An analysis of interactive influences in Mazda’s *Yokokai Keiretsu*

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**Abstract** In a *keiretsu*, i.e., a set of companies with interlocking business relationships, it is important for corporate management to identify those companies over which they reciprocally exercise greater influence and power. In this article we employ a DEcision MAking Trial and Evaluation Laboratory (DEMATEL) to illustrate the reciprocal influence of each company in Mazda’s *Yokokai keiretsu*, as measured by the number 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. Based on the findings, we identify some characteristics of effective relationships which have important managerial implications.

**Key words** Influence · Relationship · Cross-shareholdings · Transactions · DEMATEL · The *Yokokai* 

1 Introduction

Based on the perspectives of network theory, a *keiretsu* can be described as an inter-organizational network of companies with specific interlocking business relationships. These relationships include not only a symbiotic relationship and integrated work-flow processes, but also cross-company transactions and cross-shareholdings among Japanese automobile manufacturers and their automobile parts suppliers.

Using an analytical tool, the DEcision MAking Trial and Evaluation Laboratory (DEMATEL), we augment the body of knowledge on *keiretsu* by identifying and illustrating the relative influence that membership exercises among firms within Mazda’s *Yokokai keiretsu*. Specifically, we illustrate the quantitative influence of each member firm in Mazda’s *Yokokai keiretsu* to identify the effective relationships between the automobile manufacturer and its suppliers.

This article is organized as follows. In Sect. 2, we briefly review the extant literature on reciprocal relationships in the context of *keiretsu*. Section 3 introduces and applies the DEMATEL measurement technique to exhibit the influence of each firm within Mazda’s *keiretsu*. The results are discussed and the implications of the study are presented in Sect. 4. Finally, in Sect. 5, we summarize and present our conclusions.

2 Background

Among many other factors, a symbiotic relationship and integrated work-flow processes are considered to be important factors for designing an effective strategy between *keiretsu* members. Qualitative analyses of network inter-relationships offered by Hakansson and Waluszewski and Lincoln and Gerlach are considered to be the most important studies. Recently, however, due to the advances in computer technology, quantitative analytical approaches are becoming increasingly important. For example, Dyer analyzed network relationships based on distances between locations and the frequency of face-to-face communications among engineers in the automobile industry. The centrality of inter-organizational relationships has also been explored using quantitative analysis tools. A case in point is a study by Fukuoka et al. that reported this new trend in the inter-relationships between member firms in Nissan’s *keiretsu*.
Another crucial reciprocal relationship is exhibited by the level of influence exerted by network member firms. Corporate management, for example, may find it important to identify those firms that mutually manifest greater influence and power, thus helping to forge closer, more effective relationships between them. To the best of our knowledge, no study has examined quantitative relationships from an organizational network vantage point, so this study attempts to shed light on one of the most important reciprocal relationships between member firms using data gathered from Mazda’s Yokokai keiretsu.

3 Study method

Influence is exercised to directly and indirectly control or affect the actions of others. In the social sciences, influence derives from interpersonal relationships, and most research on influence is based on a psychological perspective. Fontela and Gabus[^5] developed a mathematical model for visualizing the structure of complicated causal relationships with matrices or digraphs called DEMATEL, which is an abbreviation for DEcision MAking Trial and Evaluation Laboratory. 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. Based on the principle that “the friends of my friend are my friends”, DEMATEL is employed to exhibit the direct and/or indirect influence of each member firm within Mazda’s Yokokai keiretsu.

3.1 Outline of DEMATEL and data collection

A brief overview of the mathematical basis of DEMATEL is given below.

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 on 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 \( \lambda \), 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 \( x \) number of steps. 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 the levels of indirect influence can be summarized as follows, which we refer to as the indirect matrix:

\[
A^1 = A^2 + A^3 + \cdots + A^n = A^2(I - A)^{-1} \tag{1}
\]

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

\[
T = A^0 + A^1 = A + A^2 + A^3 + \cdots + A^n = A(I - A)^{-1} \tag{2}
\]

In order to measure the influence in Mazda’s Yokokai keiretsu, transaction and cross-shareholdings data were drawn from the publications of the Japanese Automotive Parts Industries Association and Automotive Parts Publishing Company.[^7]

The relationships between the firms in each category were depicted using graph modeling. A tie shows the presence or absence of transactions or cross-shareholdings between each pair of firms. We collected direct and weighted data to measure the influence of each firm within the network. The network of transactions in the Yokokai is shown in Fig. 1, based on 177 parts suppliers for Mazda and 11 car makers.

3.2 Influence measurement

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

In order to find the firms having a strong impact on Mazda relative to other members of the Yokokai, we also calculated the influence between Mazda and all its suppliers. The transactional influence from Mazda to all other suppliers and the influence of cross-shareholdings from all other suppliers to Mazda is zero in each case, because Mazda does not supply any parts to other suppliers in the network, and thus no suppliers invest in Mazda. Figure 3 shows the details of the influence of cross-shareholdings from Mazda to other suppliers and the transactional influence from all other suppliers.

The total influence from other suppliers reached 9.12. This suggests that Mazda procures many parts from other suppliers, with the top five firms being Japan Climate System Corporation (0.9), Keylex Corporation (0.9), Sumino Kogyo (0.8), Ishizaki Honten Co. (0.7), and Kurashiki Kako Co. (0.6). All these firms have an especially close relationship with Mazda.[^8]

The influence of cross-shareholdings was calculated using similar procedures. The influences from Mazda to three other suppliers, Kurashiki Kako Co., Keylex Corporation, and Japan Climate System Corporation are 0.26, 0.12, and 0.11, respectively. These three firms also have a higher influence in transactions to Mazda. The rank of these firms is 5, 2, and 1, respectively. This result shows that there are correlations between investments and transactions.

4 Analysis and implications

These findings indicate that the more investments Mazda makes with a supplier is associated with the greater transactions Mazda has with them. This result is not unexpected. Progressively, it leads to two questions that can now be asked. First, “How strong is the relationship between the level of investment and the number of transactions?” Second, “What is the relationship between influence and centrality?” To answer these questions, we calculated the centrality index of all these firms, and analyzed the correla-