Governing Board Interlocks and Probability of an IPO

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Abstract

Using comprehensive data of Japanese firms, including small-sized and unlisted firms, this paper empirically analyzes the relationship of initial public offerings (IPOs) and the governing boards. The results show that board size, interlocks with other firms, and interlocks with other listed firms are all positively related to the probability of an IPO. These results imply that a firm's intention to conduct an IPO can be estimated by the size and interlocks of the firm's board, and that knowledge diffusion of an IPO occurs among firms.

Keywords: IPO, Small firms, Board size, Interlocks, Knowledge diffusion
JEL classification: D83, D85, M21, M13

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1. Introduction

Factors of initial public offerings (IPOs) have been attractive topics because finding a prospective candidate for an IPO is almost equivalent to finding the next leading company.[d] The factors are frequently discussed, in spite of the inevitable difficulty in predicting an IPO, because the decision-making process is characterized by a considerable amount of uncertainty and there is a significant lack of information about the stakeholders' decision-making process involved in an IPO. By compiling a few visible signals of a firm, it might be possible to anticipate the decision of the associated governing board. Among such signals, we focus on governing board size, number of board members, and the board's interlocks.

Compared to other factors of IPOs, such as liquidity needs and strategies to preempt competitors or market conditions, social ties are not discussed enough. In this research, we show whether social ties relate one of the most critical decisions of venture firms, an IPO. As far as we know, the relationships of interlocks and IPO decisions are not appeared in previous research. Do these ties, especially those with firms which are already listed, matter IPO decisions? Do these social ties convey information or enhance a board's capability? Our research attempt to give some suggestions to these questions and contributes to the corporate finance literature.

Also, we examine whether these factors reflect the board's intention and work as indicators of IPOs. Since the board members can easily maneuver the board size/ interlocks than other firm setting, they can be an ex-post indicator of public flotation of a firm. This subset of the research also contributes to the corporate governance literature, such as how the board size is decided, how the interlocks are formed or how those decisions reflect other strategies of the firm.

With our original comprehensive dataset of Japanese firms, we extracted board size and computed the number of governing board interlocks for each firm, including unlisted companies. We estimated the relationship between these factors and the possibility of an IPO. Does the possibility of an IPO increase with an increase in the number of board members or interlocks with other companies/ interlocks with listed companies?

Additionally, comprehensive statistics of board size and firm interlocks (including small and unlisted firms) are rare because of data limitations. We explore the undisclosed features of small and unlisted firms and hope that they will contribute to the analysis of the germination process of venture firms, such as how they are tied with others or whether the tendency of interlocking is different from bigger firms.

This paper is organized as follows. Section 2 reviews the previous research and builds our hypothesis. The previous research includes IPO factors and governing board size and interlocks. Section 3 continues to describe an estimation model, our original data and computation methodology. Section 4 introduces outlines our findings of governing board size and interlocks of Japanese firms that are not apparent in previous research, as far as we know and then the descriptive statistics of firms. Section 5 presents the empirical results and discusses them. Section 6 concludes the paper.

2. Previous Research and Hypothesis

Our three hypotheses regarding IPO indicators are as follows: (1) the governing board size is positively related to the probability of an IPO; (2) the interlocks with other firms are positively related to the probability of an IPO; and (3) the interlocks with listed firms are positively related to the probability of an IPO.

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[d] For instance, the 58 firms in this research that went public rapidly increased their share of sales from 3.59% to 6.62% in the sector during the following five years after the offering. While the overall sales in the sector fell 8.30%, the sales of the 58 firms jumped 70.85% in the same period [Ministry of Finance 2006].

We outline previous research related to these hypotheses and then introduce our estimation model. Board size and interlocks with other firms are only discussed as indicators, while the interlocks with listed firms are both a reason and an indicator. Here, we need to mention that the reasons/factors and indicators of IPOs are not equivalent. For example, insufficient capital can be both a reason and an indicator for a firm going public, while interlocks are not always a reason but they can still be an indicator of a firm going public.

2.1. Board Size and Interlocks as Reflections of Board Decisions

Governing board characteristics and interlocks are direct reflections of board members. [Business Roundtable 2012] explains, "It is the responsibility of the board, through its corporate governance committee, to play a leadership role in shaping the corporate governance of the corporation and the composition and leadership of the board." They are the present board members who decide who to appoint as a new member of the board based on their strategic policies.

When a board prepares for flotation, in most cases it considers the structure of the board, such as how many members are needed to manage and monitor the listed company. [Certo et al. 2001] and [Filatotchev and Bishop 2002] suggest that board size is strongly correlated with a successful flotation. This is consistent with the premise of hypothesis (1), regarding the relationship between board size and the IPO decision. We admit that there is another argument—that the relationship between firm performance and board size is not finite because of the cost of retaining an increasing number of board directors. For example, [Yermack 1996] finds that a small-sized board is valued higher in the investment market because it shows the efficacy of firm management. [Coles et al. 2008] find that the relationship between Tobin's Q and board size is U-shaped. While their empirical research mainly focuses on public firms, our study includes unlisted firms, which are naturally confronted with more severe budget constraints and not able to retain large governing board. For those firms efficacy is much less discussed compared to listed firms.

Regarding composition, the balance of outside directors [Daily et al. 2005] indicates that a firm needs to show that the it is sufficiently monitored by outside directors when publishing information about the firm. [Baker and Gompers 2003] find that the representation of outside directors increases the venture firm's reputation at the time of an IPO and that it is accompanied by a reduction of power of the CEO and an increase in power of the outside investors, such as venture capitalists. It implies that a firm planning to go public tends to appoint outside directors who are, in many cases, also other firm's director, as suggested by [Haunschild and Beckman 1998]. They also conclude that the interlocks are the reflection of the board members' management intentions, as well as the source of their performances. Thus, our second hypothesis examines the relationship of these interlocks with other firms and the probability of an IPO.

Although we leave the main basis of hypothesis (3) to the IPO factors presented in the next section, [Certo 2003] suggests that board characteristics are "signals" from a firm and [Deutsch and Ross 2003] indicate that to send the signals, firms "rent reputation" from outside directors. These authors also find that younger and smaller firms, in particular, tend to do so because of a growing need to monitor management, complement the insufficient credibility of the firm and gain better access to outside information. Based on these results, we also empirically examine the effects of the interlocks with listed firms on IPOs for younger firms and smaller firms.

2.2. Governing Board Interlocks as an IPO Factor

While the interlocks are the reflection of board decisions, as noted above, simultaneously they, in fact, bring a similarity of actions among interlocked firms by becoming conduits for information, knowledge, and experiences [Burt 1983]. Information diffuses like water; that is, from one who knows much to another who knows relatively less.

Thus, in hypothesis (3), we examine whether the interlocks with listed companies encourage other linked firms to go public and regress the relationship between the linkages of listed companies and the probability of flotation.

[Brau and Fawcett 2006] studied the major factors in going public in a questionnaire survey, which included financially rigid reasons such as "to suppress expensive debt" or "to establish market value," to other reasons such as "to enhance the reputation of our company" or "to attract analysts' attention." There is a rich literature of the factors of IPO decisions by firms in a review by [Ritter and Welch 2002]. The decisions about whether a firm goes public or not are mainly explained by financial factors [Lowry 2003], [Zingales 1995], strategic decisions [Brau et al. 2003] and exogenous market conditions [Choe et al. 1993], [Helwege and Liang 2004], [Lowry et al. 2010]. In spite of the limitation of pooling data from various firms, [Pagano et al. 1995] conducted a comprehensive estimation of the probability of an IPO by both financial needs and strategic perspectives. Our estimation models in Section 3.1 are based on this model.

Considering these financial, strategic, and market conditions, there are still residuals to be clarified. One of them is known as knowledge spillovers received by the firm. [Lerner 1994] analyzed the information spillover from the financial sectors to non-financial firms and found a positive relationship between experienced venture capitalists and their investees' potential to go public. Also, [Benveniste et al. 2003] examined the relationship between firms and IPO timing and found a "bandwagon effect" within the same industry sector, which indicates spillovers from newly listed companies to those preparing for an IPO. The effect enables followers to shorten the preparation period, however whether it affects the decision to go public or not is not mentioned in their paper. As far as we know, the IPO decision brought by knowledge spillover between firms has not been analyzed enough. We gauge the spillover effect by one of the social ties between members of different boards; that is, the interlocks with listed firms.

The financial economic literature actively discusses the ramifications of social ties to financial outcomes, as social ties expand the research field apart from sociology.[e] [Cohen and Malloy 2007] declared that boards with social ties of private equity receive higher offers from the equity funds compared to other boards without social ties. [Hwang and Kim 2009] revealed that boards with ties exhibit stronger turnover-performance sensitivity. [Stuart and Yim 2010] showed the positive relation between interlocks and private equity offerings. We pick up an IPO as financial outcomes in this research field.

When we limit the scope of social ties in terms of interlocks, we note that [Ferris et al. 2003] indicate the negative side of interlocked directors, while most of the other literature looks at the positive effects on a firm's performance. [Davis 1991] shows that the interlocks of a company, which has already installed poison pill equity, diffuse this poison pill information so that the interlocked firms install it as well. [Hillman and Shropshire 2007] suggest that when a firm with women board members is interlocked with another firm, the latter firm tends to select more women on its governing board. [Westphal et al. 2001] conclude that connected firms imitate the other firms' strategies in multiple policy domains.

3. Model and Methodology
3.1. The Estimation Model
In order to investigate the relationship of an IPO decision and board size/ interlocks,

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[e] For many decades, sociologists have discussed the effects of social ties. With a focus on interlocks, [Burt 1983], [Mizruchi 1996] define that these interlocks diffuse information and knowledge from one firm to another via networks of governing board members. In the 1970's and 80's, the interlocks were perceived as dominance of enterprises by privileged and limited layers of a society, However, after the 1990s, they have been revisited as stabilizers of management in global, unforeseeable, and intense competition in the new global era via sharing critical perspectives for survival [Borgatti and Foster 2003].

we build estimation models, which explain the probability of an IPO by board size/ interlocks accompanied with other control factors. As for the firm *i,* the probability of becoming listed, $p(yi = 1|xi)$, is estimated as follows. Since the dependent variable is dichotomous, $yi = 1$ when listed during the given period, and $yi = 0$ when not listed for firm *i*. We use a logistic regression for estimating the probability.

$$p(yi = 1|xi) = \pi(xi)$$

Logistic regression is given by the following equation. We suppress firm subscripts for simplicity.

$$g(x) = \ln\left(\frac{\pi(x)}{1-\pi(x)}\right) = \beta_0 + \beta_1 roe + \beta_2 growth$$
$$+\beta_3 lnsales + \beta_4 manufacture + \beta_5 young + \beta_6 small$$
$$+\beta_7 boardcomposition + \beta_8 interaction\ term\ of\ interlocks\ and\ young + \varepsilon$$

An IPO is explained by financial factors, strategic factors, and market conditions, as we discussed in Section 2.2. The model is based on [Pagano et al. 1995]. Regarding financial factors, we choose growth of a firm, which describes the firm's capital needs.[f] Return on equity (ROE) is also a financial factor and it proxies for the prospective return of a firm on publishing. As for the strategic factors, size represented by the logarithm of sales is an important factor; since if a firm is big enough, the information asymmetries are not severe and the firm tends to go public [Lowry et al. 2010]. A manufacturing dummy controls the heterogeneity between the manufacturing and service sectors. As [Pagano et al. 1995] suggest, there are possible tendencies of "cultural resistance" against IPOs in the manufacturing sectors. A dummy for young firms controls the heterogeneity between young and old firms. As [Brau and Fawcett 2006] suggest, sometimes there is a significant gap between these two types of firms in the decision-making process. The last factor—the market condition—is static in our estimation, since we use cross-sectional data for January 2006.

Based on the three hypotheses in Sections 2.1 and 2.2, we examine board characteristics by including the number of board members, the number of interlocks with other firms and with other listed firms. According to [Daily et al. 2005], the interlocks with other firms are almost equal to outside directors since most of the outside directors are invited from other firm's board. When a board is comprised of outside directors, a firm can be monitored better and it has access to a wide range of resources via its board members, while paying for the high cost of the board members. It simultaneously reflects the outcome of the board members' decisions to go forward with an IPO and the existence of knowledge diffusion from other firms, particularly listed firms. [Deutsch and Ross 2003] imply that the interlocks with other listed firms reflect how much a firm "rents" its reputation from other reputable firms and how younger firms tend to "rent" outside directors more than older ones, as well as "rent" reputable directors. The interaction term of the interlocks with listed firms and the young firm dummies/small firm dummies control for the interaction effect of those "rents" and the age of a firm/ size of a firm.

The regressions (1)–(7) estimate the relationship between the probability of being listed within one year and board size, the interlocks with other firms and the interlocks with listed companies. Regression (1) is for board size, regression (2)-(4) is for the interlocks with other firms, and regressions (5)–(7) are for the interlocks with listed firms.

For all regression models (1)–(7), we also apply a rare event logistic regression (Relogit) model [King and Zeng 2001] in Table 4, to check the robustness of the regression

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[f] The *growth* is computed by comparing sales in 2005 with the previous year. When the sales data in 2005 is not available, the sales in 2003 and 2004 are utilized to complement the data. The data for *ROE, logarithm of sales,* are also complemented in the same way.

models. The simple logistic regression usually expects that the dichotomous two events happen with equal frequency (50%), such as coin tossing. Although there is no clear rule among researchers about how low ratio of event frequency is allowed [Hosmer and Lemeshow 2000], when our event rate for IPOs is less than 1%, we might need to consider that coefficients and ratios of events can be estimated lower than true values. Resolving this problem, King and Zeng improved the logistic regression and proposed the Relogit to estimate very rare event probabilities such as the occurrence of war between two nations in centennial history.

3.2. Data of Firms and Interlocks

We continue to explain the feature of data in this research. In order to see the board size and compute interlocks including small or young firms, we utilized the most comprehensive firm data called "*Firms' Information File 1990*" compiled manually in 2006 by *Tokyo Shoko Research Co., Ltd* (TSR), which covers both whole industry sectors and areas of Japan. The information includes 807,722 firms, both large and small, from major companies listed in the first section of the Tokyo Stock Exchange (TSE), as well as unlisted and newly formed companies. This is the largest and most countable dataset that covers all of the Japanese firms.

The datasets are composed of interlock information and detailed firm statistics. The former includes names of representatives, other governing board members, and shareholders as well as share ratios. The latter includes industry sectors, names of sellers, foundation dates, capital amounts, number of employees, number of branches, company addresses, and financial statements such as sales, profits, and returns.

The Japanese central government categorizes size of firms and determines the number of firms in each category, according to the white paper of national medium and small firms [Small and Medium Sized Enterprises Agency 2006]. It defines "middle-sized" firms, which provide 21–300 full-time employees (6–100 for the wholesale and service sectors, and 6–50 for the retail and restaurant sectors) or retain less than 300 million yen (less than 100 million for the wholesale sectors, and less than 50 million for retail sellers and restaurants), and counts almost 500,000 firms in the nation. The "big firm" category retains more employment or capital than the middle-sized category and counts 10,000 firms, while the "small firm" category, which retains less employment or capital counts 1.1 million firms. Our final dataset covers all the big- and middle-sized firms, as well as 30% of the small firms. We later utilize the number of employees of each firm to categorize firms by size.

Our research focused on a sector within the "new economy" sectors proposed by [Ljungqvist and Wilhelm 2003], [Loughran and Ritter 2004]. As they explain, these sectors are worth to be focused because of their influence on the national economy. Clarifying the characteristics of newly listed firms in these sectors quantitatively leads to an automatic search for the new "stars" within the national economy. These sectors are defined to consist of Internet and high-tech companies. We converted the defined Standard Industrial Classification (SIC) codes at the time to the Japan Standard Industrial Classification (JSIC) code (Revised in 2002) [Ministry of Internal Affairs and Communications 2007][g]. See the details of conversion of the two codes in Table 8 in the Appendix.

3.3. Data of IPOs

The firm data above does not include the information that which firm went public after the data acquisition. In this section, we explain how we merged the IPO data with the TSR data above and basic statistics of newly listed firms.

The definition of IPO firms in this research is firms that were included in any of the stock exchanges, with the exception of the over-the-counter market, within Japan from

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[g] The TSR data retain three kinds of industry sectors for each firm. When at least one of the three sectors is included in the category above, the firm is defined "new economy" in our research.

February 2006 to January 2007. The last revised date of the TSR is January 2006 and we limited the period of occurrence of an IPO to within one year only, so that we did not include any IPOs after possible changes to their governing board members.[h] Since a newly listed firm is monitored at least one year before being listed, the period of occurrence we established here is interpreted as the post-transition period towards conducting an IPO. Additionally, the Sarbanes-Oxley Act (SOX) to enforce internal control was enacted in 2006 in Japan. The period from 2006 to 2007 is therefore interpreted as the post-preparation period of the Japanese SOX Act.

The total number of firms that went public during the given period is 206. From this number, we excluded firms that were relisted as holding companies because of simple structural changes, such as *Matsuzakaya holdings*, one of the high-quality department stores, and because of prior mergers and reorganization, such as *Aozora bank*, one of the regional commercial banks, since these companies were beyond our scope in terms of the relationship between the governing board characteristics and output. We matched this firm data and the TSR data manually and were left with 178 IPO firms.

Although the ratio of firms of the "new economy" sectors compared to the overall sectors stayed at 2.85%, the ratios of already-listed and newly listed firms jumped to 14.44% and 32.58%, respectively The sectors counted 58 newly listed firms in the given period, out of 178 IPOs overall. Also, the probability of an IPO is quite high; 0.25% in the new economy sectors compared to 0.02% in the other sectors. Firms in the selected sectors tended to go public much more often than in the other sectors. The preparation period leading to IPOs (13.10 years) is more than eight years shorter, on average. And the firms that went public in these new economy sectors were much younger than those in the other sectors.

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[h] As for the IPO data, we utilized the Online Database *Nikkei Needs*, which is provided by *Nikkei Shinbun Digital Media* Co., Ltd., an affiliated company of Japan's leading newspaper.

Table 1: Overall Sectors and "New Economy" Sectors

	Overall sectors	"New economy" sectors
Number of firms	807,722	23,050 (2.85% of the overall)
Number of listed firms	3,795	548 (14.44% of the overall)
The ratio of listed firms	0.47%	2.38%
Number of newly listed firms	178	58 (32.58% of the overall）
The ratio of newly listed firms	0.02%	0.25%
The average years since foundation to IPO	21.52 years	13.10years

3.4. Computation of Interlocks

We compute interlocks of firms utilizing the names of representatives and board members in TSR data described in 3.2. The governing board interlocks are defined as bipartite networks composed from two kinds of nodes; firms and governing board members [Allali et al. 2011],[Newman et al. 2001], [Robins 2004]. A link is structured between two firms that share more than one board member and this becomes the interlock of the two firms. If the link exists, knowledge or information about management is diffused from one firm to another or, at least, this is expected by the board members.

Figure 1 shows that firm 1 retains four board members: A, B, C, and D; and firm 11 retain two: C and D. The two firms commonly retain board members C and D. It does not matter that A, B, C, and D are a representative of the firm or not, since he/she shares information and strategic policy of a firm in the governing board meetings anyway. Although board members A and B of firm 1 do not participate in the board meeting of firm 11, they can be affected by firm 11's management policy, since in the board meeting of firm 1, they discuss and exchange management information with the other members C and D. Thus, knowledge or information about management is diffused, so when the governing boards need to recruit new members, they tend to search other boards because they can expect that such diffusion often occurs. These links are counted as 2 if they are weighted and 1 if they are not weighted. The former computation counts how many board members are linked to other firms and focuses more on the capacity of each member. The latter, on the other hand, counts how many firms are linked to the firm and focuses on the capacity of each linked firm. We applied the non-weighted count in this research since we focus on the performance of firms rather than that of directors.

The computation of number of interlocks with listed firms is as follows. Figure 2 shows that firm 1 is linked with firms 11, 12, 13, and 14. When firm 11 (underlined) is a listed company, the number of interlocks with listed firms for firm 1 is 1 when not weighted. The other firms 12, 13, and 14 are not listed and so, are not counted.

Although we limit the analysis of IPOs in the "new economy" sectors, we do not exclude any interlocks when the firm 11, 12, 13, and 14 are categorized in the other industries, but the "new economy" sectors. The inbound information and knowledge from other sectors should be counted as part of the board decision, as [Westphal et al. 2001] suggest. They say that these interlocks with other industries or under different conditions still bring some fruit to the focal firm.

We defined listed companies as the firms that had already been listed in any stock exchange market, with the exception of the over-the-counter market, in January 2006. They number 3,795 firms of the total number of firms in Japan's industrial sector.

As [Davis et al. 2003], we computed the interlocks using extensive computerized and manual data cleaning procedures to ensure the quality of data and to make certain that we had accurately identified the interlocks. This included disambiguating common names by combining them with data on personal addresses and birthdays.
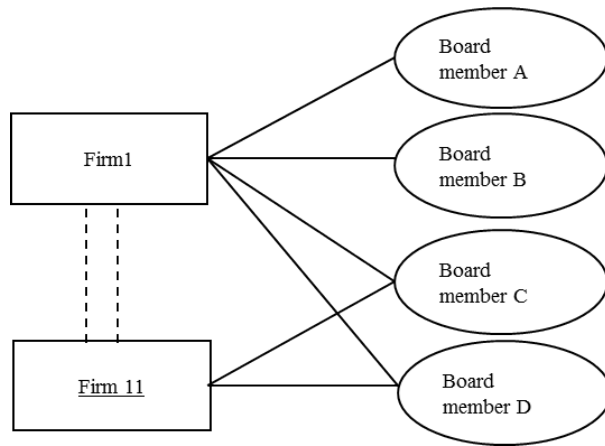
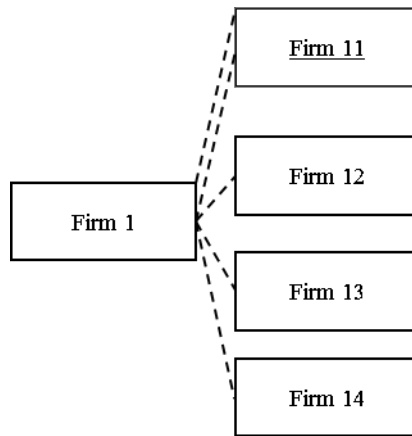Figure 1: Bipartite Graph of Governing Board Members and Firms

Figure 2: Computation of Governing Board Interlocks

4. Facts of Board Size and Interlocks

4.1. Firm Size and Governing Board

While the facts of the interlocks of listed companies are often verified, the interlocks of unlisted companies are not often verified because of data limitations.

According to our dataset, which covers both big and small firms in Japan, it is clarified that the board size and number of interlocks are distributed as outlined in Table 2. From the whole sample of 807,722 firms, we only extract the corporations, which number 483,407. The board size and the number of interlocks with other firms and with listed firms decrease as the firm size becomes smaller, especially the sharp decline in the number of interlocks with listed firms.

As [Boone et al. 2007], [Linck et al. 2008] suggest, when a firm is larger and more complex, the size of the board also becomes larger. The findings of big-sized firms are consistent with [Davis et al. 2003]. They noted that the interlocks between 600 firms in the Fortune 1000 in the United States numbered 8.6 direct interlocks, on average, in 1999, while [Davis 1991] showed that 440 firms in the Fortune 500 had a total of 3500 direct links in 1986.

Table 2: Governing Board Size and Interlocks of Firms (n = 483,407)

	Sample size	Board Size	Interlocks with Other Firms	Interlocks with Listed Firms
Big	24,097	7.29	8.21	.34
Middle	199,579	5.22	5.13	.11
Small	259,731	4.23	3.82	.06

4.2. Difference from Listed to Unlisted Firms

Before estimating the relationship of IPOs and board characteristics, we explore the static difference of listed and unlisted firms in each category of firm size. The middle and small sizes are combined, since listed firms in the small-size category are extremely rare (83 out of 259,731).

Table 3 shows the difference in board size, average number of interlocks with other firms, and interlocks with listed firms between big firms and middle & small firms for the whole sample. In each size category, there are significantly different board characteristics between the listed and unlisted firms. Table 4 shows the difference in the "new economy" population. Also in this comparison test, there are significant differences in board characteristics between the listed and unlisted firms.[i]

In each table, there is only one exceptional result in the differences between the two size categories: that is, the number of interlocks among listed firms. It is found that the number of links among the listed firms does not depend on the scale of a firm. As the two sample sizes (listed and unlisted, big and middle&small) are always unequal, we use Welch's approximation on the mean comparison tests.

These different tests are consistent with [Boone et al. 2007], [Linck et al. 2008]. They revealed that the listed firms retain more board members, more interlocks with other firms, and more interlocks with listed firms. Listed firms require higher compliance and legitimacy than non-listed firms, and this difference may reflect the difference in the number of board members [Boone et al. 2007]. Subsequently, the gaps of interlocks with other firms may reflect the need for outside directors to satisfy the requirements of listed firms [Boone et al. 2007]. It is interesting that the gaps of number of interlocks between the listed and unlisted

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[i] Please note that the new IPO firms that we estimate in the next session are included in the "unlisted" category in these tables.

firms are always larger with the middle & small firms than the big firms. Especially, the listed middle & small firms retain the same number of interlocks as the big listed firms. On the contrary, the unlisted middle & small firms retain much fewer interlocks than the listed middle & small firms and the unlisted big firms. According to both tables, these trends are consistent with the whole sector sample and the selected "new economy" sectors.

Table 3: Difference of Board Composition of Firms in the Whole Sample (n = 470,923)

	Big			Middle & Small		
	Listed (2,162)	Unlisted (21,935)	difference	Listed (1,034)	Unlisted (445,792)	difference
Board Size	11.93	6.83	***	9.39	4.60	***
Interlocks with Other Firms	12.29	7.80	***	10.87	4.29	***
Interlocks with Listed Firms	.66	.31	***	.68	.08	***

	Listed Firms			Unlisted Firms		
	Big (2,162)	Middle &Small (1,034)	difference	Big (21,395)	Middle &Small (445,792)	difference
Board Size	11.93	9.39	***	6.83	4.60	***
Interlocks with Other Firms	12.29	10.87	***	7.80	4.29	***
Interlocks with Listed Firms	.66	.68	---	.31	.08	***

Table 4: Difference of Board Composition of Firms in New Economy Sample (n =14,808)

	Big			Middle & Small		
	Listed (324)	Unlisted (2,520)	difference	Listed (206)	Unlisted (16,616)	difference
Board Size	11.31	6.91	***	8.70	4.71	***
Interlocks with Other Firms	15.40	9.07	***	12.42	5.41	***
Interlocks with Listed Firms	1.23	.49	***	1.08	.19	***

	Listed Firms			Unlisted Firms		
	Big (324)	Middle &Small (206)	difference	Big (2,520)	Middle &Small (16,616)	difference
Board Size	11.31	8.70	***	6.91	4.71	***
Interlocks with Other Firms	15.40	12.42	***	9.07	5.41	***
Interlocks with Listed Firms	1.23	1.08	---	.49	.19	***

*** denotes the significance at 1% level for the two-sided test.
--- denotes lack of significance.

4.3. Descriptive Statistics of Firms

The sample population of "new economy" firms is 23,050 out of 807,722 for all sectors. From this sample, we drop firms with missing values; firms that have already been listed; firms other than corporations, such as limited partnerships; firms with less than three board members;[j] firms operating for less than one year that had no potential to go public at that point[k] to reduce the downward bias for IPOs. The final sample size becomes 13,674 firms.

Table 5 reports the descriptive statistics and correlation of each variable. The value of interlocks with others is equal to or greater than the value of interlocks with listed companies for a given firm. However, the value of board size is not always equal to or greater than that for the interlocks with others, since one board member can be interlocked with more than two companies.

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[j] The Commercial Law Act specifies that the governing board of a corporation shall be composed of more than three members.

[k] For example, the biggest stock exchange for ventures in Japan is called "Mothers" (http://www.tse.or.jp/english/rules/mothers/, visited on April 28, 2014). The major quantity requirements for newly listed firms in 2006 are as follows. The number of shareholders shall be more than 300 before the date of publication. The ratio of publicly traded shares shall be more than a quarter of the total. The market capitalization is expected to be more than 1 billion yen (approximately 10M U.S. dollars) on the date of publication. The governing board of a firm has to be continuously operated for more than one year before the date when a listing application is submitted. Till date, these requirements have been loosened gradually to activate the national investment market.

Table 5 : Descriptive Statistics and Correlation Matrix of Variables of New Economy Firms (n=13,674)

	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7	8
Dependent Variable												
IPO	.003	.058	.000	1.000								
Independent Variable												
1 roe	.876	10.180	-77.712	1073.83								
2 growth	.171	1.765	-1.000	101.667	-.007							
3 lnsales	12.963	1.593	6.588	21.555	.075	-.027						
4 manufacture	.232	.422	.000	1.000	.010	-.017	.151					
5 young	.245	.430	.000	1.000	-.019	.090	-.151	-.172				
6 small	.948	.222	.000	1.000	-.030	-.011	-.490	-.044	.053			
7 boardsize	5.300	2.136	3.00	21.000	.022	.012	.547	.001	-.033	-.395		
8 interlocks with others	6.169	6.732	.000	44.000	.012	.018	.244	-.111	.016	-.152	.480	
9 interlocks with listed	.221	.611	.000	10.000	.007	.036	.195	-.076	.079	-.114	.292	.437

5. Empirical Results

The fitness check below describes whether our estimations by board size/ interlocks and other independent variables overall fit the probability of IPOs. The coefficients describe how the each variable relates the probability. Our focus is whether the coefficients of board size/ interlocks are significantly positive, however there are also other interesting findings related to factors of IPOs, such as size of firms and age of firms.

5.1. Fitness of Models

All the estimations in Table 6 show that there is an overall fit to the observed data. According to the likelihood ratio (LR) tests, all of the values are significant at well beyond the 5% level. We reject the null hypothesis that at least one or more of the coefficients are equal to zero [Hair et al. 2010]. Also, the Hosmer-Lemeshow (HL) tests show that all of the models fit the observations well, since the null hypothesis (i.e., the estimations equal the observations) is not denied beyond the 5% level [Hair et al. 2010]. As for the Relogit models in Table 7, they do not have any significant tests of overall fitness [King and Zeng 2001].

5.2. Estimation of Coefficients

First, we mention the board characteristics. All the variable coefficients in the models (1), (2), and (5) are significantly positive. Board size, interlocks with others, and interlocks with listed companies are positively related to the possibility of going public.

Among (1), (2), and (5), which are models without interaction terms; the model (1) with board size shows the best fit to the probability. On the contrary, the interlocks with listed firms are the most powerful estimator compared to the other two variables, given that other variables are common in all three models. Since board size is significantly positive, we can conclude that governing board members, whether or not they are inside or outside the firm, are a greater influence in determining an IPO. Interlocks with others are also significantly positive and this suggests that prospective IPO firms tend to "rent" outside directors from other firms. Interlocks with listed firms implicate that a firm appoints outside directors to obtain better resources with the intent to show the market that they have retained outstanding directors. Also, the results show the evidence that knowledge diffusion occurs from listed firms to newly listing firms.

The interaction terms of the interlocks with other firms and the young firm dummy in (3), and smaller firms in (4), were not significant. Also, the interaction terms of the interlocks with listed firms and the young firm dummy in (6), and smaller firms in (7), was neither significant. Within our data, it is not admitted that younger or smaller firms tend to "rent" reputable outside directors more than older or bigger firms.

These estimations are all robust according to the Relogit models in Table 7.

We continue with the other independent variables of firms.

First, the size of a firm is always significantly positive. The possibility of an IPO increases with size. Second, as for the young firm dummy, it includes firms within 1–10 years of their establishment and it is strongly positive with this possibility. Firms established within ten years tend to go public rather than older firms. This result is consistent with previous research, such as [Certo et al. 2001], [Loughran and Ritter 2004]. Their research explains why young firms have a high possibility for IPOs because of their high eagerness for fundraising. The result does not mean that younger firms have more chances than older firms to go public, but it does means that, if a firm aims to go public, in most cases it will be implemented within ten years. These results are also consistent with the Relogit models of Table 7. It needs to be noted that firms established less than one year are not able to go public because of stock exchange requirements. Third, the financial factors for IPOs, growth are always significantly positive with Relogit models, but not with normal logistic regression models. According to the results of former results, when the capital needs are larger, the firm tends to go public. This result is consistent with previous research, such as [Certo et al. 2001], [Loughran and

Ritter 2004]. The other financial factors, ROE was scarcely significant. The manufacturing sector dummies are slightly negative. Although it is not statistically significant level, it might show that manufacturing industries tend to avoid going public, even if they are in the "new economy" sectors.

5.3. Discussion

In particular, we mention the relation between size of a firm and our estimation results. With our sample including of both big and small firms, the board size and interlocks with other firms, and interlocks with listed firms, are all significant indicators of an IPO. However, when the sample is limited to only big-sized firms (the details are excluded here), both interlocks turned insignificant. This infers that a big-sized firm requires capable directors whether it goes public or not, whiles a middle- or a small-firm interlocks as an indispensable step to go public. The reasons for an IPO seem to be more idiosyncratic for a big firm. Worldwide, well-known firms such as *Cargill Inc., Robert Bosch Inc.* or *IKEA Inc.*[1] are not publicly traded and do not seem to do so in the near future. We still have no persuasive models or indicators to explain these firms.

We also check the endogeneity of board size and interlocks in our estimations to respond to critics such as [Hermalin and Weisbach 2001], who conclude that the relationship between firm's performance and its board characteristics always suffer an endogeneity problem. Endogeneity generally arises because of omitted variables, measurement error, and simultaneity [Wooldridge 2010]. In our case, we suspect that board size and interlocks are partially and simultaneously determined by firm size and this causes an upward bias in the coefficients of these variables. We tested endogeneity of the three variables and found that it was not critically observed within our estimations.[m]

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[1] Cargill, Inc. is a multinational corporation based in Minnesota, United States. It provides food, agriculture, financial and industrial products, and services, and retains 143,000 employees in 67 countries. Since its founding in 1965, it continues to be owned by the Cargill and MacMillan families. Robert Bosch GmbH is a multinational engineering and electronics company and the world's largest supplier of automotive components, headquartered in Gerlingen, Germany. It employs more than 281,000 associates in more than 50 countries. 92 percent of the share capital is held by Robert Bosch Stiftung GmbH, a charitable foundation and the majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. IKEA is a product and retail company of self-assembly furniture, originally founded in Sweden and headquartered in Leiden, Netherlands. It employs 139,000 in 26 countries, excluding franchises, and is privately owned. Ingvar Kamprad, a senior advisor and the founder says, "I decided that the stock market was not an option for IKEA. I knew that only a long-term perspective could secure our growth plans and I didn't want IKEA to become dependent on financial institutions." These detailed comments are all cited from the website of each corporation, as indicated below.

http://www.cargill.com/company/index.jsp (visited on April 23, 2014)
http://www.bosch.com/en/com/home/homepage.html (visited on April 23, 2014)
http://www.ikea.com/ms/en_US/this-is-ikea/company-information/index.html (visited on April 23, 2014)

[m] Given that our first stage; that is, the estimation on the probability of IPOs, is nonlinear as shown in (1.1), we do not use 2SLS but the Two–Stage Residual Inclusion (2SRI) method originally proposed by [Hausman 1978]. For the details of methods and procedures, see for example, [Chen et al. 2013] and [Terza et al. 2008].

$$(boardsize/ interlocks) = \alpha_0 + \alpha_1 employee + \alpha_2 roe + \alpha_3 growth + \alpha_4 lnsales + \alpha_5 manufacture$$
$$+ \alpha_6 young + \alpha_7 small + u \qquad (1.1)$$

$$g(x) = \ln\left(\frac{\pi(x)}{1-\pi(x)}\right) = \beta_0 + \beta_1 roe + \beta_2 growth + \beta_3 lnsales + \beta_4 manufacture +$$
$$+ \beta_5 young + \beta_6 small + \beta_7 boardsize/interlocks + \beta_8 \hat{u} + e \qquad (1.2)$$

While using number of employees of a firm as an instrumental variable to explain the boardsize/ interlocks in (1.1),"û", the estimated residuals of (1.1), is substituted in equation (1.2). There are three estimated residuals for the three first-stage regressions regarding board size, interlocks with other firms, and interlocks with listed firms. If the coefficient of $\hat{u}$; β_8 in (1.2) is statistically significant, the null hypothesis

that board size/ interlocks is exogenous becomes invalid.

  We conducted three tests regarding the significance of β_8 and found that β_8 in equation (1.2) regressed by board size is .42 (.81), β_8 for the interlocks with other firms is .11 (.52) and β_8 for the interlocks with listed firms is -.31 (-.18). Each parenthesis describes the z-score. Each coefficient of β_8 in equation (1.2) is not statistically significant, which means that there are no obvious endogeneity problems in our specification.

Table 6: Logistic Regression by board size/ interlocks on IPOs (n=13,674)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
roe	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
growth	0.01	0.02	0.01	0.01	0.01	0.01	0.02
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
lsales	0.32***	0.47***	0.47***	0.46***	0.49***	0.49***	0.49***
	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
manufacturing	-0.54	-0.57	-0.61	-0.58	-0.63	-0.68	-0.68
	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)
young	1.79***	1.77***	1.35***	1.74***	1.73***	1.51***	1.71***
	(0.31)	(0.31)	(0.46)	(0.31)	(0.31)	(0.34)	(0.31)
small	0.63	0.31	0.25	-1.08	0.29	0.24	-0.25
	(0.56)	(0.54)	(0.54)	(0.71)	(0.55)	(0.55)	(0.57)
boardsize	0.21***						
	(0.05)						
interlocks with others		0.03*	0.01	-0.08			
		(0.02)	(0.03)	(0.06)			
young*interlocks with others			0.04				
			(0.04)				
small*interlocks with others				0.13**			
				(0.06)			
interlocks with listed firms					0.25*	-0.15	-0.65
					(0.13)	(0.36)	(0.62)
young*interlocks with listed firms						0.49	
						(0.38)	
small*interlocks with listed firms							0.98
							(0.63)
constant	-12.57***	-13.25***	-12.96***	-11.89***	-13.23***	-13.15***	-12.78***
	(1.77)	(1.74)	(1.76)	(1.77)	(1.75)	(1.75)	(1.74)
LR[p-value]	78.69[.00]	66.97[.00]	68.46[.00]	73.23[.00]	66.60[.00]	68.71[.00]	70.50[.00]
HL [p-value]	11.93	6.10	9.64	15.18	12.48	8.90	8.05
	[.15]	[.64]	[.29]	[.06]	[.13]	[.35]	[.43]

parenthesis describes standard errors
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7：Rare Event Logistic Regression（Relogit）by board size/interlocks on IPOs (n=13,674)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
roe	0.20***	0.02	0.03**	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
growth	0.08***	0.08***	0.08***	0.08***	0.07***	0.08***	0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
lsales	0.25***	0.47***	0.47***	0.46***	0.48***	0.49***	0.49***
	(0.09)	(0.07)	(0.07)	(0.08)	(0.07)	(0.08)	(0.07)
manufacturing	-0.44	-0.50	-0.54	-0.51	-0.55	-0.61	-0.61
	(0.45)	(0.45)	(0.45)	(0.45)	(0.45)	(0.46)	(0.46)
young	1.85***	1.74***	1.34***	1.70***	1.70***	1.48***	1.67***
	(0.31)	(0.30)	(0.44)	(0.30)	(0.29)	(0.33)	(0.30)
small	0.59	0.25	0.19	-1.11	0.24	0.18	-0.32
	(0.63)	(0.59)	(0.59)	(0.74)	(0.60)	(0.60)	(0.62)
boardsize	0.23***						
	(0.04)						
interlocks with others		0.03*	0.01	-0.07			
		(0.02)	(0.03)	(0.05)			
young*interlocks with others			0.04				
			(0.04)				
small*interlocks with others				0.12**			
				(0.06)			
interlocks with listed firms					0.27**	-0.04	-0.40
					(0.12)	(0.37)	(0.72)
young*interlocks with listed firms						0.39	
						(0.38)	
small*interlocks with listed firms							0.74
							(0.72)
constant	-11.94***	-13.14***	-12.82***	-11.77***	-13.08***	-13.02***	-12.65***
	(1.55)	(1.43)	(1.44)	(1.49)	(1.46)	(1.48)	(1.45)

parenthesis describes robust standard errors
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6. Conclusion

This paper examines the relationship between board size and interlocks, and the probability of an IPO, and shows that these board characteristics are positively related to the possibility. Technically, we cannot conclude whether these parameters are the causes of a flotation or the effects of preparing to go public because of data limitations. However, by considering the rational sequence of the behavior of boards in the previous literature, we conclude that the relationships between the board characteristics and IPOs are as follows.

First, the analysis of the size of the governing board implies that a firm is required to enhance its legitimacy and managerial capability when it goes public. This indicates part of the firm's strategies but not the cause of an IPO. Second, the interlocks with other firms are also indicators. Interlocks indicate that a firm lacks internal directors and appoints directors from outside. Interlocks with other firms are expected to enhance the firm's reputation and bring knowledge from other firms. However, the effect is limited since the linked firms do not always enjoy better reputations or better economic performances than the focal firm. Third, the interlocks with listed firms are both an indicator and a cause of an IPO. When a firm lacks inner candidates for board directors and searches outside, in most cases it "rents" directors from more reputable firms, since it needs to rent higher management skills in the established firms and be recognized in the investment market. This implies that the interlocks with listed firms convey knowledge of IPOs, as well as other economic knowledge, among firms.

Our contribution is that we show that interlocks can explain one of the most critical financial decisions of firms; an IPO. Based on our discussion that the size and interlocks of boards are the results of board's strategy, we further clarified that these parameters explain an IPO, as well as other performance parameters of firms outlined in previous research.

We also contribute to the field of IPO factors. Our analysis revealed that board characteristics are indicators of flotation of a firm soon thereafter. Added to the major three factors, such as liquidity constrains, strategic factors, and market conditions, knowledge spillover issues have been discussed in other research. However, we found that there are spillovers not only between financial and non-financial sectors, but also among non-financial firms. These spillover effects boost the decision as to whether a firm goes public or not, rather than just contribute to the preparation process. Although we did not see any dynamic diffusion process with time trends, at least we can imply that the information diffusion related to an IPO is expected to occur via governing board interlocks, by the governing board itself.

From a practical perspective, to monitor the investment market, our research shows that the information about governing board composition is valuable to foresee the future performance of a firm. Especially for an unlisted company, governing board size or interlocks are much more easily monitored than performance statements.

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Appendix

Table 8: The Conversion of SIC codes to JSIC codes

	SIC code	JSIC code
computer hardware	3571, 3572, 3575, 3578	2821, 2822, 2823, 2824, 2829
communication equipment	3661, 3663, 3669	2811,2812, 2813,
electronics	3674	2912
navigation equipment	3812	None
measuring and controlling devices	3823,3825, 3826, 3827, 3829	2751,3116, 3117, 3119, 3121, 3154
communication services	4899	3731
software	7370, 7371, 7372, 7373, 7374, 7378, 7379	3911,3912, 3921, 3922, 3929, 8832

Please note that in [Ljungqvist and Wilhelm 2003], [Loughran and Ritter 2004], the "internet companies" are not coded and manually extracted firms are added to the sample data. On the contrary, JSIC code revised in 2002 has classification to categorize "4011: internet related services," so we utilized the category for the "internet companies."