Globalization and internal corporate organization: evidence from Japanese firms

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Abstract

Recent years have witnessed that firm hierarchies are becoming flatter amid globalization. Span of control (*Span*) has broadened and the number of levels (*Layer*) within firms has declined. Motivated by these changes in the world, international trade theory has recently incorporated a rich organizational model into trade and heterogeneous firm contexts. However, empirical evidence for this theory has been so far limited because of the constrained data availability. This paper fills a part of this gap by exploiting a unique firm-level organization data in Japan, by which we can ascertain the relationship between a firm's organization and its characteristics. The globalization of firms which is measured by the foreign sales ratio has a positive link with *Span*, but it has a negative link with *Layer*. IT investment is also negatively related with *Layer*.

Key words: Globalization; Internal Corporate Organizations; Firm-level data

1 Introduction

Cross-border business activities, such as exporting and foreign direct investment (FDI) have been facilitated by trade liberalization and the development of information technology in recent year. The expansion of these global activities has been accompanied by organizational changes inside firms. The corporate structure of the firm has become increasingly complicated accelerated by reorganization of production on a global scale. For example, a multinational corporation General Electric (GE) announced that it reorganized its energy business into three separate businesses units[1]. As the three new businesses units started to report directly to the CEO, GE's organization has become "flatter". This trend of flattering firms is documented in a number of academic literature and often discussed business papers[2]. Motivated by these changes in the world, international trade theory has incorporated a rich organizational model into trade and heterogeneous firm contexts. The theory is so unique that it sheds light on corporate organization which previous heterogeneous firm literature have never taken into account. In order to understand the firm's globalization, the role of corporate organization in expanding overseas business can no longer be ignored. The goal of this paper is to empirically examine the relationship between firms' organizational characteristics and their foreign sales ratios by exploiting a unique firm-level organization data set.

The trend of the flattening firm is broken down into two components. First, CEO's span of control has increased. The CEO has been urged to quickly cope with wider, more multidivisional and complex

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[1]General Electric distributed press release titled "GE simplifies Energy business," on July, 20, 2012.

[2]Japanese major electrical company Panasonic changed its corporation to a flatter organization, as illustrated in The Nikkei Business Daily (Nikkei-Sangyo-Shinbun in Japanese) dated November 15, 2005.

problems than before. Rajan and Wulf (2006) find that CEO's span of control increased steadily from 1986 to 1998 in a sample of 300 U.S large firms. Although the number of positions reporting directly to the CEO was 4.4 on average in 1986, it keeps on increasing to 8.2 in 1998. Second, the number of layers within firms has decreased. They reported that the number of positions between the CEO and the lowest managers with profit center responsibility is decreased by more than 25% over the same period[3].

A recent theoretical model enables us to study the internal organization of firms in the globalizing world. Caliendo and Rossi-Hansberg (2012) formalize how a firm decides its internal organization, which is defined by span of control of each agent and the number of layers of management. In this model, firms face heterogeneous demands, which lead to heterogeneity in productivity, output and employement. Because the output that minimizes average cost increases with the number of layers, the optimal number of layers varies depending on the output. As a result of trade liberalization, many of the firms that sell all their output in domestic market reduce their number of layers. In contrast, many exporters increase thier number of layers of management. Other work that links international trade to internal organization of firms includes Marin and Verdier (2008, 2010). They show that increasing international trade leads to decentralized corporate hierarchies even though they do not refer to span of control of each agent and the number of layers of management[4].

Empirical studies on international trade and the internal organization remain limited. Much literature on international trade and heterogeneous firm has documented the evidence that points to the heterogeneity not in organization but in size, productivity and wages[5]. But several papers have studied the internal organization of firms. Guadalupe and Wulf (2010) using the same data as Rajan and Wulf (2006) find that increasing competition due to trade liberalization leads organizations to become flatter. Since they use tariffs as the index of the exposure to market competition for a firm, they do not distinguish between exporters and non-exporters. Similarly, Bloom, et al. (2010) analyze the effect of market competition on the organizations using 4,000 medium sized manufacturing firms across a dozen countries. They find that the degree of import penetration is associated with greater firm-level decentralization[6]. Caliendo, et al. (2012) examine the relationship between the number of layers and firms' characteristics. They divide French manufacturing firms into a collection of hierarchical layers and find that if expanding firms, including exporters, add their number of layers, these firms decrease their wages.

Despite growing literature on internal organization within heterogeneous firm, there are no studies linking internal organization with firms' global activities because of the constrained data availability. This paper exploits detailed firm-level organization data and empirically examines how internal organizations are related to firms' global activities. Since there are various reasons that firms may change their organizational structures, this study also considers simultaneously other drivers of organizational changes, among which information technology is a prominent candidate[7].

The rest of this paper is organized as follows. Section 2 describes the data. Section 3 summarizes descriptive statistics. Section 4 explains empirical specifications. Section 5 reports estimation results. Section 6 closes with final remarks.

[3]Other academic literature documenting similar tends in the internal organization of firms includes Whittington et al. (1999) and Robert (2006).

[4]Other papers, such as Antràs (2003) , Antràs and Helpman (2004) and Conco et al. (2012) analyze the firm ownership structure (integration or non-integration) in international economy.

[5]For more detailed discussion in this field, see the survey by Helpman (2013).

[6]In addition, Bloom, et al. (2012) examine the effect of trusts on the organizations across nations. They find that trust and rule of law are associated with more decentralization.

[7]Bresnahan, et al. (2002) find complementarities between IT and workplace organization, for example.

2 Description of Data

2.1 Data source

The organization data used for this paper is derived from The Handbook of Organizational and Systematical Figures (Soshikizu-Keitouzu-Binran in Japanese). This survey includes detailed information on divisions, business offices, plants, sections and titles, and their reporting relationships. The data is unique because it allows us to identify changes in hierarchies within firms. These are collected annually from a survey conducted by DIAMOND, Inc[8]. The survey participants are listed companies and typically major players in their sectors[9].

This paper focuses on two sectors, electric machinery and chemical industries. There are two reasons for choosing these industries. First, the electric machinery and chemical industries are two of the most globalized industries in Japan[10]. Second, these industries inherently have different production processes. It is useful for this study to compare different type of industries. This paper developed over a 3-year period data from 2008 to 2010. Since some firms are represented as affiliated groups, this paper loses 37% of observations and loses another 22% while cleaning the data. The resulting sample is 253 firms for each year. The previous data set to come close to this sample size is that by Rajan and Wulf (2006) and Guadalupe and Wulf (2010) on about 300 large U.S firms.

This paper limits the sample to the listed 253 firms in the two industries in each year. This sample is not close to the population of firms in each industry. However, it is appropriate for examining the relationship between organization and firms' global activities on the data. First, small and medium-sized firms tend to have simple organization with narrow spans and few layers. Caliendo, et al. (2012) show that firms with more layers are larger in terms of value added. Further, 46% of firms in their sample have only one or zero layer. Second, it is well known that exporters and FDI firms are larger than domestic firms. Therefore small and medium-sized firms which are not included in the sample tend not to both have the complex organizations such as divisional organization and engage in overseas business. Excluding those businesses are of no matter for our analysis[11].

2.2 Measures of internal organizations

Before reporting empirical results, this section discusses two measures of internal organization. The first measure, CEO's span of control, is a measure that captures a horizontal dimension of the hierarchy. It is defined as the number of divisions, business offices, plants and sections reporting directly to the CEO. Since the CEO is at the top of the lines of authority and communication, CEO's span of control reflects the concept of decision-making at the highest level. The second measure, the number of layers, represents a vertical dimension of hierarchy and is defined as the number of divisions, business offices, plants and sections between the CEO and the lowest section. These two measures have been used repeatedly by previous research such as Rajan and Wulf (2006), Guadalupe and Wulf

[8]DIAMOND, Inc. is a lage publishing company specializing in businesses and economic issues. It was established in 1933 and currently has a total staff of 223 employees.

[9]As the survey is voluntary, it is possible that firms may not report the exact organization structure because of confidentiality or space limitations in the Handbook. In spite of this limitation, this survey is unique and very valuable information for studies of internal organization.

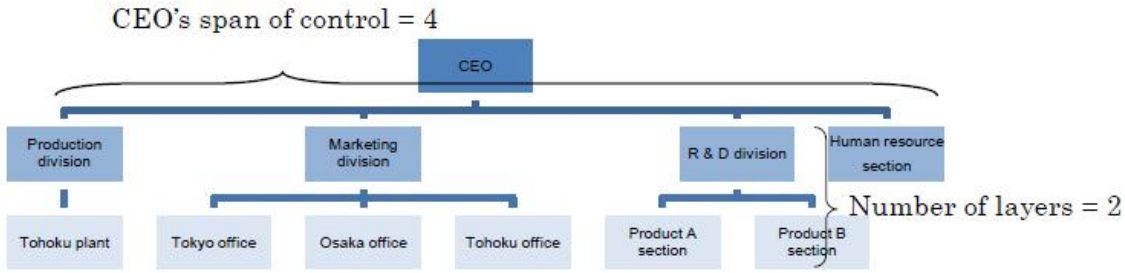
[10]Tomiura (2007) reports that electric machinery industry has the highest share of exporters, FDI firms and firms outsourcing to foreign suppliers among 22 industries in Japan. In addition, it also reports that the chemical industry has the highest percentage of exporters.

[11]Table A1 in Appendix reports statistics comparing the average of the number of employees, sales and Capital-labor ratio with Basic Survey of Japanese Business Structure and Activities (Kigyo Katsudo Kihon Chosa in Japanese). Not surprisingly, the sizes and the capital intensity in our sample are larger than those in the survey.

(2010) and Caliendo and Rossi-Hansberg (2012), although this paper substitutes the lowest section in the organization chart for the division manager[12].

Figure 1 displays an example of a hierarchy that demonstrates both measures of CEO's span of control and the number of layers. In this example, the measure of CEO's span of control is 4, since there are three divisions and one section directly connected to the CEO. On the other hand, the measure of the number of layers is 2, since there are one division and one section between the CEO and the lowest sections (in this case, the plant and the offices are the lowest).

Figure 1: An example of internal organization: CEO's span of control and number of layers



3 Descriptive statistics

3.1 Inter-industry comparisons

This section summarizes descriptive statistics derived from firm-level data. Firms are grouped by their industry. In a subsequent section, this paper will focus on characteristics of firms grouped by their involvement in export and FDI. Tables 1 and 2 present the basic statistics for CEO's span of control and the number of layers for each year respectively. Two important points emerge from these tables.

First, in the electrical machinery industry, firm hierarchies have been becoming flatter, which puts them in line with the existing evidence. CEO's span of control increases, which is 12.93 on average in 2008 and it keeps on increasing until it reaches 13.39 in 2010. On the other hand, the number of layers decreases, which is 2.30 in 2008 and it keeps on decreasing until it goes down to 2.26 in 2010. However, the same can not be seen in the chemical industry, where both CEO's span of control and the number of layers go up and down. One possible reason is that the observation period is too short to capture any long-term trend. Second, there is the possibility that the internal organizations vary across industries. For example, the chemical industry exceeds the electrical machinery industry in the number of layers. We will control for various factors in regression format to consider differences in technology or in other dimensions[13].

3.2 Inter- and Intra- industry comparisons

This section classifies firms by the volume of their export and FDI. Firms with non-zero export or FDI are defined as "globalized firms", the rest of firms which never export and invest abroad

[12]Rajan and Wulf(2006) and Guadalupe and Wulf (2010) call CEO's span of control just "Span" and the number of layers "Depth".

[13]The distributions of CEO's span of control and the number of layers are provided in Appendix.

Table 1: Descriptive statistics for CEO's span of control

Span of control										
	Electric machinery					Chemical				
Year	Mean	S.D	Min	Max	N	Mean	S.D	Min	Max	N
2008	12.93	8.87	1	67	153	13.12	8.88	3	54	100
2009	13.33	9.24	1	69	153	13.03	8.48	2	50	100
2010	13.39	9.67	1	71	153	13.39	9.27	2	51	100

Table 2: Descriptive statistics for the number of layers

Number of layers										
	Electric machinery					Chemical				
Year	Mean	S.D	Min	Max	N	Mean	S.D	Min	Max	N
2008	2.30	0.85	1	4	153	2.90	1.00	1	6	100
2009	2.28	0.88	1	5	153	2.93	0.98	1	6	100
2010	2.26	0.90	1	5	153	2.91	0.96	1	6	100

are defined as "domestic firms". Tables 3 and 4 compare globalized firms to domestic firms. Two notable differences between these two types of firms emerge from these tables.

First, internal organizations are considerably different depending on their globalized modes. Globalized firms exceed domestic firms in CEO's span of control, while domestic firms exceed globalized firms in the number of layers in both industries. Second, internal organizations have different trends depending on their globalized modes in the electric machinery industry, whose hierarchies become flatter on average as shown in Tables 1 and 2. CEO's span of control in the electric machinery industry steadily increases over the three years among globalized firms, while that of domestic firms fluctuates. On the other hand, the number of layers of globalized firms slightly increases, while that of domestic firms significantly decreases. On the whole, as we see in the previous section, the internal organization in the electric machinery industry becomes flatter. However, this trend can not be seen in the chemical industry. The evidence above is informative about the differences among firms in the same industry or with similar overseas operations, but it has been confounded by other dimensions of heterogeneity across firms. In the next section, we move to firm-level regressions controlling for various factors.

Table 3: Descriptive statistics for span of control: globalized firms vs. domestic firms

Span of control												
	Electric machinery						Chemical					
	Globalized firms			Domestic firms			Globalized firms			Domestic firms		
Year	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N
2008	13.91	9.43	118	9.63	5.59	35	14.75	10.06	67	9.82	4.28	33
2009	14.33	9.80	119	9.82	5.78	34	14.64	9.60	66	9.91	4.35	34
2010	14.55	10.33	120	9.61	5.76	36	15.11	10.20	65	10.20	4.64	35

Table 4: Descriptive statistics for the number of layers: globalized firms vs. domestic firms

Number of layers												
	Electric machinery						Chemical					
	Globalized firms			Domestic firms			Globalized firms			Domestic firms		
Year	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N
2008	2.18	0.80	118	2.71	0.89	35	2.79	1.05	67	3.12	0.86	33
2009	2.18	0.82	119	2.65	1.01	34	2.76	0.99	66	3.26	0.86	34
2010	2.21	0.88	120	2.44	0.97	36	2.75	0.87	65	3.20	1.08	35

4 Regression specification

To evaluate the effect of firm's global activities on their organizations, this paper starts by estimating the following regressions

$$Span_{ijt} = \beta_1 Foreignsales_{ijt-1} + X'_{ijt-1}\gamma + \alpha + \epsilon_{ijt} \tag{1}$$

$$Depth_{ijt} = \rho_1 Foreignsales_{ijt-1} + X'_{ijt-1}\mu + \delta + \eta_{ijt} \tag{2}$$

where i refers to a particular firm, j denotes the industry and the time period (year) is indexed by t. The dependent variables are the CEO's span of control in (1) and the number of layers in (2), respectively. The explanatory variable *Foreignsales* measures the extent to which a firm is involved in global activities. This measure is defined as the sum of export sales and sales by offshore affiliates over the total sales[14]. If a firm neither exports nor invests abroad, this ratio must be zero. X is a vector of other controls including the IT investment, the number of employees, R&D intensity, capital-labor ratio and other firm characteristics. ϵ and η are the error terms. The results from these regressions are comparable with Guadalupe and Wulf (2010) based on basically the same specifications even though they focus on the effect of import penetration on the organizations.

Equation (1) and (2) could suffer from an endogeneity problem. First, some organizational characteristics may lead firms to global activities, which results in a reverse causality problem. For example, Bloom, et al. (2012) show that more decentralized firms tend to more globally active. Second, it is possible that some omitted variables, such as management quality have an effect on both variables. In this case, the assumption that $Foreignsales$ and the error terms are independent is not held. To respond to these problems, all right-hand side variables are lagged by one year. Moreover, this paper also uses an instrumental variable, which is defined as the share of sales for North America (the United States, Canada and Mexico) in total foreign sales. The choice of this instrument is supported by the following argument: the share of foreign sales for a particular region is arguably correlated with the total foreign sales ratios while the destination composition of foreign sales is not supposed to be correlated with corporate internal organization structures[15].

[14]Hence, *Foreignsales* (Kaigai-Uriagedaka-Hiristu in Japanese) is defined as (export sales + sales by offshore affiliates) / total sales, and it is taken from Japan Company Handbook (Kaisya-Shikiho in Japane). Disaggregating *Foreignsales* into export sales and offshore sales or the volume of import is impossible due to data limitation in the Handbook.

[15]In order to check the robustness of results, the author replaces North America with Asia region including China, India, Korea, Thailand, Indonesia and has confirmed the robustness of our results.

As this paper exploits the panel nature of the data set, regressions including firm fixed effects to control for unobserved heterogeneity are as follow.

$$Span_{ijt} = \beta_1 Foreignsales_{ijt-1} + X'_{ijt-1}\gamma + \alpha_i + \epsilon_{ijt} \tag{3}$$

$$Depth_{ijt} = \rho_1 Foreignsales_{ijt-1} + X'_{ijt-1}\mu + \delta_i + \eta_{ijt} \tag{4}$$

where α_i and δ_i are the time-invariant characteristics for firm i. Firm-level data for all independent variables are taken from the securities report (Yukashoken-Hokokusho in Japanese). All listed companies are annually required to submit this publicly disclosed report to the government.

The right-hand side variables are expected to have following signs. First, *Foreignsales* is positively related with *Layer*. Caliendo and Rossi-Hansberg (2012) theoretically show that exporters increase the number of layers of management as a result of a trade liberalization. Second, IT investment is positively associated with *Span*. A number of papers such as Garicano (2000), Bresnahan, et al. (2002), Bartel, et al. (2007), demonstrate that IT is an important determinant of organizational design. Garicano (2000) predicts that a decrease in the cost of communication or the cost of acquiring knowledge increases the span of control, while they may have an ambiguous effect on the number of the layer. Third, the number of employees should be positively related with the internal organization since the larger firm has the greater internal organization. Fourth, R&D intensity might affect the internal organization. Acemoglu, et al. (2007) analyze the relationship between new technologies and organizational change. They show that firms closer to the technological frontier are more likely to choose decentralization. Therefore, this paper includes R&D-sales ratios as a measure of innovative activity. Finally, it is possible that the stock option dummy, which takes the value of one if a firm adopts the stock option, affects the internal organization. Prendergast (2002) and Wulf (2007) point out that decentralized decision-making can be coupled with higher performance pay.

This paper also includes other control variables. Capital / labor (K/L) is the typical determinant of overseas operations in the standard Heckscher-Ohlin factor proportions trade theory. Moreover, the author adds the holding company dummy, which takes the value of one if a firm is the holding company. The holding company whose aim is to own other companies' stock should have simple internal organizations. The subsidiary dummy, which takes the value of one if a firm is the subsidiary of another company, is also included, as the subsidiary organization might be different because of parent-subsidiary transactions.

5 Estimation results

This section reports our estimation results and discusses their interpretations. Table 5 displays the results of the CEO's span of control by pooled OLS, IV estimation and a fixed-effect model in all firms combined (columns 1, 2 and 3) and in each industry (columns 4-6 for the electric machinery industry and columns 7-9 for the chemical industry). The following findings are worth noting.

First, the main coefficients of interest, β is positive and statistically significant in columns 1, 4 and 7 in the OLS results. Since the coefficient β captures the effect of firms' global activities on their span of control, this finding implies that increases in the foreign sales ratio are associated with wider span of control. The signs of the results are the same in both industries and the magnitudes of estimated coefficients are also similar (0.058 and 0.050). Columns 2, 5 and 8 present the IV results confirming

that the main results remain unchanged even when using the instrument[16]. Second, the IT investment has different effects depending on the industry. The IT investment has a positive links with the span of control in the chemical industry, which is consistent with Garicano (2000). However, it has a negative link in the electric machinery industry. The same results remain in the IV estimates. One possible reason for this difference between industries is that industry combines IT with its production process differently. Products in the electric machinery industry themselves are related to IT, so measured IT investment might include investment in specific products handled in. On the other hand, the IT investment is likely to be related with corporate activities of the whole company in the chemical industry, as predicted by the theoy.

Third, the larger a firm is, the greater span of control it has, confirming the existing evidence such as Guadalupe and Wulf (2010) and Caliendo, et al. (2012).

Fourth, controlling for the firm fixed-effect reduces the statistical significance of many of the independent variables. As the detailed description of the data in tables A4 and A5 indicate, there is little variation of the internal organization within a firm across three years. Therefore, the firm-specific characteristics (the firm dummy) explain a large part of the variations in the internal organization[17].

Fifth, not surprisingly, the holding company dummy has a negative effect on the span of control. The holding company clearly tends to have narrower span of control.

Finally, other control variables are not necessarily statistically significant. Although the signs of R&D coefficient are negative and statistically significant in the whole sample, they are not significant

Table 5: Estimation results (Span of control)

	Dependent variable: Span of control								
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Industry	All industries			Electric machinery			Chemical		
Estimation method	OLS	IV	FE	OLS	IV	FE	OLS	IV	FE
Foreign sales/Total sales	0.075	0.127	-0.047	0.058	0.082	-0.017	0.050	0.175	-0.144
	[4.79]***	[3.37]***	[-1.31]	[3.27]***	[1.88]*	[-0.31]	[1.67]*	[2.00]*	[-1.81]*
Employee	1.042	0.991	-0.337	0.994	0.976	-0.494	3.985	3.005	14.398
	[6.50]***	[6.04]***	[-0.71]	[6.14]***	[5.90]***	[-1.02]	[5.62]***	[2.88]***	[1.79]*
IT/Total assets	-1.063	-0.915	-0.269	-1.642	-1.571	-0.325	8.084	7.707	0.299
	[-1.49]	[-1.20]	[-0.82]	[-2.36]**	[-2.10]**	[-0.31]	[6.79]***	[6.07]***	[1.28]
R&D/Total sales	-10.304	-11.596	1.245	-6.968	-8.062	2.645	-22.439	-36.903	-9.397
	[-2.20]**	[-2.11]**	[0.57]	[-1.52]	[-1.55]	[0.81]	[-1.45]	[-1.75]*	[-0.54]
Capital/labor (K/L)	10.332	11.665	-1.280	0.266	-0.261	0.174	22.862	37.758	9.665
	[2.14]**	[2.06]**	[-0.57]	[0.29]	[-0.03]	[0.38]	[1.43]	[1.74]*	[0.54]
Stock option Dummy	0.033	-0.008	-0.012	-0.020	-0.033	-0.023	2.379	1.303	-0.213
	[0.71]	[-0.15]	[-0.62]	[-0.48]	[-0.69]	[-0.44]	[1.09]	[0.68]	[-0.74]
Holding Dummy	-5.667	-6.008		-4.091	-3.853		-8.515	-9.034	
	[-3.39]***	[-3.15]***		[-2.25]**	[-2.20]**		[-3.76]***	[-3.66]***	
Subsidiary Dummy	0.370	0.977		1.402	1.700		-1.963	-0.561	
	[0.47]	[1.11]		[1.41]	[1.54]		[-1.55]	[-0.39]	
Electric Dummy	-1.713	-2.262							
	[-2.37]**	[-2.57]**							
Constant	10.971	9.957	15.128	9.726	9.080	14.816	8.734	7.231	4.379
	[18.87]***	[13.19]***	[12.42]***	[16.73]***	[7.34]***	[7.23]***	[14.16]***	[7.05]***	[0.66]
Adjusted R-squared	0.335	0.318	-0.004	0.417	0.413	-0.006	0.332	0.288	0.067
N	506	506	506	306	306	306	200	200	200

Note: The asterisks ***, ** and * denote the statistical significance at 1%, 5% and 10%, respectively. T statistics (in parentheses) are computed from Heteroskedasticity-robust standard errors. All explanatory variables are one-year lagged.

[16]The estimated coefficient β with IV for the electric machinery industry (column 5) is smaller than that of the chemical industry (column 8), although the sings are both positive. The difference between industries will be discussed after reporting the result on *Layer*.

[17]The F-test indicates that the null hypothesis that all the firm-specific effects are zero is rejected at the 1% significance level.

Table 6: Estimation results (Number of Layers)

Dependent variable: Number of layers									
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Industry	All industries			Electric machinery			Chemical		
Estimation method	OLS	IV	FE	OLS	IV	FE	OLS	IV	FE
Foreign sales/Total sales	-0.008	-0.018	0.005	-0.007	-0.017	0.003	-0.014	-0.025	0.013
	[-4.83]***	[-3.97]***	[0.61]	[-3.78]***	[-3.01]***	[0.31]	[-2.39]**	[-2.34]**	[0.60]
Employee	0.008	0.017	0.102	0.006	0.014	0.111	0.101	0.186	-1.076
	[1.21]	[1.96]*	[1.12]	[0.93]	[1.60]	[1.19]	[1.62]	[2.01]**	[-1.06]
IT/Total assets	-0.673	-0.700	-0.035	-0.517	-0.547	-0.043	-2.435	-2.402	0.082
	[-3.75]***	[-3.98]***	[-0.75]	[-5.60]***	[-5.08]***	[-0.80]	[-13.02]***	[-13.01]***	[0.50]
R&D/Total sales	-1.676	-1.439	-0.378	-2.009	-1.534	-0.775	-0.991	-0.264	3.184
	[-3.08]***	[-2.46]**	[-0.86]	[-3.78]***	[-2.23]**	[-1.38]	[-0.46]	[0.10]	[1.56]
Capital/labor (K/L)	1.728	1.439	0.390	0.357	1.624	0.135	1.034	-0.258	-3.280
	[3.08]***	[2.46]**	[0.86]	[0.33]	[1.07]	[0.80]	[0.46]	[-0.10]	[-1.56]
Stock option Dummy	0.034	0.041	0.003	0.037	0.042	0.007	-0.021	0.072	-0.168
	[6.32]***	[6.70]***	[0.86]	[6.76]***	[6.14]***	[1.42]	[-0.13]	[0.40]	[-0.84]
Holding Dummy	-1.022	-0.959		-0.897	-1.001		-0.804	-0.759	
	[-3.98]***	[-3.78]***		[-2.48]**	[-2.64]***		[-5.38]***	[-4.99]***	
Subsidiary Dummy	-0.404	-0.515		-0.479	-0.608		-0.293	-0.414	
	[-2.84]***	[-3.40]***		[-2.54]**	[-3.05]***		[-1.38]	[-1.66]*	
Electric Dummy	-0.455	-0.355							
	[-5.09]***	[-3.60]***							
Constant	3.116	3.302	2.240	2.665	2.946	1.991	3.162	3.292	3.561
	[40.37]***	[29.40]***	[8.64]***	[29.33]***	[21.26]***	[5.88]***	[28.22]***	[29.40]***	[3.65]***
Adjusted R-square	0.177	0.124	-0.003	0.101	0.009	0.006	0.052	0.024	-0.006
N	506	506	506	306	306	306	200	200	200

Note: The asterisks ***, ** and * denote the statistical significance at 1%, 5% and 10%, respectively. T statistics (in parentheses) are computed from Heteroskedasticity-robust standard errors. All explanatory variables are one-year lagged.

in each industry. The similar results can be seen in K/L.

Table 6 displays the results in the number of layer. The noteworthy findings are as follows. First, the coefficient of *Foreignsales* ρ is negative and statistically significant in columns 1, 4 and 7. IV estimates in columns 2, 5 and 7 produce almost the same results. This finding implies that increases in the foreign sales dependence are associated with fewer layer. Although this outcome differs from the implication form the theory by Caliendo and Rossi-Hansberg (2012), this finding is in line with the result of Bloom, et al. (2012) which show that multinationals are more likely to decentralize. Thus, the decline of the number of layers could reflect delegation[18].

Second, IT investment is significant and negatively related with *Layer*. This finding might suggest that IT investment is the driver of decreasing the number of layers. Guadalupe and Wulf (2010) find that the communication technology (CT) investment has the positive link with Layer. This difference might come from our data on IT investment where CT investment is not distinguished among IT in general.

Third, the fixed-effect model reduces the statistical significance of the independent variable, which is the same as *Span*. Fourth, R&D intensity is negatively associated with *Layer* in the whole sample and in the electric machinery, as consistent with the result by Acemoglu, et al (2007) but not in the chemical industry. One possible reason for this difference is that technology progress in the electric machinery industry is more dynamic than the chemical industry during our sample period. Finally,

[18]The magnitude of estimated coefficient ρ in the electric machinery industry is larger than that in the chemical industry in the result of *Layer*. We find larger coefficient in the chemical industry in the result of *Span*. Although this difference is partly due to the difference in the original absolute level of *Span*/*Layer*, it also implies that the organization of firms in the chemical industry tend to be more complex since the chemical industry usually spends more on R&D. The complex organization might be pressured to change for speedy decision making to cope with global activities.

the holding company dummy and subsidiary dummy have a negative effect on *Layer*, as expected.

6 Concluding remarks

This paper empirically examines how internal organizations are related to firms' global activities using firm-level data. In order to study this relationship, this paper uses firm-level data in Japan over the year 2008 to 2010. This paper first divides firms' organizations by the extent of firm's global activities and compare their features. The disaggregation shows that exporters or FDI firms exceed domestic firms in CEO's span of control (*Span*) on average, while domestic firms exceed exporters or FDI firms in the number of layers (*Layer*). Then this paper estimates firm-level regressions controlling for various factors. The major findings of regressions are threefold. First, the organizations of more globally engaged firms tend to have broader *Span*. Second, they also tend to have fewer *Layer*. Third, IT investment has a negative link with *Layer*.

The findings of this paper have important policy implications. It is widely supported by many previous literature that only productive firms are able to tap into foreign markets. Helpman, et al. (2004) predict the sorting pattern among FDI firms, exporters and domestic firms according to productivity and empirical papers such as Tomiura (2007) confirm this ordering. On the other hand, it is also evident that the organization affects the firm performance (Bresnahan, et al. (2002), Acemoglu, et al. (2007)). These two line of studies combined imply that organization could be one of the channels to link firms' global activities to their productivities. Further organizational change may make this link stronger. This paper is an attempt to focus on this unexplored link. As there are many organizational restrictions in many countries, facilitating corporate reorganizations might be useful to overcome entry barriers to exporting and FDI. For instance, improving regulations on mergers and acquisition is fruitful for potential exporters and FDI firms.

Although this paper reports informative firm-level observations, cementing the generality of this finding will be desirable in the future studies. One will also find it interesting to seek firms' organization data which are linked with trade liberalization in longitudinal format and identify the causal effect among firms' organization, international trade and their productivities.

Acknowledgment

The author is deeply grateful to the editor (Noritsugu Nakanishi), an anonymous referee, Eiichi Tomiura, Craig Parsons, Ryo Nakajima, Kiyotaka Sato, Ayako Kondo and participants of the 71th Japan Society of International Economics conference and 2013 Japanese Economic Association Spring Meeting. All remaining errors are mine. This research was partly supported by Association of Yokohama International Social Science Studies.

Appendix. Data Description

Figure A1: Span of control in 2008

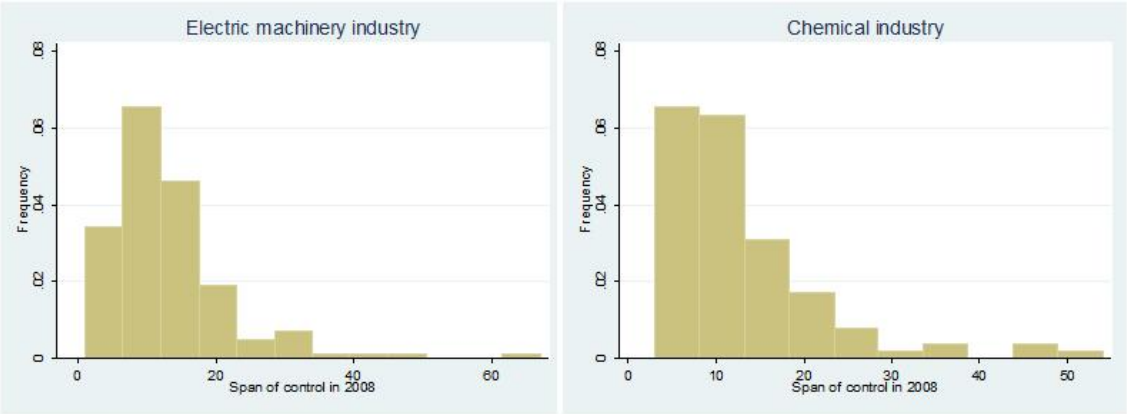


Figure A2: Number of layers in 2008

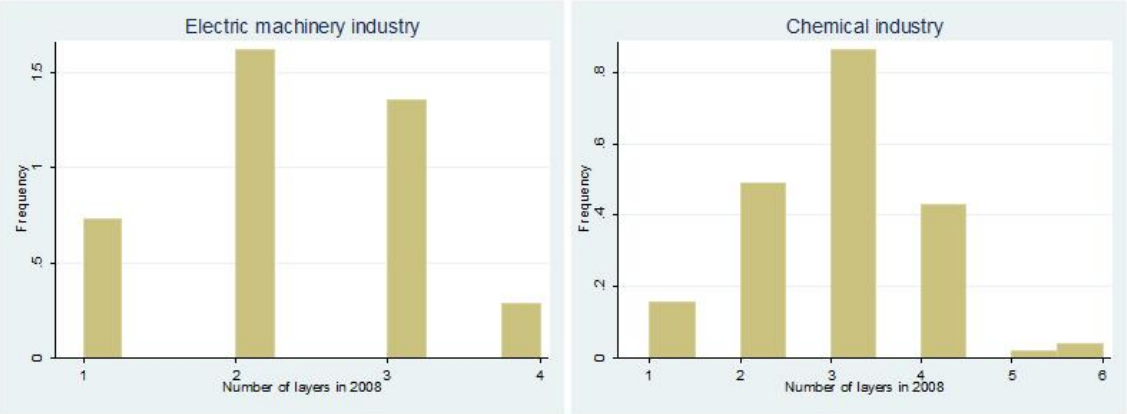


Table A1: Comparisons with the average in Basic Survey of Japanese Business Structure and Activities (BSJ)

	Electric machinery		Chemical	
	Our sample	BSJ	Our sample	BSJ
Number of employees	2,135	622	810	501
Sales	182,406	46,870	79,827	40,114
Capital/labor (K/L)	12.7	10.7	27.6	24.8

Notes: The original data of sales are in millions of yen.

Source: The securities report, Basic Survey of Japanese Business Structure and Activities

Table A2: Correlation matrix of electric machinery industry

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Foreign sales/Total sales	[1]	1.00							
Employee	[2]	0.18	1.00						
IT/Total assets	[3]	-0.01	-0.003	1.00					
R&D/Total sales	[4]	0.19	0.003	-0.01	1.00				
Capital/Labor (K/L)	[5]	0.16	0.01	-0.01	0.08	1.00			
Stock option Dummy	[6]	0.09	0.00	0.02	0.34	-0.01	1.00		
Holding Dummy	[7]	0.03	-0.05	-0.02	0.10	0.56	-0.01	1.00	
Subsidiary Dummy	[8]	-0.13	-0.04	-0.01	-0.01	-0.05	0.14	-0.05	1.00

Source: The securities report

Table A3: Correlation matrix of chemical industry

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Foreign sales/Total sales	[1]	1.00							
Employee	[2]	0.49	1.00						
IT/Total assets	[3]	0.01	-0.02	1.00					
R&D/Total sales	[4]	-0.01	-0.03	0.15	1.00				
Capital/Labor (K/L)	[5]	-0.02	-0.03	0.15	0.99	1.00			
Stock option Dummy	[6]	0.32	0.24	-0.01	-0.04	-0.04	1.00		
Holding Dummy	[7]	0.03	-0.07	-0.01	-0.01	-0.01	0.20	1.00	
Subsidiary Dummy	[8]	-0.10	-0.01	-0.01	-0.02	-0.02	0.05	-0.03	1.00

Source: The securities report

Table A4: Basic statistics of electric machinery industry

Variable		Mean	S.D.	Min	Max	Observations
Span of control	overall	13.21	9.25	1	71	N = 459
	between		9.08	1	69	n = 153
	within		1.84	-0.79	22.21	T = 3
Number of Layers	overall	2.28	0.88	1	5	N = 459
	between		0.82	1	4.33	n = 153
	within		0.32	0.95	3.61	T = 3
Foreign sales/Total sales	overall	32.66	27.33	0	100	N = 459
	between		27.22	0	100	n = 153
	within		3.01	17	44	T = 3
Employee	overall	2.15	5.64	0.01	37.28	N = 459
	between		5.64	0.01	35.16	n = 153
	within		0.34	-1.95	4.26	T = 3
IT/Total sales	overall	0.02	0.13	0	2.58	N = 459
	between		0.07	0	0.86	n = 153
	within		0.10	-0.84	1.74	T = 3
R&D/Total sales	overall	0.06	0.08	0	0.64	N = 459
	between		0.06	0	0.38	n = 153
	within		0.04	-0.17	0.43	T = 3
Capital/Labor (K/L)	overall	0.16	0.40	0	4.92	N = 459
	between		0.33	0	3.28	n = 153
	within		0.23	-2.96	1.80	T = 3
Stock option Dummy	overall	0.48	3.15	0	67.00	N = 459
	between		1.86	0	22.67	n = 153
	within		2.54	-22.19	44.81	T = 3
Holding Dummy	overall	0.02	0.15	0	1	N = 459
	between		0.15	0	1	n = 153
	within		0.04	-0.64	0.36	T = 3
Subsidiary Dummy	overall	0.10	0.30	0	1	N = 459
	between		0.30	0	1	n = 153
	within		0	0.10	0.10	T = 3

Notes: In “Observations” column, N refers to the total observations; n refer to the number of firms; T refers to the year when data are available.

Source: The securities report and The Handbook of Organizational and Systematical Figures (Soshikizu-Keitouzu-Binran in Japanese).

Table A5: Basic statistics of chemical industry

Variable		Mean	S.D.	Min	Max	Observations
Span of control	overall	13.18	8.85	2	54	N = 300
	between		8.72	3	51.67	n = 100
	within		1.71	4.18	19.85	T = 3
Number of Layers	overall	2.91	0.98	1	6	N = 300
	between		0.90	1	5.33	n = 100
	within		0.39	1.25	4.25	T = 3
Foreign sales/Total sales	overall	19.73	17.96	0	68	N = 300
	between		17.93	0	67.33	n = 100
	within		1.77	9.73	26.73	T = 3
Employee	overall	0.82	1.06	0.04	6.23	N = 300
	between		1.06	0.04	6.07	n = 100
	within		0.06	0.22	1.15	T = 3
IT/Total sales	overall	0.01	0.05	0	0.80	N = 300
	between		0.03	0	0.27	n = 100
	within		0.04	-0.26	0.54	T = 3
R&D/Total sales	overall	0.16	1.48	0	18.34	N = 300
	between		1.21	0	12.17	n = 100
	within		0.86	-11.20	6.33	T = 3
Capital/Labor (K/L)	overall	0.14	1.38	0	17.80	N = 300
	between		1.12	0	11.27	n = 100
	within		0.80	-11.12	6.67	T = 3
Stock option Dummy	overall	0.21	0.41	0	1	N = 300
	between		0.39	0	1	n = 100
	within		0.12	-0.46	0.87	T = 3
Holding Dummy	overall	0.01	0.10	0	1	N = 300
	between		0.10	0	1	n = 100
	within		0.00	0.01	0.01	T = 3
Subsidiary Dummy	overall	0.07	0.26	0	1	N = 300
	between		0.26	0	1	n = 100
	within		0.00	0.07	0.07	T = 3

Notes: See note to Table A4.
Source: The securities report and The Handbook of Organizational and Systematical Figures (Soshikizu-Keitouzu-Binran in Japanese).

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