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Abstract

Headquarters play an important role in modern companies, but the downsizing of headquarters is often advocated as a way to improve organizational efficiency. The size of headquarters is closely related to the centralization/decentralization of decision making, and a theoretically optimal level of (de)centralization depends on various conditions. Using a panel of more than 40,000 Japanese companies for the period 2001-2011, this paper empirically analyzes the determinants of the size of headquarters functions and their effect on productivity. The major results of this study are as follows. First, the cross-sectional dispersion of the size of headquarters functions is very large even within an industry. Second, company size, diversification of business activities, and the number of establishments are negatively related to the size of headquarters functions, suggesting that the growth and complication of businesses lead to decentralization of decision making. Third, the information and communications technology (ICT) network inside a company reduces the size of headquarters functions, although the magnitude of this effect is small. Fourth, headquarters functions contribute positively to a company's total factor productivity (TFP). Finally, ICT network and headquarters functions have a complementary role in productivity.

Keywords: Headquarters, Centralization, Decentralization, ICT network, TFP
JEL classifications: D23, L22, L25, M10

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Are Large Headquarters Unproductive? Evidence from a Panel of Japanese Companies

1. Introduction

Using a large panel data from more than 40,000 Japanese companies for the period 2001-2011, this paper empirically analyzes the determinants of the size of headquarters functions and their effect on productivity.

Headquarters play an important role in modern companies. As the core service sector inside companies, headquarters conduct a wide range of highly strategic activities, including the choice of business areas, the decision to introduce new products and services, the adoption of investment projects, human resources management, and financial management. Headquarters functions are the indirect business units behind direct activities, such as production in the manufacturing sector and selling in wholesale and retail. Because the costs of headquarters functions are treated as the selling, general, and administrative (SG&A) expenses in the current accounting standards, reducing these indirect costs is often regarded as an effective measure to improve profitability and productivity. In particular, during economic downturns, SG&A expenses are likely to be the target of cost reductions. However, headquarters functions executed in the general affairs, personnel, and accounting departments are not simple routine tasks. Their quality and quantity may determine the excellence of managerial decision making and, as a result, companies' overall performance.[1]

The role of headquarters functions is closely linked with the productivity of white-collar workers.[2] Partly because the productivity of white-collar workers is hard to measure, there is a prevailing myth that white-collar workers have low productivity. However, given the trend toward a knowledge-intensive industrial structure and offshoring production activities to low-wage countries, white-collar workers engaged in headquarters functions may play important roles for the competitiveness of companies in advanced countries.

Recent studies have made clear that intangible assets contribute significantly to the productivity of companies, industries, and the economy. In estimating the value of intangible assets, executives' salaries and bonuses are often used as a measure of investment in "organizational capital"—an element of intangible assets (e.g., Corrado et al., 2009; Fukao et al.,

[1] Foss (1997), for example, points out that headquarters, by exploiting economies of scope and other synergies and in building up internal capital markets, may "create the positive" rather than merely "avoid the negative."

[2] Radner (1993), one of the representative theoretical papers on organizational decentralization, states that roughly one third or more of the U.S. workforce are managers and those who support managerial functions.

2009). The relatively low level of executive compensation (e.g., Goergen and Renneboog, 2011, for an international comparison of CEO compensation) and the relatively large headquarters size (e.g., Collis et al., 2007) of Japanese companies compared with the U.S. and European companies suggest that the workforce in headquarters and executives of Japanese companies participate in important managerial decision-making. If organizational capital contributes to the company performance, not only the costs for executives but also SG&A expenses related to headquarters functions that support senior executives can be regarded as part of intangible investments.

The optimal size of headquarters is closely related to the centralization of decision making. In other words, the more that decision rights are delegated to separate business units such as individual factories and shops, the lighter the burden on the headquarters will be. In this sense, the size of headquarters functions can be regarded as a good proxy for the degree of centralization.[3] Many theoretical studies on the trade-off between centralization and decentralization of decision-making have been conducted. According to these studies, both centralization and decentralization have costs and benefits, and the optimal level of centralization depends on various company characteristics. In other words, large headquarters are not necessarily inefficient from a theoretical point of view.

The size of headquarters functions is also related to the impact of information and communications technology (ICT) on organizational structure, as the use of ICT may strengthen the advantage of centralization to headquarters through quick and efficient communications with business units and establishments within a company. Another aspect of ICT may promote decentralization to the individual units by superior information processing at the local level (Bloom et al., 2013). This paper addresses the relationship between the size of headquarters functions and the use of ICT.

International comparative studies have shown that Japanese companies are unique in their relatively large headquarters (Collis et al., 2007) and low degree of decentralization (Bloom et al., 2010a, 2012). A possible interpretation of these distinct characteristics is that under Japanese style management, with practices such as long-term employment and frequent rotation of employees operated by personnel affairs departments (Aoki, 1990), headquarters have strong control over individual business units and establishments. However, formal empirical studies on the headquarters of Japanese companies have been scarce in the economics literature.

Against these backgrounds, this paper, employing panel data from the Basic Survey of Japanese Business Structure and Activities (Ministry of Economy, Trade and Industry: METI)

[3] Acemoglu et al. (2007), for example, measure the degree of decentralization as whether different units of the firm are organized into “profit centers.” Our interpretation that the size of headquarters functions is a good proxy for centralization is similar to their idea.

for the period 2001-2011, empirically analyzes the determinants on the size of headquarters functions and their effect on total factor productivity (TFP). The novel contributions of this paper are as follows. First, while there are case studies and international comparisons in the business and management literature, econometric studies on headquarters have been limited and, in particular, studies on the relationship between headquarters functions and productivity are—to the best of our knowledge—almost nonexistent. Second, from the viewpoint of productivity studies on the service sector, past micro-level studies generally analyze companies or establishments classified in the service industry as analytical units. This paper contributes to the literature by focusing on the service sector inside companies and its relationship with TFP that has not previously been explored. Third, empirical studies on centralization/decentralization of decision making have progressed recently through collection of data using extensive interviews and manager surveys. However, these studies depend on discrete measures of respondents, and generally provide a cross-sectional analysis. This paper complements the previous literature by focusing on the size of headquarters functions—an objective and continuous measure of centralization. The availability of long-term panel data is also an advantage of using this measure as a proxy for centralization.

The major findings of this paper can be summarized as follows. First, the mean size of headquarters functions is stable during the sample period, but the cross-sectional dispersion of the size is very large even within an industry. Second, company size, diversification of business activities, and the number of establishments are negatively related to the size of headquarters functions, suggesting that the growth and complication of businesses lead to decentralization of decision making. Third, the information and communications technology (ICT) network inside a company reduces the size of headquarters functions, although the magnitude of this effect is small. Fourth, headquarters functions contribute positively to the total factor productivity (TFP) of the companies. This result is robust after accounting for a potential endogeneity in the size of headquarters functions. Finally, ICT network inside a company and headquarters functions have a complementary role for productivity.

The rest of this paper is structured as follows. Section 2 reviews the literature. Section 3 explains the method of analysis and the data used in this paper. Section 4 reports the descriptive findings on the size of headquarters functions followed by the results on the determinants of the size of headquarters functions. Section 5 presents the results regarding the relationship between the headquarters functions and productivity. Finally, Section 6 concludes with policy implications.

2. Literature Review

In the field of management literature, companies' headquarters have attracted attention for a long time dating back to the discussion about the advantage of unitary (U-form) and multidivisional (M-form) organizations (Chandler, 1962; Williamson, 1975, 1985). Since then, a large number of case studies on the organizational structure of big companies have been conducted. In this line of study, Collis et al. (2007) provide a recent international comparative analysis based on an original survey of more than 600 big companies located in four European countries, the U.S., Japan, and Chile on the organization and staffs of their headquarters. They find a wide variation in the size of headquarters (the number of employees) after accounting for the absolute size of the companies. They also indicate that the industry, geographical scope, degree of diversification, and ownership structure are important determinants of the size of headquarters and that the size of headquarters has a positive association with the companies' profitability (ROA). Based on these findings, they argue that simply reducing the size of headquarters does not guarantee an improvement in company performance. Interestingly, they show that, at the mean and median, Japanese companies have the largest headquarters among their sample of seven countries.

While the subject is not the size of headquarters, studies on the relationship between the selling, general, and administrative (SG&A) expenses and the performance of companies (e.g., Lev and Radhakrishnan, 2005; Tronconi and Marzetti, 2011; Eisfeldt and Papanikolaou, 2013) have similarity in motivation to our study. Eisfeldt and Papanikolaou (2013), for example, use SG&A expenses as a proxy for intangible investments, and find positive associations with the measures of company performance (productivity, Tobin's q) and the management quality (Bloom and Van Reenen, 2007). Nakajima (2000) is an example of studies for Japanese companies with similar motivation to ours, although the subject is the productivity of white-collar workers, including those working outside headquarters. Specifically, using a panel of listed companies belonging to the three manufacturing industries, he shows that white-collar workers contribute positively to the companies' TFP growth.

As mentioned in the introduction, the optimal size of headquarters functions is related to the centralization/decentralization of decision making. A large number of theoretical analyses on centralization and decentralization have been conducted from the viewpoints of transaction cost theory and incentive theory (e.g., Bolton and Dewatripont, 1994; Garicano, 2000; Hart and Moore, 2005). Mookherjee (2006) is a representative survey on the theoretical literature. Bloom et al. (2010), Gibbons and Roberts (2012), and Aghion et al. (2013) are excellent surveys covering both theoretical and empirical studies on this topic. To summarize, both centralization and decentralization have their costs and benefits, and the optimal level of centralization/decentralization depends on various company characteristics. When the

coordination among business units or establishments is necessary, the benefits of centralization outweigh the costs and, as a result, the role of the central headquarters will be greater. Conversely, when the collection of information at the local level and quick response to the market changes are important, the benefits of decentralization increase and the role of the central headquarters will be smaller.

Colombo and Delmastro (2004) and Bloom et al. (2010b, 2012) are the empirical studies on the centralization/decentralization of decision making. Using survey data for Italian manufacturing plants, Colombo and Delmastro (2004) empirically test theoretical predictions on the determinants of the allocation of decision making authority in organizations. They indicate that multi-plant organization and business diversification have negative associations with decentralization, but that the adoption of advanced communication technologies (e.g., local area network) is positively related to the delegation of authority from headquarters to plant managers. Using data on the delegation of decision making from CEO to plant managers taken from an original survey of approximately 4,000 manufacturing companies across 12 countries in Europe, North America, and Asia, Bloom et al. (2010b) indicate that greater product market competition increases the degree of decentralization. Using the same data as their 2010 study, Bloom et al. (2012) find that companies headquartered in high-trust countries/regions are significantly more likely to decentralize. Interestingly, they show that the degree of decentralization of Japanese companies is relatively low despite the fact that Japan is a high-trust country. [4]

Studies on the centralization/decentralization of decision making and its effects on productivity often devote attention to the impact of ICT utilization. This is a natural extension because, theoretically, the costs of communication and information processing play an important role in the delegation of decision-making authority. The effects of ICT adoption have the potential to work in two opposite directions (Bloom et al., 2010; 2013): the use of ICT may strengthen the advantage of centralization through quick and efficient communications with business units and establishments within a company, but another aspect of ICT may promote decentralization to the individual units by superior information processing at the local level. Empirical studies on this subject include Bresnahan et al. (2002), Acemoglu et al. (2007), and Bloom et al. (2013) as well as the above mentioned study of Colombo and Delmastro (2004).[5] Using U.S. firm-level survey data, Bresnahan et al. (2002) find evidence of complementarity between the use of ICT and organizational innovations, including the delegation of

[4] Using detailed data of managerial job descriptions and reporting relationships in large U.S. companies, Rajan and Wulf (2006) find that hierarchies are becoming flatter. Specifically, the number of positions reporting directly to the CEO has increased while the number of levels between the division heads and the CEO has decreased. Although their study does not directly deal with centralization/decentralization, the findings are closely related to this issue.

[5] Brynjolfsson and Hitt (2000) and Garicano (2010) present surveys of the studies on this topic.

decision-making authority. Acemoglu et al. (2007) present a theoretical model on the relationship between the diffusion of new technologies and the decentralization of companies and empirically test the prediction of the theory using data for French and UK establishments. They investigate whether different units of the firm are organized into “profit centers” as the measure of decentralization. Empirical analysis supports the prediction of their theory that companies closer to the technological frontier, companies in more heterogeneous environments, and younger companies are more likely to be decentralized. These relationships are stronger among companies in high-tech industries that use ICT intensively. This study provides useful suggestions on the determinants of the size of headquarters functions. Finally, Bloom et al. (2013), using a dataset of American and European manufacturing companies, analyze the impact of ICT on worker and plant manager autonomy and span of control. They focus on the different effects that information-processing and communications technologies have on centralization/decentralization. Their results show that advanced information technologies (e.g., Enterprise Resource Planning and CAD/CAM) are associated with more decentralization, but better communications technologies (e.g., intranets) tend to centralize decision making. Following these studies, this paper considers the relationship between the use of ICT and the size of headquarters functions.

To summarize, many studies in the management literature directly focus on the role of headquarters and present interesting findings, but the limitation of these studies is their reliance on case studies and descriptive analyses for a small number of samples. In the economics literature, a large number of theoretical and empirical analyses on the centralization and decentralization of organization have been performed although the subjects are not on headquarters. Theoretical studies have made clear that the trade-offs between the necessity of coordination among business units or establishments on the one hand and the importance of information processing at the local units on the other hand determine the optimal delegation of decision-making authority. Empirical studies have found that various company characteristics such as multi-plant operations, business diversification, the degree of product market competition, and the diffusion of ICT influence the degree of centralization/decentralization. However, empirical studies generally depend on the subjective discrete measures from interviews or surveys of managers, and suffer from the limitation of the cross-sectional analyses. An advantage of our paper is its use of the size of headquarters functions—an objective and continuous measure of centralization—available from the official statistics. As a result, we can control unobservable company characteristics (fixed-effects) by using a large panel of more than 40,000 companies.

3. Data and Methodology

This paper uses micro data from the Basic Survey of Japanese Business Structure and Activities (BSJBSA: by the Ministry of Economy, Trade and Industry) for the period 2001-2011. The BSJBSA has been frequently used in empirical studies on Japanese companies. The BSJBSA, an annual survey begun in 1992[6], provides representative government statistics on all Japanese companies with 50 or more regular employees engaged in mining, manufacturing, electricity and gas, wholesale, retail, and several service industries. The purpose of the BSJBSA is to capture a comprehensive picture of Japanese companies, including their basic financial information (sales, costs, profits, book value of capital, etc.), the number of employees, R&D expenditures, IT usage, and foreign direct investment. Approximately 30,000 companies are surveyed every year, and we can easily construct a longitudinal dataset because the sample companies are coded by using unique perpetual numbers. We construct panel data for 11 years from 2001 to 2011. The reason for using data from 2001 is because that is the year the survey began to cover a large number of service industries. The total number of companies and observations are approximately 46,000 and approximately 310,000, respectively.

Regarding the headquarters functions—the focus of this paper—the BSJBSA collects information on the number of regular employees (including part-time workers) by the functional units of the headquarters and other establishments. The BSJBSA defines the "headquarters" as the establishments that manage and control the overall businesses of a company.[7] It should be stressed that the "headquarters function" is different from the "headquarters" in the BSJBSA. As the subsets of the headquarters establishments, "headquarters functions" include "research and planning," "information processing," "research and development," "international affairs," and "other (general affairs, personnel, and accounting)" functions (see Table 1). Direct production activities such as "manufacturing," "selling," and "service provision" conducted at the headquarters establishments are not classified in the "headquarters functions."[8] While the information on the composition of employees by the functional units of companies is very unique in the official statistics, these data have not been fully utilized in empirical studies.

Throughout the analysis in this paper, we define the size of the headquarters functions as the ratio of workforce engaged in the general affairs, personnel, and accounting functions

[6] The flow figures (e.g., sales, costs, and profits) of the 1992 Survey, for example, are for the fiscal year 1991 (April 1991 to March 1992).

[7] Most companies have only one headquarters, but a small number of companies (about 3% of the sample) have two or more headquarters.

[8] The categorization of the functional units of headquarters has been unchanged since the beginning of the Survey, but the classification of the direct production activities has changed several times. The current classification indicated in Table 1 has been in place since 2006.

(departments) of the headquarters divided by the total employees of the company. In other words, our definition of headquarters functions is narrower than that defined by the BSJBSA. The reason for adopting this narrow definition is because the existence and the size of the "research and planning," "information processing," "research and development," and "international affairs" functions (departments) included in the "headquarters functions" of the BSJBSA differ significantly among companies, and the majority of sample companies does not have these functional units. For example, according to the 2011 survey, of approximately 30,000 sample companies, the percentages of companies that have non-zero employees in these functions are 34.5% for "research and planning," 32.8% for "information processing," 24.8% for "research and development," and 13.6% for "international affairs," respectively. Conversely, almost all companies have general affairs, personnel, and accounting functions. In fact, 98.0% of the sample companies in the 2011 survey have a positive number of employees in the "other (general affairs, personnel, and accounting)" functions. Furthermore, the mean and median share of employees engaged in this narrowly defined headquarters functions to the broadly defined headquarters functions is 77.1% and 90.0%, respectively. Therefore, we adopt this narrow definition of headquarters functions throughout this paper as the measure of the headquarters size (denoted as *hqratio*) and use it as the key variable for the analysis.

It should be mentioned that the company level data used in this paper are not the consolidated company group level data that include subsidiaries.[9] As a result, when a company separates a factory or a store to an independent legal entity, for example, the ratio of employees engaged in direct production activities will decrease and the ratio of headquarters functions will increase. To control for this influence, we use the number of subsidiaries as an explanatory variable in the regressions to explain the size of headquarters functions.

Major independent variables to explain the size of headquarters functions (*hqratio*) are company size (log annual sales: *lnsale*), company age (years since the year of establishment: *age*), the number of establishments (*nest*), a proxy for business diversification (the number of businesses at the 3 digit industry classification: *nseg*), the number of subsidiaries (*nsub*)[10], a dummy for having a parent company (*parent*), the foreign ownership ratio (*foreign*), the ratio of part-time workers to the total number of employees (*part*), a dummy for the use of ICT network inside the company (*itnet*). Many alternative variables are available as the measure of company size, and the number of employees is frequently used in empirical studies. The reason for avoiding the number of employees as the measure of company size here is because our key variable (*hqratio*) is defined by using the number of employees. We choose to use annual sales

[9] Among the pooled sample for the years 2001-2011, 43.4% have subsidiaries (domestic or overseas) and 16.2% have overseas subsidiaries.
[10] The number of subsidiaries is the sum of domestic and overseas subsidiaries.

that are neutral to measuring the size of headquarters functions. The "parent company" is defined as a company holding more than 50% of the decision rights or a company having substantial controlling power. The ICT network (*itnet*) is defined as "local area network (LAN) constructed inside the company" in the BSJBSA. However, because this survey item was dropped in 2009, the analysis using this variable is confined to the period 2001-2008.

In the latter part of this paper, we use TFP as the dependent variable. The TFP is calculated by using value added, book value of capital, labor input (total hours), and the cost shares of capital and labor. To be more specific, the TFP is calculated in a nonparametric manner that uses a hypothetical representative company as a reference. This is the cost-share based index number method, which is developed by Caves et al. (1982) and has often been applied for TFP measurement in recent studies (e.g., Nishimura et al., 2005; Fukao and Kwon, 2006; Morikawa, 2010). In this method, the input and output of a hypothetical representative company in the base year (2001) are calculated as the geometric means of those of all companies, and the cost shares of labor and capital are calculated as arithmetic means. The TFP for each company in each year is calculated relative to the hypothetical representative company in the base year. This cost-share-based TFP index number has the advantage of ensuring the cross-section and time-series comparability of firm-level productivity and avoiding problems commonly associated with using restrictive functional forms. The value added is the sum of the operating profit, rent, wage, depreciation and paid tax. The total hours are calculated as the sum of the number of full-time employees multiplied by their industry-level working hours and the number of part-time employees multiplied by their industry-level working hours. The numbers of full-time and part-time employees are taken from the BSJBSA. Data on working hours at the industry-level are taken from the Monthly Labor Survey (Statistics Bureau, Ministry of Internal Affairs and Communications). Data on capital is the book value of tangible assets reported in the BSJBSA. The GDP deflators taken from the National Accounts (Cabinet Office) are used to calculate real values of value added and capital.

In addition to the variables explained above, year dummies and 3 digit industry dummies are included in the pooling OLS and fixed effects (FE) estimations, where the ratio of headquarters functions (*hqratio*) is the dependent variable. The baseline FE equation to be estimated is expressed as follows.

$$\begin{aligned} hqratio_{ijt} = {} & \beta_0 + \beta_1 lnsale_{it} + \beta_2 age_{it} + \beta_3 nseg_{it} + \beta_4 nest_{it} + \beta_5 nsub_{it} \\ & + \beta_6 parent_{it} + \beta_7 foreign_{it} + \beta_8 part_{it} + \varphi_{jt} + \lambda_t + \eta_i + \varepsilon_{ijt} \end{aligned} \quad (1)$$

In this equation, φ_{jt}, λ_t, and η_i represent the industry dummies, year dummies, and company fixed-effects, respectively. ε_{ijt} is the iid disturbance term. In addition to this baseline estimation,

we use ICT network inside the company (*itnet*) as an additional explanatory variable. The estimation results will be presented in Section 4.

Next, we analyze the relationship between the size of headquarters functions and productivity (TFP). We run pooling OLS and FE estimations where the dependent variable is the TFP and the main explanatory variable is the ratio of headquarters functions (*hqratio*). Control variables are company size (*lnsale*), company age (*age*), the ratio of part-time workers to the total number of regular employees (*part*), industry dummies, and year dummies. The baseline FE equation to be estimated is as follows. φ_{jt} , λ_t, η_i, ε_{ijt} are the same with the equation (1).

$$TFP_{ijt} = \beta_0 + \beta_1 lnsale_{it} + \beta_2 age_{it} + \beta_3 part_{it} + \beta_4 hqratio_{it} + \varphi_{jt} + \lambda_t + \eta_i + \varepsilon_{ijt} \quad (2)$$

In this equation, among the explanatory variables, the inclusion of *part* has two purposes: 1) adjustment of the difference in the quality of workers, 2) controlling for the possible measurement error of the TFP. Because the BSJBSA does not have detailed information on the characteristics of the workforce, we are unable to include detailed employee characteristics such as gender, age, education, and tenure. In addition, as explained already, we use industry level working hours in calculating the TFP, meaning that the TFP may be mismeasured by the difference in working hours among companies in the same industry. We expect that the ratio of part-time workers partially controls the difference in the quality of workforce and the heterogeneity of working hours. In fact, as shown later, the estimated coefficients for *part* are negative and highly significant.

As we have seen in Section 2, past studies on the centralization/decentralization of decision making and its effects on productivity often pay special attention to the influence of ICT utilization. To address this point, we include a dummy for the use of ICT network inside the company (*itnet*) and its interaction with the size of headquarters functions (*hqratio*itnet*) as additional variables (equation (3)). If the estimated coefficient for the interaction term (β_6) is positive, the use of ICT network and the size of headquarters functions have a complementary role for the TFP.

$$TFP_{ijt} = \beta_0 + \beta_1 lnsale_{it} + \beta_2 age_{it} + \beta_3 part_{it} + \beta_4 hqratio_{it} + \beta_5 itnet_{it} + \beta_6 hqratio_{it} * itnet_{it} + \varphi_{jt} + \lambda_t + \eta_i + \varepsilon_{ijt} \quad (3)$$

Next, to see the nonlinear relationship between the headquarters functions and the TFP, we include the square term of the ratio of headquarters functions (*hqratiosq*) as an additional variable (equation (4)). If the estimated coefficient for *hqratio* (β_4) is positive and *hqratiosq* (β_5)

is negative, there is an optimal size of the headquarters functions.

$$TFP_{ijt} = \beta_0 + \beta_1 lnsale_{it} + \beta_2 age_{it} + \beta_3 part_{it} + \beta_4 hqratio_{it} + \beta_5 hqratiosq_{it} + \varphi_{jt} + \lambda_t + \eta_i + \varepsilon_{ijt} \quad (4)$$

We can control unobservable company characteristics by including company fixed-effects, which greatly reduces omitted variable bias. However, we cannot rule out a reverse causality running from productivity to the size of headquarters functions. To verify the direction of causality running from the size of headquarters functions to productivity, we employ a standard instrumental variable approach and conduct the two-stage least squares (2SLS) and fixed-effects instrumental variable (FE-IV) estimations. For this purpose, it is necessary to find an instrument that is correlated with the size of headquarters functions but uncorrelated with the error term of the TFP estimation. In this paper, we use the industry (3-digit) average ratio of headquarters functions for each year (*hqind*) as the instrument for *hqratio* of the individual companies. This instrument represents industry-year specific shocks to the size of headquarters functions. We conjecture that the size of headquarters functions depends on the industry characteristics of production technology and government rules and regulations or business practices specific to the industry. For example, companies operating in an industry where market conditions frequently change must delegate decision-making authority to the local units to ensure quick response to the market. As a result, optimal size of headquarters functions should become smaller. Another example is that the companies operating in a highly regulated industry must deal with a variety of paperwork and coordination activities to cope with the regulators at the central level, leading to larger headquarters functions. In fact, as we will show later, this instrument has a strong correlation with the size of headquarters functions of individual companies. Conversely, this instrument is plausibly exogenous because individual companies cannot directly control the industry average size of headquarters functions.

4. Determinants of the Size of Headquarters

Before presenting regression results, it is worth giving an overview of the descriptive statistics concerning the time trend and the distributional characteristics of the size of headquarters functions defined in the previous section. Column (1) of Table 2 shows the trend of the mean ratio of headquarters functions for the entire sample companies. Throughout the period of the analysis, the ratio is fairly stable: between 8.5% and 8.8%. However, the figures may be

affected by the entry into and exit from the sample. Column (2) of Table 2 indicates the figures for the restricted subsample companies that continuously appear from 2001 to 2011. The absolute ratios and the time-series trend of this subsample are essentially similar to those for the full sample. We do not observe a downsizing trend of the headquarters functions.

Next, Table 3 displays the means and the measures of distribution of the size of headquarters functions by industry. The figures are calculated from the pooling data for the years 2001-2011. Looking at the mean ratios, the electricity and gas industries have the largest headquarters functions followed by the wholesale industry. The size of headquarters functions is smaller in the retail and the (narrowly-defined) service industries. We should note that the dispersions of the size of headquarters functions are very large in all industries. The standard deviations are similar in size with the means, and the 90th percentile (p90) is more than 8 times larger than the 10th percentile. Cross-sectional heterogeneity in the size of headquarters functions is remarkable even within the same industry.

When we run a simple regression to explain the change in the size of headquarters functions from the previous year by the initial size, the estimated coefficient for the initial size is negative (about -0.2) and highly significant, suggesting the tendency of regression toward the mean. In other words, companies with relatively small headquarters functions expand the size, and companies with relatively large ones downsize the headquarters functions.

As we mentioned in the introduction and the literature survey, the size of headquarters functions may be positively linked to the centralization of decision making. In relation to this point, we calculate the correlation between the number of directors on the board (relative to the total number of employees) and the ratio of headquarters functions. We expect that the larger board must accompany more supporting staff at the headquarters, because the board of directors is the core entity of executing strategic decision making. According to this calculation, the larger the number of directors, the higher the ratio of headquarters functions (the correlation coefficient is 0.252 in 2011). This positive relationship is indirect evidence supporting the hypothesis that the size of headquarters functions has positive association with the centralization of decision making.

In the rest of this section, we report the estimation results of equation (1) on the determinants of the size of headquarters functions. Table 4 is the summary statistics of the major variables used in the analysis. As we often use FE estimators, both overall standard deviation and within standard deviation are presented in this table. We observe that all of the variables have significant overall and within variations.

The baseline OLS and FE estimation results are shown in columns (1) and (3) of Table 5, respectively. While there are some differences in the size of the coefficients, the OLS and FE estimation results generally exhibit similar pictures. Even after controlling for unobservable

company characteristics, most variables have statistically significant relationships with the size of headquarters functions. The coefficients for company size (*lnsale*) is negative and highly significant, indicating that the share of workforce engaged in headquarters functions is smaller in larger companies. One possible interpretation of this result is the economies of scale in headquarters functions. Another interpretation is that larger company size makes it difficult for central headquarters to control or coordinate individual businesses and, as a result, delegates decision-making rights to business units and establishments. These two interpretations are not mutually exclusive, and the negative coefficients are the results from the combination of these two mechanisms.

The coefficient for company age (*age*) is close to zero and generally insignificant. [11] Acemoglu et al. (2007) find that younger companies are more decentralized for the samples of French and UK companies, but as far as the size of headquarters functions is used as a proxy for centralization, we do not observe a significant relationship between age and the delegation of decision-making rights for our sample of Japanese companies.

The coefficients for the degree of business diversification (*nseg*) and the number of establishments (*nest*) are negative and highly significant both in the OLS and FE estimations. In other words, after controlling for other company characteristics, including company size, diversified companies and companies holding a large number of establishments tend to have smaller headquarters functions. Theoretically these variables have two opposite effects on the size of headquarters functions: 1) a greater necessity to coordinate among business units or establishments may increase the size of the central management, but 2) a wide variety of businesses or a large number of establishments may enhance decentralization due to the limit of central monitoring and control. The estimation results suggest that the latter mechanism dominates over the former one. [12] Colombo and Delmastro (2004), for a sample of Italian manufacturing plants, report that multi-plant organizations and business diversification have negative associations with decentralization. Our results for Japanese companies have the opposite implication to their study.

The coefficients for the number of subsidiaries (*nsub*) are positive and significant at the 1% level in the OLS estimation while insignificant in the FE estimation. The OLS result suggests that companies holding a large number of subsidiaries must have greater headquarters functions.[13] It is natural to expect that companies holding subsidiaries must execute a variety of

[11] Because company age grows in parallel with year, this variable in the FE estimation is similar to the time trend.

[12] When the ratio of sales of the main business to total sales is used as an alternative measure of the degree of diversification, the estimated coefficients for this variable are positive and significant, which is consistent with the results using the number of businesses.

[13] When we divide the subsidiaries into domestic and overseas subsidiaries, only the number of

additional jobs, such as preparation of consolidated financial statements in the accounting department and human resources management related to the exchange of employees with the subsidiaries in the personnel department. While the number of establishments (*nest*) and the number of subsidiaries (*nsub*) may have similar effects on the headquarters functions, the signs of the estimated coefficients are the opposite. A likely reason for this contrast is that the number of employees belonging to the establishments of a company is included in the total number of employees—the denominator to calculate the size of headquarters functions—but that the number of employees working in the subsidiaries of a company is not. In other words, although both the numbers of establishments and subsidiaries have similar potential effects to increase the absolute size of the headquarters, in the case of the number of establishments, the opposite effect to delegate decision making— increase in the number of employees in the establishments other than the headquarters—is dominant. As a result, the estimated coefficient for *nest* is negative. Conversely, if business units are separated as subsidiaries, only the effect to burden headquarters is measured, and the estimated coefficient for *nsub* will become positive. A general lesson from the results is that it is desirable to include the number of subsidiaries as a control variable, when analyzing the role of headquarters by using individual company (not consolidated company group) level data.

The coefficients for a dummy to have a parent company (*parent*) are negative and significant both in the OLS and FE estimations. The headquarters functions of companies with a parent holding more than 50% of voting rights tend to be smaller. This result is consistent with the positive coefficient for the number of subsidiaries explained above. Because the parent company partially bears the burden of managing and coordinating the subsidiaries, the headquarters functions of the subsidiaries can be smaller.

Unexpectedly, the coefficient for the foreign ownership ratio (*foreign*) is positive and statistically significant in the OLS estimation. Namely, the size of foreign owned companies located in Japan is larger than the comparable domestic companies. As we have mentioned, international comparative studies have indicated that Japanese companies are unique in their relatively large headquarters (Collis et al., 2007) and the low degree of decentralization (Bloom et al., 2010a, 2012). It is interesting to observe that the foreign-owned companies that have smaller headquarters in their home countries have similar to or larger headquarters functions in Japan. Our interpretations are that, in order to adapt to the host country environments, including entry barriers and differences in language, headquarters of foreign-owned companies must conduct tasks specific to the host countries and that the foreign subsidiaries must bear the burden of reporting back and coordinating with the parent companies located in their home

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domestic subsidiaries is significant.

countries.

The coefficients for the ratio of part-time workers (*part*) are negative and highly significant both in the OLS and FE specifications. Furthermore the sizes of the coefficients are fairly large, indicating companies with high dependency on part-time workers tend to have smaller headquarters functions. As we have seen in Table 3, the size of the headquarters functions is relatively small for retail and service industries—industries characterized as having a large share of part-time workers. In the regression analysis industry dummies (3 digit level) are controlled, but we still observe a negative effect of the share of part-time workers on the size of headquarters functions. The BSJBSA has information about the numbers of full-time and part-time employees only at the overall company level: unfortunately, the numbers of part-time employees by the functional units of headquarters and by establishment are unavailable in our dataset. Therefore, we cannot make a concrete interpretation, but we conjecture that the part-time workers are more likely to be allocated to production, selling, and service activities of the establishments (including headquarters establishments) rather than to the core functions of the headquarters establishments.

Columns (2) and (4) of Table 5 are the estimation results where the use of ICT network inside the company (*itnet*) is added as an explanatory variable (equation (2)). As we explained in Section 3, because this survey item was dropped in 2009, the sample period of the analysis is for the years 2001-2008. While the coefficient of this variable is positive and significant in the OLS estimation, it is negative and significant in the FE estimation. That is, after controlling for unobservable company characteristics, the use of ICT tends to reduce the size of the headquarters functions. Past studies on the effects of ICT on centralization/decentralization suggest that ICT has two opposing forces to facilitate the delegation of decision making and to centralize it and that the net effect is theoretically ambiguous. The empirical result of this paper suggests that ICT tends to decentralize decision-making authority from the central headquarters to the individual units. However, the size of the coefficient is small in magnitude, meaning that the effect of ICT on the delegation of decision is quantitatively limited.

To summarize the results of this section by focusing on comparisons with past studies, while complexity of the organizational structure—diversification of businesses and the number of establishments—has theoretically two opposing effects on the delegation of decision-making authority from the central headquarters to the individual business units, the empirical results of this section indicate that the effects to decentralize is relatively strong. Past studies on the impact of ICT have suggested that information technologies are associated with more decentralization, but that communication technologies tend to centralize decision making. This paper's analysis indicates that the use of an ICT network inside a company (LAN) works as a decentralizing force, but the effect is small in magnitude. Finally, past studies indicate that

Japanese companies are unique in their large headquarters and the low degree of decentralization. However, the size of the headquarters functions of foreign-owned companies located in Japan is larger than that of the domestic counterparts.

5. The Size of Headquarters and Productivity

In this section, we report regression results on the effects of the size of headquarters functions on productivity (TFP). Columns (1) and (3) of Table 6 are the results of the baseline OLS and FE estimations (equation (2)) to explain TFP, where the size of headquarters functions (*hqratio*), company size (*lnsale*), company age (*age*), the ratio of part-time workers (*part*), year dummies, and industry dummies are used as a set of regressors. The estimated coefficients for *hqratio*, our main interest of the analysis, are positive and statistically significant at the 1% level in both the OLS and FE specifications. According to the OLS result, one standard deviation (7.7%) larger headquarters functions is associated with a 3.6% higher TFP. The size of the coefficient is somewhat smaller in the FE estimation, but one standard deviation (within: 4.2%) larger headquarters functions is associated with a 1.3% higher TFP. The results do not support a popular belief that downsizing of headquarters functions conducted in the general affairs, personnel, and accounting departments improves organizational efficiency; rather, the result suggests that strengthening the headquarters functions may contribute to the productivity of the company as a whole. Although the result cannot be interpreted as a causal relationship, estimations using instrumental variable to control possible endogeneity of the headquarters functions confirm the causality running from the headquarters to productivity, as we will show later.

The estimation results, including a dummy for the use of an ICT network inside the company (*itnet*) and its interaction with the size of headquarters functions *(hqratio*itnet*) as additional explanatory variables (equation (3)), are reported in columns (2) and (4) of Table 6. The sample period of the analysis including ICT is restricted to the years 2001-2008. The primary interest of these regressions is the coefficients for the interaction term. While the coefficients for ICT itself are negative, the coefficients for the interaction term are positive and statistically significant both in the OLS and FE specifications. In other words, the effect of adopting intra-company ICT has a positive contribution in terms of productivity only for companies with sufficiently large headquarters functions, suggesting a nuanced complementary role of ICT and headquarters functions for company performance. Based on the estimated coefficients, the overall effect of ICT is positive for companies of which the ratio of headquarters functions exceeds approximately 11% (11.5% in the OLS and 10.6% in the FE estimations, respectively). Recent

studies on the relationship between ICT and productivity note that in order to realize fully the benefit of ICT, investments in organizational capital are essential (e.g., Bresnahan et al., 2002; Brynjolfsson and Hitt, 2003; Basu et al., 2004). This paper's findings suggest that the headquarters functions are the key elements of organizational capital.

While headquarters functions play an important role for strategic decision making, it is possible that oversized headquarters functions are detrimental to company performance. To check this nonlinear relationship, we include the square term of the ratio of headquarters functions (*hqratiosq*) as an additional variable (equation (4)). The OLS and FE estimation results are presented in Table 7. As expected, the coefficient for the square term is negative and statistically significant at the 1% level both in the OLS and FE estimations, indicating a nonlinear inverted-U form relationship. In other words, there is an optimal size of headquarters functions. However, according to the estimated coefficients, the optimal size is fairly large: 45.6% in the OLS and 47.0% in the FE specifications. As we have seen in Table 3, the mean and the 90th percentile figures of the size of headquarters functions are 8.6% and 16.7%, respectively. Therefore, in most of the size distributions, greater headquarters functions are associated with higher productivity. Although it is a matter of course that the optimal headquarters size of individual companies depends on various company and market characteristics, the finding suggests that the actual size of headquarters functions is generally smaller than the optimal level.

We should be careful that the size of headquarters functions is a potentially endogeneous variable. Although the FE estimation considerably eliminates omitted variable bias, we cannot rule out the reverse causality running from productivity to the size of headquarters functions. To address the causality issue, we report the 2SLS and FE-IV estimation results where the average ratio of headquarters functions at the 3 digit industries for each year (*hqind*) is used as instrument for *hqratio* of the individual companies. The intuition of using this instrument is that the size of headquarters functions depends on the industries' technological characteristics and the government regulations or business practices specific to the industry. At the same time, this instrument is plausibly exogenous because individual companies cannot directly control the industry average. Table 8 presents estimation results. The F-values of the first-stage regression exceed 400, meaning that this instrument has a strong correlation with the individual companies' headquarters functions. In the second-stage regression results, the coefficients for the size of headquarters functions (*hqratio*) are positive and highly significant both in the 2SLS and FE-IV specifications. Moreover, the sizes of the coefficients are larger than those found in the OLS and FE estimations. These results reinforce the main conclusion of this section that the headquarters

functions positively contribute to the productivity of the company as a whole. [14]

If headquarters functions are productive, why do companies underinvest in the headquarters functions? In the OLS estimations, some omitted variables such as management quality may affect both the size of headquarters and productivity. The smaller coefficient in the FE estimation suggests that this is the case in the OLS estimation. However, even in the FE estimation and the IV estimations, the size of headquarters functions has significant positive association with the TFP. While we cannot identify the specific reasons behind this underinvestment puzzle, our interpretation is as follows: Because the costs of headquarters functions are treated as the SG&A expenses, these indirect costs are often faced with pressure to reduce unnecessary costs. Conversely, the quantitative benefits from investing in organizational capital are difficult to measure.

6. Conclusions

Headquarters functions, the core service sector inside companies, support management's strategic decision making by executing a wide range of important activities that are not simple routine tasks. However, popular belief is that the downsizing of headquarters improves organizational efficiency. By using a large panel of Japanese companies for the period 2001-2011, this paper empirically analyzes the determinants of the size of headquarters functions and their effect on productivity.

Recent studies highlight the fundamental role of "management quality" for organizational performance, but the quality of management is not determined solely by the senior executives. It is natural to expect that the quality and quantity of headquarters staff have significant influence on the quality of management. However, econometric studies on headquarters functions have been scarce. This paper, employing a large company-level panel data set and using the objective measure of the size of headquarters functions, intends to shed light on this issue.

The major findings of this paper can be summarized as follows. First, the mean size of headquarters functions is stable during the sample period, but the cross-sectional dispersion of

[14] According to the findings presented in the previous section, business diversification (*nseg*), the number of establishments (*nest*), and the number of subsidiaries (*nsub*) are significant determinants of the size of headquarters functions. We use these variables as additional instruments in the 2SLS and FE-IV estimations, but the conclusion that the size of headquarters functions has positive effect on the TFP and that the size of the coefficients are larger than the OLS and FE estimations are unchanged. Because these additional variables (*nseg*, *nest*, and *nsub*) are determined by the individual companies (not plausibly exogenous), we do not use these variables in the baseline 2SLS and FE-IV estimations presented in the text.

their size is very large even within an industry. Second, company size, diversification of business activities, and the number of establishments are negatively related to the size of headquarters functions, suggesting that the growth and complication of businesses lead to decentralization of decision making. Third, adoption of ICT network inside company reduces the size of headquarters functions, but this relationship is quantitatively small. Fourth, headquarters functions contribute positively to the TFP of the companies as a whole. This result is robust after accounting for potential endogeneity by employing instrumental variable estimations. Finally, ICT networks inside a company and the headquarters functions have a complementary role for the productivity. These results suggest that strengthening the headquarters functions generally contributes to the productivity of companies and that downsizing headquarters due to shortsighted objectives related to reducing indirect costs may be harmful for long-term company performance.

Some limitations of this study should be mentioned. While the BSJBSA is a unique set of government statistics that has detailed information on the number of employees by the functional units of the headquarters and other establishments, the data do not contain detailed information on the characteristics of the workforce, such as gender, age, education, and tenure. The difference in the quality of the workforce engaged in headquarters functions and other business units may affect the measured contribution of headquarters functions on productivity. The inclusion of the ratio of part-time workers partially controls the difference in the quality of the workforce, but it is far from perfect. To fully adjust this compositional effect, employer-employee linked data are necessary. Unfortunately, however, employer-employee linked datasets are not well developed in Japan.

Because the analysis of this paper is confined to Japanese companies, we are uncertain whether the results of this study can be generalized for companies in other countries. Past studies indicate that Japanese companies are unique in their relatively large headquarters and low degree of decentralization. Therefore, similar analysis for companies located in other countries and international comparative studies are needed.

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Table 1 Classification of Headquarters Departments in the Basic Survey of Japanese Business Structure and Activities (BSJBSA)

Headquarter		
	Headquarter functions	
		Research and planning
		Information processing
		Research and development
		International affairs
		Others (general affairs, personnel, and accounting)
	Direct production functions	
		Manufacturing, mining, etc.
		Wholesale & retail
		Restaurant
		Information service
		Services
		Other direct functions
Establishments other than headquarter		

Notes: The classification of direct production activities has changed several times. The current classification indicated in the table was adopted in 2006. The categorization of functional units of headquarters was unchanged throughout the sample period.

Table 2 Mean Ratio of the Headquarters Functions

	(1) Full sample	(2) Subsample of surviving companies
2001	8.8%	8.7%
2002	8.7%	8.7%
2003	8.6%	8.5%
2004	8.5%	8.5%
2005	8.6%	8.6%
2006	8.5%	8.5%
2007	8.6%	8.5%
2008	8.7%	8.6%
2009	8.6%	8.6%
2010	8.7%	8.7%
2011	8.7%	8.7%
Average	8.6%	8.6%

Notes: The figures are calculated from the BSJBSA. Column (1) is for the full sample. Column (2) indicates the figures for restricted subsample companies that appear continuously from 2001 to 2011.

Table 3 Ratios of Headquarters Functions by Industry

Industry	mean	sd	p10	p50	p90
Manufacturing	8.5%	7.4%	2.5%	6.4%	16.8%
Electricity & gas	13.0%	8.1%	4.1%	11.8%	23.4%
Wholesale	10.6%	8.3%	3.6%	8.6%	19.0%
Retail	6.9%	6.3%	1.5%	5.3%	13.8%
Information & communication	7.9%	6.4%	2.9%	6.5%	14.0%
Service	7.7%	8.8%	1.4%	5.4%	15.6%
Others	10.4%	8.8%	3.2%	8.1%	19.1%
All industries	8.6%	7.7%	2.4%	6.7%	16.7%

Note: The figures are calculated from the pooled data of the BSJBSA for the period 2001-2011.

Table 4 Summary Statistics

	Mean	Std. Dev.	Std. Dev. (within)	Min	Max	Observations
hqratio	0.086	0.077	0.042	0	1	307,183
lnsale	8.583	1.374	0.227	1.609	16.324	312,512
age	39.858	19.319	-	0	657	312,512
nseg	2.426	1.723	0.708	1	43	312,511
nest	12.943	54.363	16.911	1	4,458	312,510
nsub	2.984	19.175	5.988	0	1,382	312,512
parent	0.533	0.499	0.386	0	1	312,512
foreign	2.209	12.495	4.246	0	100	312,506
part	0.147	0.222	0.076	0	1	312,512
itnet	0.838	0.368	0.228	0	1	223,199
lnrtfp	-0.022	0.592	0.287	-8.016	5.926	247,184
hqind	0.086	0.019	0.007	0.010	0.238	312,511

Note: The figures are calculated from the pooled data of the BSJBSA for the period 2001-2011 (*itnet* is for the period 2001-2008).

Table 5 Determinants on the Size of Headquarters Functions

	(1) OLS		(2) OLS		(3) FE		(4) FE	
lnsale	-0.00382	***	-0.00389	***	-0.00991	***	-0.00783	***
	(0.00013)		(0.00016)		(0.00089)		(0.00089)	
age	0.00002	*	0.00000		0.00003		0.00001	
	(0.00001)		(0.00001)		(0.00003)		(0.00003)	
nseg	-0.00132	***	-0.00131	***	-0.00118	***	-0.00100	***
	(0.00008)		(0.00009)		(0.00018)		(0.00020)	
nest	-0.00006	***	-0.00006	***	-0.00006	***	-0.00008	***
	(0.00001)		(0.00001)		(0.00002)		(0.00003)	
nsub	0.00006	***	0.00005	**	0.00003		0.00006	
	(0.00001)		(0.00002)		(0.00003)		(0.00005)	
parent	-0.00462	***	-0.00518	***	-0.00124	***	-0.00104	
	(0.00033)		(0.00038)		(0.00036)		(0.00060)	
foreign	0.00022	***	0.00023	***	0.00005		0.00002	
	(0.00002)		(0.00002)		(0.00003)		(0.00004)	
part	-0.06879	***	-0.06897	***	-0.03264	***	-0.02945	***
	(0.00075)		(0.00087)		(0.00188)		(0.00209)	
itnet			0.00287	***			-0.00086	**
			(0.00043)				(0.00054)	
Year dummies	yes		yes		yes		yes	
Industry dummies	yes		yes		yes		yes	
R-squared	0.0874		0.0889		0.0096		0.0079	
Number of obs	307,174		219,528		307,174		219,528	

Notes: The figures are OLS and FE estimations using the panel data of the BSJBSA for the period 2001-2011 (Columns (2) and (4) are for the period 2001-2008). Robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6 The Size of Headquarters Functions and TFP

	(1) OLS		(2) OLS		(3) FE		(4) FE	
lnsale	0.1364	***	0.1375	***	0.3758	***	0.3976	***
	(0.0008)		(0.0010)		(0.0069)		(0.0081)	
age	-0.0053	***	-0.0052	***	-0.0009	***	-0.0004	
	(0.0001)		(0.0001)		(0.0003)		(0.0003)	
part	-0.3745	***	-0.3771	***	-0.0939	***	-0.0748	***
	(0.0059)		(0.0069)		(0.0144)		(0.0156)	
hqratio	0.4611	***	0.2442	***	0.3012	***	0.2274	***
	(0.0161)		(0.0453)		(0.0263)		(0.0553)	
itnet			-0.0287	***			-0.0132	***
			(0.0049)				(0.0055)	
*hqratio*itnet*			0.2507	***			0.1249	**
			(0.0486)				(0.0547)	
Year dummies	yes		yes		yes		yes	
Industry dummies	yes		yes		yes		yes	
R-squared	0.4029		0.3850		0.1448		0.1418	
Number of obs	243,283		176,235		243,283		176,235	

Notes: The figures are OLS and FE estimations using the panel data of the BSJBSA for the period 2001-2011 (Columns (2) and (4) are for the period 2001-2008). Robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7 Estimations Including the Square Term of the Headquarters Functions

	(1) OLS		(2) FE	
lnsale	0.1380	***	0.3771	***
	(0.0008)		(0.0069)	
age	-0.0054	***	-0.0009	***
	(0.0001)		(0.0003)	
part	-0.3601	***	-0.0872	***
	(0.0059)		(0.0143)	
hqratio	0.8898	***	0.6396	***
	(0.0301)		(0.0464)	
hqratiosq	-0.9753	***	-0.6811	***
	(0.0690)		(0.0829)	
Year dummies	yes		yes	
Industry dummies	yes		yes	
R-squared	0.4039		0.1456	
Number of obs	243,283		243,283	

Notes: The figures are OLS and FE estimations using the panel data of the BSJBSA for the period 2001-2011. Robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8 Instrumental Variable Estimation Results

	(1) 2SLS		(2) FE-IV	
lnsale	0.1446	***	0.4024	***
	(0.0016)		(0.0044)	
age	-0.0054	***	-0.0010	***
	(0.0001)		(0.0002)	
part	-0.2594	***	-0.0017	
	(0.0202)		(0.0146)	
hqratio	2.1067	***	3.0424	***
	(0.2764)		(0.3274)	
Year dummies	yes		yes	
Industry dummies	yes		yes	
R-squared	0.3644		0.0078	
Number of obs	243,283		243,283	
(First stage)				
hqind	0.9011	***	0.4832	***
	(0.0426)		(0.0214)	
F-statistic	446.56	***	509.40	***
R-squared	0.0936		0.0113	

Notes: The figures are OLS and FE estimations using the panel data of the BSJBSA for the period 2001-2011. Robust standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.