An Empirical Research on Inter-firm Capital Relationship in Yokokai Using IDE Spatial Model

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Abstract

This paper introduces recent fundamental modifications to Japanese alliance system known as the keiretsu, and analyses how these changes have affected corporate performance. Specially, the performance of Japanese auto manufacturers, such as Toyota, Nissan and others, has significantly improved due to sophisticated production system technologies, highly productive workers, and recurring transaction relationship with other partners in their network family. One possible determinant of their success could be due to their unique organization forms –the keiretsu– which provides a strong platform to forge their strategic alliance relationship with their parts suppliers as well as collaboration in research and development with other automobile makers. After economic bubble of the 1990', the strong ties between automobile makers and their supplier partners experienced significant changes, which are known as "keiretsu loosening". Consequently, what is the status quo of automotive keiretsus? Does cross-shareholding, which is one specific form of capital relationship in keiretsu, still contribute to improving corporate performance? To answer these questions, this paper reports the results of a study that collected data on cross-shareholdings to shed light on the relationship between inter-firm capital relationship and corporate performance. The findings of this empirical investigation reveal that: (1) Keiretsu is a flexible, highly adaptive organizational form; its scale changes in response to economic situations; (2) Capital relationship is still a significant determinant of increasing profits for keiretsu partners even after the bubble burst in the 1990s.

Keywords: Influence, Degree, Effective Size, the IDE model, keiretsu loosening.

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1. Introduction

Japanese automobile manufacturers still show signs of performing at a significantly higher level than their global counterparts. This could possibly be due to the sophisticated technologies deployed for their production systems, highly productive employees, and continuous transaction relationships with other member-partners in the keiretsu network. Possibly, one explanatory factor contributing to their success could be due to their unique organization forms –the keiretsu– which provides a strong platform to forge strategic alliances with their parts suppliers, as well as collaboration in research and development with other automobile makers. This manuscript is organized as follows: Section 2 reviews the relevant literature associated with keiretsu networks. Section 3 describes the data collection process and the new network model. Based upon the findings, the managerial implications are discussed in section 4. In section 5, the study limitations are identified and avenues of future research are proffered.

2. Variables Selection

To shed light on these issues and to examine the network relationship between cross shareholdings and corporate performance, data were collected from Mazda' keiretsu, Yokokai,. The Mazda's keiretsu is composed of three sub-organizations: Nishi-Nihon Yokokai, Kanto Yokokai and Kansai Yokokai.

As previously noted, many structural indices of network analysis have been developed. This study selected degree, influence and effective size of the firms included in Yokokai to analyze the relationship between those indices and corporate performance.

Degree is an index of a firm's potential communication activity. In a network, cross shareholding degree includes two categories: in-degree and out-degree. This is because cross shareholding networks are considered to be asymmetric organizations. In-degree refers to a firm accept investment from other member firms, whereas out-degree reflects a firm that only buy stocks from other firms within the network. Degree is calculated as below [7].
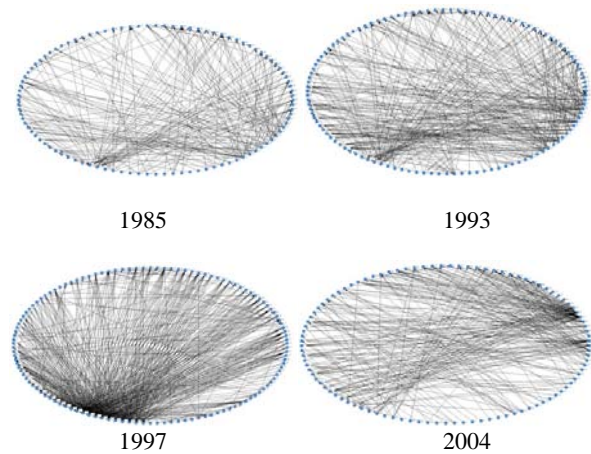
$$C_D(p_k) = \sum_{i=1}^{n} a(p_i, p_k) \qquad (1)$$

where

Fig.1. Capital Networks in Yokokai.

$a(p_i, p_k) = 1$; if and only if pi and pk are connected by a line

$\qquad = 0$; otherwise

Percentage data of inter-firm's transactions were collected from Yokokai. In a transactional network, high value of degree is positively associated with its corporate performance such as sales and profit [9-10]. Based upon this prior work, the following hypothesis is postulated:

H1: Out-degree will be positively associated with its profit, and in-degree will be negatively associated with its profit.

Influence reflects the power to influence or have an impact on other member firms directly and indirectly in a network. Consequently, influence is being divided into two parts: direct influence and indirect influence. Suppose that A is the matrix of the direct network, and An means the indirect influence from one firm to another firm by n steps. Then influence is calculated as follows.

$$T = A + R = A + A^2 + A^3 + \cdot\ \cdot\ \cdot + A^n$$
$$= A(I - A)^{-1} \qquad (2)$$

where

    T: Total influence;
    A: direct influence;
    R: indirect influence;
    I: Identity matrix.

In an asymmetric network, cross shareholding influence includes two categories: influence and affectedness. Influence refers to a firm have strong impact on other member firms, whereas affectedness reflects a firm that only is influenced by other firms within the network. In same network, influence has strong impact on its corporate performance [4, 10]. Consequently, the following hypothesis proffered:

H2: *Influence will be positively associated with its performance and affectedness## will be negatively associated with its profit.*

Effective size of the network refer to the number of alters that ego has, minus the average number of ties that each alter has to other alters. It can be calculated as follows [8].

$$ES(p_k) = (n-1) - \frac{1}{n-1}\sum x_{pk} \qquad (3)$$

where

n: number of ego network (pk is not included);

x_{pk}: node k's connection line in k's ego network.

A recent study investigated the relationship between firm network position and corporate venture capital investment [11]. In another study, Sakamoto et al. reported effective size is one of the key determinants associated with corporate performance in transaction network [12]. Accordingly, the following hypothesis is posited:

H3: *Effective-size will be positively associated with its profit.*

3. Analysis and Discussion

The implications of our results can be considered as follows.

3.1. *Out-degree and In-degree*

In capital network, out-degree means the amount of investment in other partner companies, and in-degree refers to the amount of investment accepted from other companies. From 1985 to 2004, the partial correlation coefficient of out-degree is -0.2756, -0.863, -0.3822,

and -0.319 respectively. In-degree is significant only in 1985 and 1993. The value of in-degree is -0.2191 and -0.3493, which is illustrated in Fig. 2.

All of the out-degree is significant, but the relationship is the inverse. This means that higher investments are associated with less profit. According to the findings reported by Sakamoto et al., hypothesis 1 holds in transactional network, but in capital network, out-degree is negatively associated with profit. However, in McGuire and Dow's study, one of the conclusions is inconsistent because out-degree is negative even before the bubble economy collapsed. Much more quantitative research should be done to find support for their arguments. As interesting findings is that value in 1997 is very high. And the value returned to normal levels in 4 years after its adjustment. The values of in-degree in 1985 and 1993 are significant, but in 1997 and 2004 they are not significant. The bubble economy occurred at the beginning of 1990. Evidently, keiretsu began to adjust their structure after bubble economy collapsed. Therefore, it is apparent that the dramatic loosening of keiretsu occurred in Yokokai. Out-degree is a reflex of this change. Upon close investigation, the member of Yokokai is found to have been significantly changed. Most firms with weak competition disappeared and some strong firms such as Toyota's suppliers become new members in Yokokai. Thus, based upon the analysis described above, H1 partially holds.
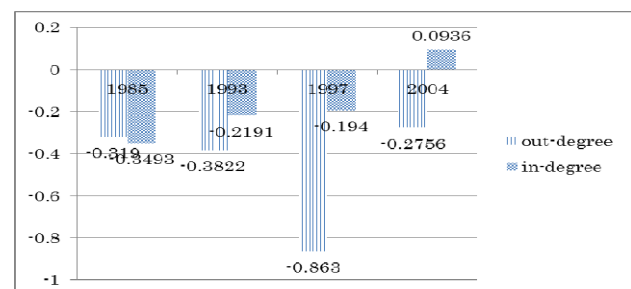

Fig.2. Out-degree and in-degree in Yokokai (1985-2004).

3.2. *Influence*

Influence means one kind of power to affect persons or events without any direct or discernible effort. Influence reflects the power to influence or have an impact on other member firms directly and indirectly in a network. Influence depends on network depth. The depth of

Yokokai is 3, which means that depth still has impact on its influence. From 1985 to 2004, the partial correlation coefficient of influence is 0.3023, 0.864, 0.3874, and 0.3146 respectively. It can be shown as Fig. 3.

Fig. 3 shows that all partial correlation coefficients are positive and significant. The value in 1997 is extra high. And the value returned to normal by 7 years after its adjustment. This result coincides with the result of out-degree. Invest or buy stock from other companies is an effective way to maintain its influence in network. This means that higher influence is associated with higher profits. Therefore, H2 holds completely.
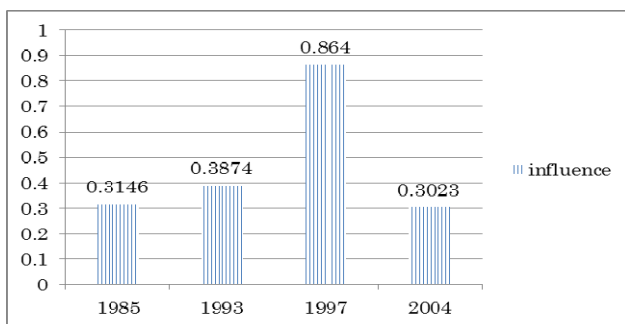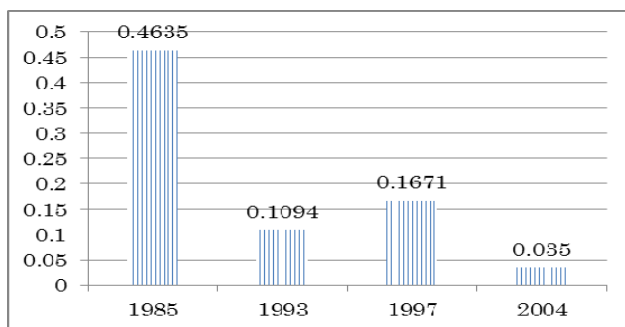

Fig.3. Influence in Yokokai (1985-2004).

Fig.4. Effective Size in Yokokai (1985-2004).

3.3. *Effective Size*

All partial correlation coefficients of effective size can be drawn as Fig. 4.

Effective size refers to the situation of ego's network. The firm has strong connected neighbors if the value of effective size is high. Basically, strong connected neighbors can be considered as good condition to invest because all of the firms invest with each other in keiretsu. The value of effective size only in 1985 is high

and significant. Therefore, there is support for H3 only before bubble economy collapsed. The evidence reveals that keiretsu has already made a major policy shift by breaking with the so-called convoy system of alliance organization.

4. Conclusion and Future Research Avenues

This paper proposed three hypotheses between profit and network indexes including degree, influence and effective size. The relationship between profit and influence is supported, but the association between profit and degree is partially supported. The linkage between profit and effective size holds only before bubble economy collapsed. On analyzing the background of the membership change in Yokokai, the results show that rational inter-firm relationships in keiretsu are still associated with corporate performance. This suggests that keiretsu loosening resulted in performance improvement as cross share-holdings still maintained.

Some factors, such as affectedness and effective size are not statistically significant. Thus, additional factors should be identified as potential determinants of profit. Data were drawn from Mazda's Yokokai to test the hypotheses. Thus, additional studies should replicate these findings by drawing data from other keiretsus, such as Toyota's Kyohokai and Nissan's Nishokai, thus testing the validity of these research findings.

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