IS FIRM VALUATION AFFECTED BY ITS POSITION IN
B-TO-B RELATION NETWORK?

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Abstract
The structural position of a firm in the whole industry is one of the most important factors that affect the capability and potential of the firm. There are many financial measures that show the condition of a firm, however, these measures can not reveal the condition of a firm in the context of its position in the whole industry. In that sense, social network analysis, which is one of the key techniques in research of complex relationships between members of social systems, can be used as complement to financial measures to capture the condition of a firm. In this research, we apply social network analysis to BtoB transaction network in order to reveal how the structural position in BtoB network affects the evaluation of a firm.

A BtoB network was constructed based on public data of BtoB transaction relationship in Japanese manufacturing industry. Positions in this network are clarified and firms are categorized based on social network analysis. The result of analysis is then compared with the comprehensive firm evaluation data published by Nikkei Inc., which consists of four perspectives: scale, profitability, safeness and growth. The result shows a strong correlation between certain measures of the BtoB network and the valuation of firms.

Keywords: Social network analysis, BtoB.
1 INTRODUCTION

There are many ways to evaluate a firm. Most of the objective measures for evaluating firms are based on financial or organizational data, which is about inside of the firm. There are few objective measures that focus on the outside of the firm. Meanwhile, the structural position of a firm in the whole industry is one of the most important factors that affect the capability and potential of the firm. Our motivation is to explore a way of assessing firms’ valuation using objective measures focused on the structural position of firms. This drives us to question about the relation between structural position of a firm in the industry and its general valuation in the society. Is firm valuation affected by its structural position?

To address this question, measures that reflect the structural position of a firm must be defined first. Social network analysis, which is one of the key techniques in research of complex relationships between members of social systems, can be applied to generate objective measures that reflect the structural position of firms.

In the first phases of this research, we constructed a social network based on public data of BtoB transaction relationship in Japanese manufacturing industry (hereafter we refer this network as “BtoB network”). Firm positions in this network are clarified and several social network indices were calculated based on position of firms in the industry. Construction of the BtoB network is explained in section 3.

The second phase of this research is analysis of the relationship between indices of the BtoB network and firm valuation data. We have applied several analyses using different firm valuation data in our research. As the space is limited, we will only introduce and discuss the result of one of the analysis.

In this analysis, a comprehensive firm valuation made by a prestigious economic journal in Japan is adopted as the indicator of general valuation of firms. This valuation consists of valuations from four perspectives: scale, profitability, safeness and growth. We use each of these valuations as response variable and applied multiple linear regression analysis to model the relationship between social network indices in BtoB network and firm valuations. Result of the analysis is explained in section 4.

2 BACKGROUND AND RELATED WORKS

Social network analysis is an analyses technique based on the graph theory. In social network analysis, the target organization or group is expressed by nodes and ties. Nodes indicate individual units and ties represent the relationships between individual units. Social network analysis has been wildly used in researches of complex relationships between members of social systems. In 2005, Sugiyama et al. constructed a social network of listed companies in Japan based on BtoB transaction relationship in order to investigate the structure of BtoB transactions (Sugiyama et al. 2005). In our research, we focus on Japanese manufacturing industry and try to clarify how the structural position in the industry affect the valuation of a firm.

Well known social network indices that reflect structural position of nodes include Degree centrality, Closeness centrality, Betweenness centrality, Structural advantage and Structural constraint. Degree centrality is the simplest and most intuitive measure among all the centrality indices. It measures a node’s centrality according to the number of connections to others, including the degree of nodes in social networks. The closeness centrality measures a node’s centrality according to the degree of its closeness to others, which can be quantified by its geodesic distances to all the other nodes in the network. This is a more global measurement than degree centrality, which is involved in the closeness to all network members, not just the connections to immediate neighbour nodes. Betweenness offers a more precise way of measuring centrality than closeness centrality. It measures a node’s centrality according to the betweenness which is the capacity of this node standing on the geodesics or short
paths of other two nodes. Closeness centrality index does not take this into account (Wasserman and Faust 1994). Structural advantage is a measure defined by Sugiyama, which indicate the advantage over neighbour nodes (Sugiyama 2005). Structural constraint is defined by Burt (Burt 1992) as a constraint that each node is imposed from a related structure of the network.

3 DATA COLLECTION AND NETWORK CONSTRUCTION

3.1 Construction of BtoB network

In the first phase of our research, the network to be analyzed is constructed. We put our focus on manufacturing firms, the driving force of Japanese economy. We obtained information about trading partners of listed firms in manufacturing industry from the Nikkei Kaisha Jyouhou (Japanese Affiliated Companies’ Information) (Nikkei Kaisha Jyouhou 2004). To construct the social network, first, we treat each firm as a node. Then a tie is drawn between the two nodes if a firm is a trading partner of another firm. In that sense, only information related to BtoB transaction structure is considered and information such as the scale and profitability of firms are ignored. The original social network constructed includes 836 companies. Since there are 240 isolated nodes in the network, we eliminated those isolated nodes from the network and obtained a complete graph. This BtoB network includes 596 firms in the manufacturing industry.

Figure 1 shows the graph of BtoB network. The average shortest path length is a measure to explain the characteristic of the whole network. It is the mean of distance over all couples of nodes in the network. If the score is low, it means that each pair in the network has more reachability (Yasuda 2005). The average shortest path length of our network is 4.185. In previous study, Sugiyama showed that the average shortest path length of whole industry network is 3.36～5.36 (Sugiyama 2005). We can observe that that there is no significant difference of reachability between pairs of nodes in manufacturing industry and the whole industry.

After constructing the BtoB network, we calculated Structural advantage on Microsoft Excel 2007 and used UCINET 6.0 (AnalyticTech 2007) to calculate other social network indices including degree centrality, closeness centrality, betweenness centrality, and structural constraint. These indices are then used as indicators of structural positions of firms in the analysis phase of our research.

The top three firm of Degree centrality are Toyota Moto Corporation, Matsushita Electric Industrial Co., Ltd. and Toshiba Corporation; The top three firms of Closeness centrality are Toyota Motor Corporation, Mitsubishi Electric Corporation and Hitachi, Ltd.; The top three of Betweenness centrality are Toyota Motor Corporation, Hitachi, Ltd., Mitsubishi Electric Corporation.
Two kinds of data sources were used in the analysis phase. Financial data including ROE (Return on Equity), Shareholders' equity and Total market value were obtained from Nikkei Kaisha Jyouhou (Japanese Affiliated Companies’ Information) (Nikkei Kaisha Jyouhou 2004). As for firm valuation data, we adopted Nikkei NEEDS-CASMA 2004, which is also called the Nikkei Yuryou Kaisya Ranking 2004 (NIKKEI TELECOM 21). This ranking is published by the Nikkei Digital Media Inc. It is a ranking of firms based on financial data and questionnaire survey to journalists of a prestigious economic journal group, the Nikkei Inc. The NEEDS-CASMA 2004 includes five scores for each listed company. These scores are total valuation and valuations from the following perspectives: scale, profitability, soundness and growth. Hereafter we refer to these scores as total valuation, scale valuation, profitability valuation, soundness valuation and growth valuation.

4 ANALYSIS AND RESULT

We applied multiple linear regression analysis to examine the relationship between BtoB network indices and the five valuations, using one valuation as response variable each time. Indicator of structural position in BtoB network including Degree centrality, Closeness centrality, Betweenness centrality, Structural advantage and Structural constraint and financial data including ROE (Return on Equity), Shareholders' equity and Total market value are used as candidate explanatory variable.

SPSS was adopted as the analysis tool. Table 1 shows the result of the stepwise regression analysis. The most important indices to explain different valuation are shown in each line. Stepwise regression analysis is an automatic procedure for statistical model selection in cases where there are a large number of potential explanatory variables, and no underlying theory on which to base the model selection. In this table, model1 use only one variable as the explanatory variable of company evaluation and, and underlying figure is contributing ratio which is the model1’s power of explanation. In Model2, we add one more variable as the explanatory variable, and Model3 has three explanatory variables.

<table>
<thead>
<tr>
<th></th>
<th>model1</th>
<th>model2</th>
<th>model3</th>
<th>model4</th>
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<td><strong>Total evaluation</strong></td>
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<tr>
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<td>ROE</td>
<td>shareholders' equity</td>
<td>Structural constraint</td>
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<td>0.378</td>
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<td>Degree centrality</td>
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<tr>
<td>Contributing ratio ($R^2$)</td>
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<td>0.611</td>
<td>0.681</td>
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<tr>
<td>Factor</td>
<td>ROE</td>
<td>Structural constraint</td>
<td>shareholders' equity</td>
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<td>0.384</td>
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<tr>
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<td>Betweenness centrality</td>
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<tr>
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<td>ROE</td>
<td>Degree centrality</td>
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<tr>
<td>Contributing ratio ($R^2$)</td>
<td>0.106</td>
<td>0.156</td>
<td>0.185</td>
<td></td>
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</table>

*Table 1  Result of the regression analysis, main factors and power of explanation of the model*
4.1 Factors Affecting Total valuation

After stepwise regression analysis, Total market value, ROE, Shareholders’ equity and Structural constraint are adopted as the explanatory variable to explain Total evaluation. The result shows that the most important explanatory variable is Total market value. From the SNA index, only Structural constraint is adopted, but its contribution is little.

4.2 Factors Affecting Scale Valuation

After stepwise regression analysis, Degree centrality, Structural constraint and Shareholders’ equity are adopted as the explanatory variable to explain Scale. The result shows that the most important explanatory variable is Degree centrality. It is natural to think that Total market value strongly correlate to the evaluation of scale, but Total market value is rejected, so this result is remarkable. This result shows the effectivity of using social network analysis to evaluate the companies.

4.3 Factors Affecting Profitability Valuation

After stepwise regression analysis, ROE, Structural constraint and Shareholders’ equity are adopted as the explanatory variable to explain Profitability. The result shows that the most important explanatory variable is ROE, and Structural constraint is second most effective explanatory variable of Profitability. Structural constraint contributes to increase the power of explanation.

4.4 Factors Affecting Soundness Valuation

After stepwise regression analysis, Shareholders’ equity, Betweenness centrality and ROE are adopted as the explanatory variable to explain Soundness. The result shows that the most important explanatory variable is Shareholders’ equity, and Betweenness centrality is second most effective explanatory variable of Profitability. Structural constraint contributes a little to increase the power of explanation.

4.5 Factors Affecting Growth Valuation

After stepwise regression analysis, Structural constraint, ROE and Degree centrality are adopted as the explanatory variable to explain Growth. The result shows that the most important explanatory variable is Structural constraint, but the power of explanation is low, so we can not establish the effectivity of using social network analysis in evaluating Growth.

5 CONCLUSION AND FUTURE WORKS

The structural position of a firm in the whole industry is one of the most important factors that affect the capability and potential of the firm. As the objective way to evaluate the position of a company, we focused on the social network indices and we tried to reveal the relation between firm valuation and social network indices. After the analysis, we found the correlation between evaluation of companies and social network indices of the BtoB network. Regression analysis shows that these indices can explain firm valuations from different perspectives.

This research has some limitations. First limitation is about the construction of the BtoB network. Since the database we used only include major trade partner of each listed firm, the BtoB network constructed in this research could not cover all business transactions. The second limitation is about the regression analysis. In the analysis, we used only three financial indexes as the candidate explanatory variable, so we need to use more indices in the future work. Also, it will be the future direction of research to reveal the affect of shifting position in the network.
References


