on investment activities and thus not contaminated by relative operating efficiency within the group. The results based on these measures, reported in Table 6, also support our predictions. Second, we try to isolate the effect of the relative efficiency of the parent company by controlling for the industry efficiency in the analyses. For each year, we first calculate the relative efficiency of the group company by dividing the parent company's asset turnover over consolidated asset turnover, and then use the industry mean of this ratio in a particular year, denoted as *Ind_RelEff*, to capture industry relative efficiency. The asset turnover ratio is defined as sales divided by operating assets. The results after controlling *Ind_RelEff* are displayed in Panel A of Table 5. We can see that the main inferences remain unchanged.

Parent company without operating activities. *DI* is mainly based on the allocation of decision rights about operating activities between the parent company and its subsidiaries. Some parent companies, however, are purely investment entities that do not engage in any operating activities. *DI* cannot capture control if it is through funding or other non-operating channels, and thus may not be an appropriate measure for investment-oriented parent companies.

To address this concern, we exclude group companies that do not report any sales revenue on the parent company's financial statements, and re-estimate Equation 1 based on

the reduced sample of groups with only operation-oriented parent companies. Panel B of Table 5 shows that our conclusions remain unchanged.

Relative scale of the parent company and its subsidiaries. The operation of the parent company relative to its subsidiaries is associated with their relative scale. We therefore adjust *DI*, by subtracting the assets owned by the parent company relative to the subsidiaries. With this adjustment, we classify a group whose parent company retains more operating activities (purchase or sales) relative to its operating resources (i.e., assets) as having a more centralized structure.

To further ensure that the results are not driven by the size of the parent company relative to its subsidiaries, we partition the sample according to *Rel_scale*, defined as the operating assets owned by the parent company divided by the consolidated assets, and run subsample regressions. The results in Panel C of Table 5 are very similar in the two subsamples, which helps mitigate concerns about potential noise due to the relative size of the parent company.

[Insert Table 5 here]

Alternative Measures of the Main Variables

Decentralization of investment decisions. As mentioned earlier, *DI* as used in this study only considers companies' decisions about operating activities, which could introduce some potential noise into our main inferences. Investment and financing decisions are not covered by *DI*. As a robustness check, we construct two alternative measures: decentralization of investment activities, denoted as *DIinv*1 and *DIinv*2.

According to the new accounting standards adopted by China in 2007, listed companies are required to disclose "income from investments in associates and joint ventures" in both

the consolidated and the parent company's financial statements. As investing companies have high ownership and can exercise significant influence on associates and joint ventures, the equity method is used to record such investment in consolidated financial statements.[16] Meanwhile, investment in subsidiaries is recorded using cost methods in the parent company's financial statements, i.e., the earnings of subsidiaries are not recorded by the parent company. Therefore, the difference in "investment income from associates and joint ventures" reported by the group and the parent company can represent the subsidiaries' investment income, or indicate whether the subsidiaries have investment.

We construct *DIinv*1 based on this information. When a parent company (or its subsidiaries) has a non-zero "income from investment in associates and joint ventures," we assume that the parent company (or its subsidiaries) has investment in associates and joint ventures.[17] If only the subsidiaries have investment in associates and joint ventures, the group company allocates all decision rights on investment to its subsidiaries and *DIinv*1 is coded as 3; if only the parent company has such investment, the group centralizes the decision rights in the headquarters and *DIinv*1 is coded as 1; if both the parent company and its subsidiaries have such investment, *DIinv*1 is coded as 2. If companies do not have such investment in either the parent company or its subsidiaries, we drop these observations.

Next, we estimate Equation 1 using *DIinv*1 as the dependent variable. We use an ordinal logistic regression model based on the reduced sample after the implementation of the new accounting standards, excluding the companies that do not report investments in associates and joint ventures. The results are presented in Panel A of Table 6. Similar to the results in Table 3, the coefficient on *EU* is significantly positive (0.695, p <0.001), and the coefficient

[16] The equity method recognizes the investor's share of investee income, and the investor's declared share of investee dividends is recorded as decreases in the investment account.

[17] Regarding the importance of investment in associates, we find that on average, the income from such investment accounts for 12.47% of the whole group's net income. Thus, investment in associates comprises a relatively significant part of the group's operations.

on *IQ* is significantly negative (-1.063, $p = 0.027$).

We also construct another variable for decentralization based on capital investment, denoted as *DIinv*2.[18] We use capital expenditure, defined as cash paid for purchase of intangible assets and PPE (property, plant, and equipment), as the measure of investment. We calculate the measure as follows:

$$DIinv2 = -\frac{Parent's\ Capital\ Expenditure}{Consolidated\ Capital\ Expenditure}$$

Panel B of Table 6 shows that the allocation of decision rights for capital investment is positively related to external environmental volatility (*EU*), and negatively associated with internal information quality (*IQ*). Hence, the main inferences remain unchanged based on *DIinv*1 and *DIinv*2.

[Insert Table 6 here]

External environmental uncertainty. Following Mason and Fredrickson (2001), we construct an alternative proxy for external environmental uncertainty, denoted as *EU*2, which eliminates the temporal trend of sales. For each firm-year, we regress sales in the five previous years against time. *EU*2 is then measured as the standard error of the regression coefficient divided by average sales over the five-year period.[19]

As shown in Panel A of Table 7, the coefficient of *EU*2 is 0.079 ($p = 0.013$), which is consistent with the results based on *EU* in the main analyses.

Internal information quality. Following Gallemore and Labro (2015), we use internal control quality as another proxy for internal information quality, denoted as *IQ*2. Companies with material weaknesses of internal control have to make decisions based on low-quality

[18] We thank the reviewer for the suggestion about alternative measures of decentralization.
[19] To mitigate the effect of survivor bias, we use all available data to calculate *EU*2 if companies have been listed for less than five years.

financial information. Furthermore, business units report information to the headquarters in an untimely and inaccurate manner (Feng, Li, & McVay, 2009). If a company reports a material weakness, it is likely that the quality of internal information is low.

Before 2007, the Shanghai and Shenzhen Stock Exchanges did not require listed companies to report internal control self-assessments or to hire auditors to verify their reports (Sun, Yi, & Lin, 2012). Therefore, internal control data are only available after 2007, which makes the sample size much smaller (7,249).

Panel B of Table 7 shows that the coefficient of *IQ*2 is -0.051 (p = 0.018), which is consistent with the results based on *IQ* in the main analyses.[20] Furthermore, the results (untabulated) still hold if we use both *EU*2 and *IQ*2 in Equation 1.

[Insert Table 7 here]

Subsample Regressions

We run the regression of Equation 1 with different subsamples to check the robustness of the results.

New Chinese accounting standards. The new accounting standards introduced in China in 2007 substantially changed the requirements for the preparation of financial statements for a group company and its parent company. To address the potential influence of this exogenous event on information quality and then *DI*, we estimate Equation 1 using subsamples from before and after 2007. The results in Panel A of Table 8 show that the coefficients of *EU* are significant and positive for both time periods, whereas *IQ* is significantly and negatively associated with *DI* in the 2002 to 2006 period, and only marginally significant in the post-2007 period. Therefore, the main inferences remain unchanged despite the change in accounting standards.

[20] There were no mandatory requirements for internal control reports for Chinese listed companies before 2010 (Sun et al., 2012). Thus, the results should be interpreted with caution.

State-owned companies. Table 3 shows that state-owned enterprises tend to be decentralized (0.030, p <0.001), consistent with the findings of Fan, Wong, and Zhang (2013). That is, state-owned companies tend to extend the layers of their pyramidal structure to insulate them from political interference. We examine whether state-owned companies show a different pattern from that of private companies, as a result of political interference.

As illustrated in Panel B of Table 8, the coefficient of the interaction term *EU*SOE* is not statistically significant, indicating that environmental uncertainty has a similar effect on power structure for both state-owned and private companies. However, the effect of internal information quality varies between the two types of company (*IQ*SOE*): internal information quality is far more important for state-owned enterprises than for private companies. One possible explanation is that state-owned companies tend to decentralize more to avoid political influence (Fan, Wong, & Zhang, 2013), and thus better communication is needed between the parent company and its subsidiaries to reduce information loss.

[Insert Table 8 here]

The Endogeneity Issue

There may be some concerns over reverse causality regarding the effect of internal information quality on decentralization.[21] That is, centralized companies may be more likely to make earnings announcements earlier due to their low organizational complexity (Jennings et al., 2014). We use one-year lagged *IQ* in Equation 1 to address this concern, and the untabulated results remain the same. Furthermore, we run a two-stage regression to alleviate the endogeneity concern. We choose two-year lagged *IQ* as the instrumental variable, because the speed of a company's earnings announcement two years ago may not be affected by its

[21] We are less concerned about the endogeneity problem for external environmental uncertainty, because we use the previous five years' data to construct this variable.

power structure in the current year.

Specifically, in stage one we regress concurrent *IQ* on the two-year lagged *IQ* to estimate the predicted *IQ* in the current year. In the second stage, we regress *DI* on the estimated *IQ*. We include the same control variables as in Equation 1 for both stages. Panel A of Table 9 shows that the results of the second stage regression are the same as those in Table 3.

However, decentralization is a relatively stable arrangement within a group and lagged variables may not fully solve the endogeneity problem.[22] In the earlier part of this paper, we also use the mandatory adoption of IFRS-convergent accounting standards in 2007 to address this problem. Adoption of the standards is an exogenous event and has a positive effect on internal information (e.g., Liu at al., 2011). As in Table 3, we find a significantly negative coefficient on *After* (the indicator for the period after the adoption), indicating that a better information environment decreases the level of decentralization.

To further address this issue, we use the adoption of the ERP (enterprise resource planning) system as an alternative proxy for internal information quality. As Zeng, Wang, and Xu (2012) discuss, the adoption of the ERP system in the early 2000s was primarily promoted by the Chinese government under the plan of "Industrialization with Information Technology," and is generally exogenous. Such systems can improve top management's access to decision-relevant internal information and thus lead to a better internal information environment (Dorantes et al., 2013).

We use hand-collected data from 2002 to 2006 about whether and when companies adopted ERP system. We construct a dummy variable *ERP*, which takes the value of one if the company has ERP system in a specific year and zero otherwise. We find that *ERP* is significantly negative, suggesting that higher internal information quality leads to a more

[22] Thanks for the reviewer's suggestion.

concentrated structure. The results are consistent with our hypothesis (Panel B of Table 9).

We acknowledge that despite our best efforts, the potential endogeneity problem has not been fully addressed.

[Insert Table 9 here]

The Effects of Overdecentralization and Overcentralization on Future Performance

Table 4 shows that companies with suboptimal power structure have weak future performance. Previous theoretical studies have revealed that inappropriate decentralization increases agency costs due to conflicts of interest between the parent company and its subsidiaries, whereas overcentralization leads to growing communication costs or information loss (Jensen & Meckling, 1992; Dessein, 2002; Bloom et al., 2012).

Therefore, we may need to explore whether the effect on performance of an inappropriate power structure varies between overdecentralization and overcentralization. To do so, we extend Equation 2 and run the following model.

$$Perf_{i,t+1} = \beta_0 + \beta_1 AbDIpos_{i,t} + \beta_2 AbDIneg_{i,t} + \beta_3 Perf_{i,t} + \beta_4 \text{Controls}_{i,t} + \varepsilon_{i,t} \quad (3)$$

AbDIpos, representing overdecentralization, is the absolute value of the residuals from Equation 1 if the residuals are positive, and zero otherwise. *AbDIneg*, representing overcentralization, is the absolute value of the residuals from Equation 1 if the residuals are negative, and zero otherwise. Other variables are defined as above.

Untabulated analyses show that the mean of *AbDIpos* is 0.137, and that of *AbDIneg* is 0.175. Table 10 reports that the performance of overdecentralized companies is significantly weaker than that of overcentralized companies, as the coefficients on *AbDIpos* are significantly negative, and those on *AbDIneg* are insignificant. The results suggest that companies that overdelegate decision rights to their subsidiaries experience greater agency costs due to conflicts of interest, whereas the information loss due to overcentralization is not

that substantial.

[Insert Table 10 here]

We try to explore the insignificant relation between overcentralization (*AbDIneg*) and performance. The negative effect of overcentralization is primarily due to the information loss under centralization, which we conjecture may vary across companies. Gallemore and Labro (2015) suggest that the effect of internal information quality is stronger for companies with greater coordination needs. Because large companies tend to have more complicated business (Grossmann, 2007) and thus greater coordination needs, the negative effect of information loss due to overcentralization may be stronger for such companies. To test this conjecture, we perform the analysis with a sample of companies of relatively larger size (top 30% of total assets). Untabulated results show that overcentralization only leads to an adverse effect on future performance for large firms.

Conclusions

We use more than a decade's data on China's A-share listed companies to examine the relation between environmental factors and decentralization. We find that group companies operating in volatile business environments tend to allocate more decision rights to their subsidiaries because local knowledge is more valuable in such companies, whereas the groups that have high-quality internal information are more centralized due to effective communication within the group. Furthermore, a mismatch between power structure and environmental factors harms future performance, especially in cases of overdecentralization.

This paper suggests that environmental factors are important determinants of power structure, and a mismatch in this regard can reduce future profitability and thus hurt the interest of stockholders.

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Table 1. Descriptive Statistics and Correlations

Panel A: Descriptive Statistics

Variables	Mean	StdDev	Min	Median	Max
DI	-0.056	0.220	-0.747	-0.023	0.523
AbDI	0.154	0.143	0.000	0.108	0.836
EU	0.317	0.216	0.032	0.268	1.217
IQ	-0.247	0.060	-0.329	-0.247	-0.077
Size	21.650	1.178	19.240	21.51	25.330
Lev	0.486	0.196	0.062	0.497	0.904
MB	3.398	3.089	0.662	2.441	20.710
Age	2.483	0.415	1.386	2.565	3.219
SOE	0.555	0.497	0.000	1.000	1.000
Diversify	0.584	0.493	0.000	1.000	1.000
After	0.682	0.466	0.000	1.000	1.000
ROA	0.000	0.056	-0.275	0.000	0.182
ROE	-0.019	0.175	-1.229	0.000	0.334
ROS	-0.004	0.166	-1.162	0.000	0.536

This table reports descriptive statistics based on 16,062 observations over the period from 2002 to 2013. Refer to Appendix B for variable definitions.

Table 1. Descriptive Statistics and Correlations (Cont')

Panel B: Correlations

	DI	*AbDI*	*EU*	*IQ*	*Size*	*Lev*	*MB*	*Age*	*SOE*	*Diversify*	*After*	*ROA*	*ROE*	*ROS*
DI	1.000	-0.220**	0.056**	-0.011	-0.134**	-0.078**	0.052**	0.008	0.045**	0.068**	-0.123**	-0.031**	-0.045**	-0.039**
AbDI	-0.026**	1.000	0.015	-0.016*	-0.007	0.047**	0.019*	0.01	-0.053**	0.029**	0.027**	-0.044**	-0.037**	-0.035**
EU	0.047**	0.044**	1.000	0.049**	0.074**	0.177**	0.137**	0.072**	-0.015	0.060**	-0.054**	0.073**	0.074**	-0.011
IQ	-0.015	-0.01	0.054**	1.000	-0.023**	-0.058**	0.034**	-0.085**	0.037**	-0.031**	-0.046**	0.218**	0.194**	0.169**
Size	-0.149**	-0.041**	0.132**	0.004	1.000	0.317**	-0.330**	0.159**	0.257**	0.067**	0.234**	0.112**	0.153**	0.112**
Lev	-0.083**	0.034**	0.196**	-0.071**	0.321**	1.000	0.125**	0.189**	0.147**	0.103**	-0.025**	-0.339**	-0.214**	-0.292**
MB	0.049**	0.044**	0.095**	0.044**	-0.377**	-0.003	1.000	0.073**	-0.097**	-0.039**	0.171**	-0.020*	-0.134**	-0.070**
Age	0.011	0.017*	0.032**	-0.081**	0.186**	0.179**	0.019*	1.000	0.046**	0.183**	0.379**	-0.073**	-0.040**	-0.034**
SOE	0.052**	-0.050**	0.004	0.052**	0.249**	0.142**	-0.140**	0.040**	1.000	0.001	-0.095**	-0.042**	-0.016*	-0.016*
Diversify	0.068**	0.036**	0.071**	-0.030**	0.071**	0.102**	-0.035**	0.183**	0.001	1.000	0.028**	-0.040**	-0.004	-0.025**
After	-0.115**	0.007	-0.074**	-0.030**	0.233**	-0.020*	0.216**	0.399**	-0.095**	0.028**	11.000	0.055**	0.057**	0.086**
ROA	-0.021**	-0.041**	0.120**	0.253**	0.077**	-0.364**	0.117**	-0.110**	-0.068**	-0.050**	0.008	1.000	0.832**	0.783**
ROE	-0.056**	-0.046**	0.202**	0.257**	0.181**	-0.074**	0.144**	-0.067**	-0.035**	-0.023**	0.0110	0.895**	1.000	0.716**
ROS	-0.034**	-0.041**	0.062**	0.210**	0.034**	-0.391**	0.088**	-0.095**	-0.110**	-0.053**	0.018*	0.816**	0.704**	1.000

Pearson (Spearman) correlations are presented above (below) the diagonal. * and ** indicate significance at two-tailed probability levels of 5%, and 1%. Refer to Appendix B for variable definitions.

Table 2. Sample Distribution of Decentralization Index (*DI*)

Panel A: By Year

Year	N	Mean	Median
2002	881	-0.006	-0.004
2003	960	-0.002	-0.004
2004	1,027	-0.011	-0.003
2005	1,100	-0.018	-0.004
2006	1,145	-0.040	-0.013
2007	1,229	-0.049	-0.019
2008	1,334	-0.062	-0.025
2009	1,373	-0.067	-0.023
2010	1,476	-0.070	-0.033
2011	1,734	-0.080	-0.034
2012	1,863	-0.085	-0.039
2013	1,940	-0.091	-0.050

Panel B: By Industry

Industry	N	Mean	Median
Agriculture (A)	339	0.022	0.019
Mining (B)	361	-0.162	-0.111
Manufacturing (C)	9,526	-0.066	-0.031
Electricity, Gas, and Water (D)	621	-0.080	-0.056
Construction (E)	363	-0.163	-0.114
Transportation and Warehousing (F)	630	0.031	0.018
Information Technology (G)	1,001	0.011	0.007
Wholesale and Retail Trade (H)	1,084	-0.089	-0.047
Real Estate (J)	803	-0.052	-0.014
Public Services (K)	484	0.026	0.013
Communication and Media (L)	124	0.001	-0.006
Others (M)	726	-0.010	-0.004

This table presents sample distribution of *DI* by year (2002-2013) and industry. Industry classification follows Industrial Classification Codes for Listed Companies (Edition 2001).

Table 3. External Environmental Uncertainty, Internal Information Quality, and Decentralization

	(1)	(2)	(3)
Dependent Variable	*DI*	*DI*	*DI*
EU	0.053***		0.055***
	(6.51)		(6.65)
IQ		-0.067**	-0.077***
		(-2.39)	(-2.73)
Size	-0.015***	-0.013***	-0.015***
	(-7.67)	(-6.94)	(-7.64)
Lev	-0.077***	-0.074***	-0.079***
	(-7.51)	(-7.20)	(-7.69)
MB	0.003***	0.004***	0.003***
	(4.13)	(5.35)	(4.24)
Age	0.037***	0.039***	0.037***
	(7.66)	(7.93)	(7.52)
SOE	0.029***	0.028***	0.030***
	(7.93)	(7.53)	(8.03)
Diversify	0.029***	0.030***	0.029***
	(8.21)	(8.35)	(8.21)
After	-0.059***	-0.061***	-0.059***
	(-6.05)	(-6.32)	(-6.09)
Constant	0.268***	0.232***	0.249***
	(6.34)	(5.41)	(5.80)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	16,062	16,062	16,062
Adjusted R^2	0.084	0.082	0.085

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Table 4. Suboptimal Decentralization and Future Performance

	(1)	(2)	(3)
Dependent Variables	ROA_{t+1}	ROE_{t+1}	ROS_{t+1}
AbDI	-0.005*	-0.026***	-0.015*
	(-1.91)	(-2.64)	(-1.68)
ROA	0.469***		
	(58.05)		
ROE		0.267***	
		(29.14)	
ROS			0.312***
			(37.43)
Size	0.007***	0.027***	0.021***
	(14.22)	(16.16)	(14.55)
Lev	-0.044***	-0.129***	-0.161***
	(-16.25)	(-14.25)	(-19.52)
MB	0.003***	0.008***	0.008***
	(17.90)	(14.01)	(15.88)
Age	-0.005***	-0.020***	-0.011***
	(-4.33)	(-4.83)	(-3.09)
SOE	-0.001*	-0.007**	0.001
	(-1.67)	(-2.33)	(0.35)
Constant	-0.129***	-0.524***	-0.431***
	(-12.48)	(-14.37)	(-13.35)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	13,770	13,770	13,770
Adjusted R^2	0.308	0.115	0.178

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Table 5. Environmental Uncertainty, Information Quality, and Decentralization: Further Tests on *DI* Measures

Panel A: Controlling *Ind_RelEff*

Dependent Variable	*DI*
EU	0.055***
	(6.73)
IQ	-0.078***
	(-2.75)
Ind_RelEff	-0.007***
	(-3.37)
Control variables	Included
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	16,062
Adjusted R^2	0.085

Panel B: Subsample Regression Deleting Parent Companies without Operating Activities

Dependent Variable	*DI*
EU	0.054***
	(6.46)
IQ	-0.076***
	(-2.66)
Control variables	Included
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	15,915
Adjusted R^2	0.085

Panel C: Subsample Analyses based on Relative Scale

	High *Rel_scale*	Low *Rel_scale*
Dependent Variable	*DI*	*DI*
EU	0.128***	0.055***
	(11.26)	(4.80)
IQ	-0.093***	-0.103**
	(-2.83)	(-2.37)
Control variables	Included	Included
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	8,034	8,028
Adjusted R^2	0.152	0.090

High (Low) *Rel_scale* includes the companies with *Rel_scale* equal to or higher than (lower than) annual median.

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Table 6. Environmental Uncertainty, Information Quality, and Decentralization: Alternative Measures of *DI*

Panel A: *DIinv*1

	(1)	(2)	(3)
Dependent Variable	*DIinv*1	*DIinv*1	*DIinv*1
EU	0.695***		0.695***
	(5.43)		(5.43)
IQ		-1.061**	-1.063**
		(-2.21)	(-2.21)
Control variables	Included	Included	Included
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	5,831	5,831	5,831
Pseudo R^2	0.041	0.039	0.041

Results of ordinal logistic regression of Equation 1 with *DIinv*1 as dependent variable are presented. Z-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%.

Panel B: *DIinv*2

	(1)	(2)	(3)
Dependent Variable	*DIinv*2	*DIinv*2	*DIinv*2
EU	0.170***		0.172***
	(12.75)		(12.89)
IQ		-0.107**	-0.139***
		(-2.33)	(-3.02)
Control variables	Included	Included	Included
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	15,904	15,904	15,904
Pseudo R^2	0.156	0.148	0.156

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Table 7. Environmental Uncertainty, Information Quality, and Decentralization: Alternative Measures of Variables of Interest

Panel A: Environmental Uncertainty

Dependent Variable	*DI*
*EU*2	0.079**
	(2.47)
IQ	-0.074**
	(-2.41)
Control variables	Included
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	13,916
Adjusted R^2	0.079

Panel B: Internal Information Quality

Dependent Variable	*DI*
EU	0.064***
	(5.22)
*IQ*2	-0.051**
	(-2.37)
Control variables	Included
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	7,249
Adjusted R^2	0.083

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Table 8. Environmental Uncertainty, Information Quality, and Decentralization: Subsample Regressions

Panel A: Different Time Periods

	Year 2002-2006	Year 2007-2013
Dependent Variable	*DI*	*DI*
EU	0.068***	0.049***
	(4.64)	(4.91)
IQ	-0.137***	-0.052
	(-2.91)	(-1.47)
Control variables	Included	Included
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	5,113	10,949
Adjusted R^2	0.074	0.077

Panel B: SOEs and Non-SOEs

	SOE	Non-SOE	Full Sample
Dependent Variable	*DI*	*DI*	*DI*
EU	0.058***	0.045***	0.051***
	(5.32)	(3.64)	(4.43)
*EU*SOE*			0.008
			(0.50)
IQ	-0.172***	0.038	0.021
	(-4.54)	(0.91)	(0.51)
*IQ*SOE*			-0.189***
			(-3.38)
SOE			-0.019
			(-1.27)
Control variables	Included	Included	Included
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	8,912	7,150	16,062
Adjusted R^2	0.093	0.093	0.085

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Table 9. Environmental Uncertainty, Information Quality, and Decentralization: Endogeneity Issues

Panel A: Two-stage Regression

	First Stage	Second Stage
Dependent Variables	*IQ*	*DI*
IQ_{t-2}	0.283***	
	(33.35)	
EU	0.005**	0.044***
	(2.05)	(4.42)
IQ		-0.366***
		(-3.18)
Control variables	Included	Included
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	11,753	11,753
Adjusted R^2	0.110	0.075

Panel B: ERP Adoption

Dependent Variable	*DI*
EU	0.063***
	(4.31)
ERP	-0.029***
	(-3.58)
Control variables	Included
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	5,113
Adjusted R^2	0.074

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Table 10. Suboptimal Decentralization and Future Performance: Overdecentralization and Overcentralization

	(1)	(2)	(3)
Dependent Variables	*ROA* $_{t+1}$	*ROE* $_{t+1}$	*ROS* $_{t+1}$
AbDIpos	-0.015***	-0.073***	-0.048***
	(-3.91)	(-5.37)	(-3.98)
AbDIneg	-0.001	-0.003	0.002
	(-0.18)	(-0.28)	(0.18)
ROA	0.468***		
	(57.90)		
ROE		0.265***	
		(28.92)	
ROS			0.311***
			(37.28)
Control variables	Included	Included	Included
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	13,770	13,770	13,770
Adjusted R^2	0.308	0.116	0.179

T-statistics are reported in parentheses.*, **, and *** indicate significance at two-tailed probability levels of 10%, 5%, and 1%. Refer to Appendix B for variable definitions.

Appendix A. *DI* and Different Power Structures

		Group 1- all external sales by the parent		Group 2 - most external sales by the parent		Group 3 - 50% external sales by the parent and 50% by the subsidiaries		Group 4 - all external sales by the subsidiaries	
		Parent	Sub.	Parent	Sub.	Parent	Sub.	Parent	Sub.
External	Buy	$ 200	$ 200	$ 200	$ 200	$ 200	$ 200	$ 200	$ 200
	Sales	500	0	375	125	250	250	0	500
Internal	Buy	250	0	125	0	0	0	0	250
	Sales	0	250	0	125	0	0	250	0
Parent	Expense	450		325		200		200	
	Sales	500		375		250		250	
Consolidated	Expense	400		400		400		400	
	Sales	500		500		500		500	
DI		-0.56		-0.28		0		0	

As shown in the table, we assume that there are four groups whose parent company and subsidiaries both have the capacity to processing $200 external purchases, and the external selling price for these purchases is $250. Thus, the normal purchase (sales) volume for the parent company and its subsidiaries is both $200 ($250). Each group has $400 consolidated purchases and $500 consolidated sales. The relative assets within the group are also the same across the groups.

Group 1: External sales are completely concentrated in the parent company (the subsidiaries only making internal sales to the parent).

Group 2: External sales are mostly concentrated in the parent company (the subsidiaries selling a half to the parent, and a half to the market).

Group 3: External sales are not concentrated in either the parent company or the subsidiaries (no internal transactions).

Group 4: External sales are completely concentrated in the subsidiary companies (the parent only making internal sales to the subsidiaries).

For group 1 and 2, external sales are concentrated toward the parent company and the degree of concentration changes in a descending order. We can see that *DI* can correctly show group 1 is more concentrated than group 2, and they both are more concentrated than group 3 where there is no concentration.

For group 4, external sales are concentrated toward the subsidiary companies, and thus it is more decentralized than group 3. Nonetheless, *DI* does not distinguish these two groups.

Appendix B. Variable Definitions

Variables	Definitions
DI	Decentralization index of operating activities.
*DIinv*1	Decentralization index of investing activities.
*DIinv*2	Decentralization index of capital investment.
EU	Environmental uncertainty, defined as the coefficient of variation in sales over the prior five years ending in current year.
*EU*2	Environmental uncertainty, equal to the standard error of the coefficient from regressing sales against time over the previous five-year period, divided by average sales for the same period.
IQ	Internal information quality, defined as earnings announcement speed, which is the number of days between the end of fiscal year and earnings announcement date, divided by 365 and multiplied by minus one.
*IQ*2	Internal information quality, equal to one if the company did not report a material weakness in current fiscal year, and zero otherwise.
ERP	Indicator for ERP system, equal to one if the company has ERP system in a specific year and zero otherwise.
Size	Natural logarithm of total assets.
Lev	Total liabilities divided by the total assets.
MB	Market-to-book ratio, equal to market value of common equity divided by book value of equity.
Age	Natural logarithm of the number of years that the company has been in business.
SOE	Indicator for state-owned companies, equal to one for state-owned companies and zero otherwise.
Diversify	Indicator for diversified companies, equal to one for companies having sales in two or more industries, and zero otherwise.
After	Indicator for the adoption of new accounting standards in 2007, equal to one for the years later than 2007 (inclusive) and zero otherwise.
Ind_RelEff	Industry mean of relative efficiency of parent company and its subsidiaries, and relative efficiency is calculated as parent's asset turnover divided by consolidated asset turnover.
Rel_scale	Relative size of parent company, defined as operating assets owned by parent company divided by the consolidated assets.
ROA	Return on assets, equal to net income divided by total assets.
ROE	Return on equity, equal to net income divided by shareholders' equity.
ROS	Return on sales, equal to net income divided by sales.
AbDI	Suboptimal decentralization, equal to the absolute value of residuals from Equation 1.
AbDIpos	Overdecentralization, equal to the absolute value of residuals from Equation 1 if residuals are positive, and zero otherwise.
AbDIneg	Overcentralization, equal to the absolute value of residuals from Equation 1 if residuals are negative, and zero otherwise.