An Analysis of Interactive Influence in the Keiretsu of Mazda

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Abstract: One of the most important issues in corporate management is to find those companies that have higher influence and strength their reciprocal relationship with them. A set of companies with interlocking business relationships is known as a Keiretsu in Japan. In this paper we use the influence analysis tool DEMATEL (DEcision MAking Trial and Evaluation Laboratory), to measure one kind of reciprocal relationship, the influence, of each company in the keiretsu of Mazda Yokokai from the viewpoints of transactions and cross-shareholdings. Furthermore, we calculate the centrality index of each company, and then analyze the relationship between centrality index and influence in order to identify the determinants of the influence. The results of this research are used to identify some characteristics of the effective relationships between Mazda and its suppliers.

Keywords: Influence, Relationship, Cross-shareholdings, Transactions, DEMATEL, Mazda**.**

I. INTRODUCTION

A keiretsu is a set of companies with specific interlocking business relationships. These relationships include not only friendship and workflow, but also cross-company transactions and cross-shareholdings among automobile manufacturers and companies supplying their parts in the Japanese automobile manufacturing industry. A keiretsu can be considered as a type of network organization based upon the viewpoint of network theory.

The main contributions of this paper are to identify the important issue of determining the board of network, and to measure the influence of the keiretsu of Mazda using one kind of analytical tool DEMATEL (DEcision MAking Trial and Evaluation Laboratory). And then we measure the quantitative influence of each company in the keiretsu of Mazda Yokokai, and hence discover the effective relationships between the automobile manufacturers and their suppliers.

This paper is organized as follows. In Section 2, we briefly review some previous studies of relationships. Section 3 introduces and applies the DEMATEL measurement technique, showing the result of the influence of each firm in the keiretsu of Mazda. An analysis and discussion of the implications of the measurement results are presented in Section 4. Finally,

in Section 5 we conclude by a summary of this paper and discuss opportunities for future research.

II. BACKGROUND

Many kinds of reciprocal relationships such as friend relationship and workflow relationship will be considered as the important factors for designing an effective strategy. As an effective approach, qualitative analysis is considered as one of the most important studies of the relationship [1, 2]. Recently, quantitative approach is becoming more and more important analytical tool due to the advances in computer technology. Dyer H. J. analyzed the relationship among firms based on distances between their locations and the frequency of face-to-face communication among engineers in the automobile industry [3, 4]. Furthermore, inter-organizational relationships in keiretsu have been analyzed with quantitative analysis tools such as centrality analysis. Fukuoka et al. reported a new trend in relationships between firms in the keiretsu of Nissan from the viewpoint of network organization [5].

One kind of reciprocal relationship is the level of influence between firms. An important strategy in the field of corporate management is to find those firms that have higher influence and strength their reciprocal relationship with them. Measuring this level of

influence helps to identify effective relationships between firms. However, there are only a few empirical studies that analyze the influence, one of the most important reciprocal relationships between the firms in the keiretsu.

III. MEASUREMENT

Influence is defined as one of the powers to directly and indirectly control or affect the actions of other persons or things. In the social sciences, influence derives from an interpersonal relationship, and most research into influence is based on a psychological approach. Fontela E. and Gabus A. developed a mathematical model for visualizing the structure of complicated causal relationships with matrixes or digraphs, called DEMATEL, which is an abbreviation for DEcision MAking Trial and Evaluation Laboratory [6]. This model distinguishes the cause and effects between individual firms and identifies the structure presenting these two groups separately. DEMATEL model has been successfully applied in many fields.

As a new analytical tool, DEMATEL can be considered as an approach to find not only direct relations but also indirect relations in a group. In this paper, DEMATEL model is used to measure the influence of the direct and/or indirect power of each firm within the keiretsu of Mazda Yokokai, based on the principle "Friends of my friend are my friends".

1. Outline of DEMATEL and data collection

A brief overview of the mathematical basis of DEMATEL is as follows.

In a social network composed of n actors, the binary relation between each actor and the strength of this binary relation can be identified. Based upon the structure of this pattern of reciprocal relationships, an $n \times n$ adjacent matrix A^* can be obtained. The first step in the analysis is to normalize this matrix by multiplying each element of A^* by λ, the largest row sum of A^*. The normalized matrix $A = \lambda A^*$ is therefore obtained. The (i, j) element of a_{ij} of this matrix denotes the level of direct influence from actor i to actor j.

The reachable matrix, denoted by A^x, refers to the fact that actor i can reach actor j through the number of steps x. For instance, A^2 means that actor i can reach actor j through 2 steps. Therefore, A^x measures the indirect influence from actor i to actor j. All of the

levels of indirect influence can be summarized as follows, which we refer to as the indirect matrix.

$$A^f = A^2 + A^3 + \cdots + A^n = A^2(I - A)^{-1} \quad (1)$$

The total influence matrix, which includes both the direct and indirect influence matrix, can therefore be expressed as follows.

$$T = A + A^f = A + A^2 + A^3 + \cdots + A^n = A(I - A)^{-1} \quad (2)$$

In order to measure the influence among Yokokai, data showing the transactions and cross-shareholdings in the keiretsu of Mazda Yokokai were collected from the publications of the Japan Auto Parts Industries Association and Automotive Parts Publishing Company [7]. Yokokai is the suppliers' association of Mazda. It is composed of three groups categorized by the geographic location, namely, Kanto Yokokai, Kansai Yokokai, and Nishinihon Yokokai.

The relationships between the firms in each category were identified through graph modeling. A tie shows the presence or absence of transactions or cross-shareholdings between each pair of firms. We collected directed and weighted data to measure the influence of each firm. The network of transactions in Yokokai is shown in Fig. 1.
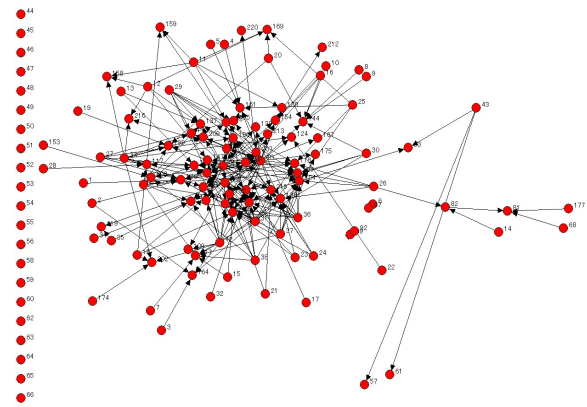

Fig.1. Graph of transaction relationship in Yokokai in 2003-04.

2. Influence measurement

We developed a computer program and calculated the influence of each firm in Yokokai. The result of the influence of transactions is shown in Fig. 2.

In order to find the firms with high influence to Mazda in Yokokai, we also calculated the detailed

influence between Mazda and all other suppliers. The transactional influence from Mazda to all other suppliers and the influence of cross-shareholdings from all other suppliers is zero respectively because Mazda does not supply any parts to other suppliers in the network of transaction, and no any suppliers invest to Mazda. Fig. 3 shows the details of the influence of cross-shareholdings from Mazda to other suppliers and the transactional influence from all other suppliers.
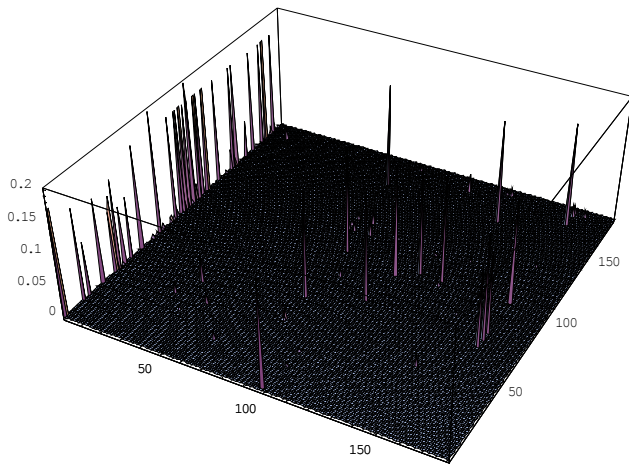

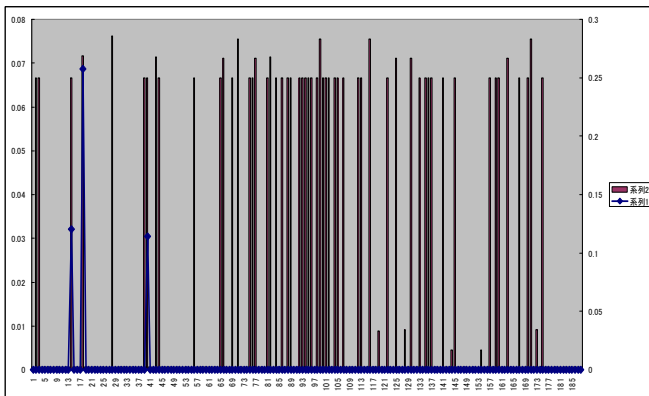Fig.2. The results of the influence of transactions in Yokokai.

Fig.3. Influences of transactions from other suppliers to Mazda (bar graph) and cross-shareholdings from Mazda to other suppliers (line graph).

Fig. 3 shows the influence of transactions from other suppliers to Mazda and the influence of cross shareholdings from Mazda to other suppliers in detail. The total influence from other suppliers reaches 3.85. This shows Mazda received many parts from suppliers. The top five firms are Sumino Kogyo Co., Ltd. (0.076), NOK Corporation (0.075), NSK Ltd. (0.075), Marui

Industrial Co., Ltd. (0.075), and Hanshin Electric Co., Ltd. (0.075).

The influence of cross-shareholdings was calculated using the same method. The influence from Mazda to other three suppliers, Kurashiki Kako Co., Ltd., Keylex Corporation, and Japan Climate System Corporation, are high. These three firms also have higher influence of transaction to Mazda. The rank of these firms is 6, 14 and 14 respectively. This result shows that there are correlation between investments and transactions.

IV. ANALYSIS AND IMPLICATIONS

The finding that the more investment that Mazda makes in its supplier firms the more transactions Mazda will have with them is not an unexpected result. Two questions can now be asked. The first is "How strong is this relationship between level of investment and number of transactions?" The second is "what kind of relationship between the influence and centrality?" To answer these two questions, we calculated centrality index of all these firms, and analyzed the correlation coefficients between transaction and cross share-holdings. The details of centrality index are described in Ito et al. [8]. The results of this analysis are shown in Table 1.

In Table 1, Influence A means actor i directly influences actor j, and Influence B means actor i is influenced from actor j. This shows that two correlations, that between influence B of transactions and influence A of cross-shareholdings, and that between influence A of transactions and influence B of cross-shareholdings, were significant ($P < 0.01$). The correlation ratios were 0.678 and 0.399 respectively, which shows that a strong relationship exists between the level of transactions and cross-shareholdings. In other words, the statement that "the more a firm invests in a supplier, the more the firm receives parts from that supplier" is valid. The reciprocal finding that "the higher level of investment that a firm accepts, the more parts that firm will supply" is also valid.

V. CONCLUSION

In this paper, the influence of each firm was measured in order to investigate the pattern of relationships in the keiretsu of Mazda. The study found that the influence of cross-shareholdings in other firms is closely related to the influence of the transactions

between them. This means that the higher influence of cross-shareholdings has a strong impact on the influence of transactions. The implication of this finding for the automobile manufacturer Mazda is that an important strategy for them is to find those firms that have higher influence in the keiretsu and strengthen their reciprocal relationship with them.

One limitation of the paper is that the data of transactions and cross-shareholdings in this analysis are restricted to one fiscal year. Data from more years would be required in order to more completely study the trend of these identified influences through time series analysis.

Table 1. Matrix of correlation coefficient between transaction and cross-shareholdings.

		Cross-shareholdings		Transaction	
		Influence A	Influence B	Influence A	Influence B
Cross-shareholdings	Influence A	1.000	0.030	0.039	0.678[**]
		-	0.687	0.604	0.000
		181	181	181	181
	Influence B		1.000	0.399[**]	-0.033
			-	0.000	0.660
			181	181	181
Transaction	Influence A			1.000	-0.036
				-	0.633
				181	181
	Influence B				1.000
					-
					181

$**P < 0.01$.

In addition, the form of influence investigated in this study is only one aspect of the reciprocal relationship between an automobile manufacturer and its suppliers. Further quantitative research, such as the use of capacity analysis between two actors and clique analysis of the network structure, will be undertaken in the future, to attempt to capture the complexity of the relationships in the keiretsu of Mazda.

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