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CHANGING SUBCONTRACTING RELATIONS AND RISK-SHARING IN JAPAN: AN ECONOMETRIC ANALYSIS OF THE AUTOMOBILE INDUSTRY*

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Abstract

Some argue that the Japanese subcontracting system includes a sort of risk sharing mechanism, and is therefore efficient. A survey of previous empirical studies on this subject reveals that their results are not persuasive enough because of some serious estimation problems. This paper proves in an alternative way the existence of and recent changes in risk sharing in subcontracting relations since the mid-80s, using two data sets of Japanese auto parts makers. The results suggest that the auto makers absorb a part of the risk of parts suppliers: The profit rate of suppliers as well as its stability is significantly influenced by the intensity of business relations. The structural change in the subcontracting relations in recent years seems to have weakened the effect of risk sharing between business partners.

I. *The Japanese Corporate System and Risk Sharing*

The Japanese corporate system is characterized by generally long-lasting relationships between large corporations and their stakeholders, such as shareholders, creditors, suppliers, dealers and employees. A large part of stocks of many leading corporations is held by other corporations. There exists widespread cross-shareholding among the member firms of corporate groups like Mitsui and Mitsubishi. Leading companies have also long-term relationships with their main banks, their most important creditors. Long-term relationships with suppliers and dealers are also as well known as enduring employment in large corporations.

The Japanese corporate system, represented by business affiliations ("Keiretsu") and subcontracting relations, has long been considered to show the backwardness of the Japanese economy. However, with the emergence of the so-called "economic theory of information" since the 1980s, we have begun to recognize the economic rationality of such business relationships from the viewpoint of reducing transaction costs and enhancing informational efficiency. This new perspective of economics supports the approach which regards corporate

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groups, the main bank system and subcontracting relations as a sort of implicit insurance mechanism. The Japanese corporate system is said to include a mechanism for risk sharing through long-term relations, which lets the whole system function quite efficiently[1].

As for the subcontracting relations, Aoki (1984) explains the inherent insurance mechanism as follows: If there is a difference in the degree of risk aversion between the business partners, it is more efficient in total respect that higher risk is taken by the more risk-taking firm (with a lower degree of risk aversion). The common rent made by an efficient risk sharing between the business partners will be distributed according to their relative bargaining power. In this case, the more risk-taking firm will intend to take a higher risk in return for a bigger part of the pie (higher risk premium). In subcontracting relations in Japan, it may be assumed that, in general, big assemblers have a greater risk bearing capability than smaller suppliers because of their relatively higher degree of diversification and stronger financial power. Thus, it will be efficient that big assemblers take a greater part of the business risk for a risk premium in form of monopolistic profit. In this case, the former get a greater profit share in return for insuring the latter against profit fluctuation. Therefore, even if the profit rate of the big assemblers exceeds that of the suppliers for a long time, it may be the result of risk sharing as an implicit contract, and so the result of a rational choice of the business partners.

Such a viewpoint stands against the traditional view in which the subcontracting relations partly play the role of a buffer against business fluctuations. The results of empirical studies [Kawasaki/McMillan (1987), Asanuma/Kikutani (1992)] seem to support the new idea of risk sharing, but we hesitate to accept these results because of some problems in the research method. So it is the first purpose of this paper to prove in an alternative way if the Japanese subcontracting relations have an insurance function, i.e., if the big assemblers really absorb a part of the risk of their suppliers.

The Japanese subcontracting system, as well as the corporate system as a whole, has been dramatically changing in recent years. The big assemblers are restructuring their subcontracting relations above all by purchasing more parts from non-group and foreign suppliers, while reducing the number and variety of purchased parts. Suppliers are also trying to get more customers for their products. Such structural changes have occurred continuously since the mid- 80s, and were accelerated in recent times. The flexibilization of the subcontracting system on both sides of the business partners, together with the increasing demand of the assemblers for cost reduction and quality improvement, may influence the risk sharing in subcontracting, if any. Thus, the second purpose of this paper is to examine if there is an obvious change in risk sharing in recent years.

The next section provides a critical survey of the previous empirical studies on risk sharing in subcontracting in Japan. In Section 3 the existence of and changes in the risk sharing will be proved in an alternative way using two firm-level data sets from the Japanese automobile industry. Concluding remarks follow in Section 4.

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[1] Nakatani (1984), for example, argues that insurance is the main function of corporate groups and main bank relations. For an empirical analysis of risk sharing in corporate groups see Nakatani (1984) and Odagiri (1992). The analytical idea of this paper owes much to their studies.

II. *Critical Survey of the Previous Empirical Studies*

Asanuma (1984), which reveals in detail the mechanism of price/volume adjustments in the trade of auto parts through case studies, reports as follows some interesting business practices which suggest risk bearing by automobile manufacturers:

To decide the unit price of each part, it is necessary to estimate the cost of the metal mold for it. The estimation is based on the planned production volume in the depreciation period of the metal mold. If the car in which the part is used finds poor sales and so the depreciation of the metal mold is not yet finished when the production is stopped, there applies a rule that the auto maker compensates for the rest of the depreciation. The car makers also often allow the parts suppliers to shift the increase in the material cost to the unit price of parts at the renewal of price which takes place every half year. Furthermore, the unit price will be adjusted to the increase in cost caused by draft changes from auto makers or to the decrease in cost caused by the rationalization of suppliers. Such rules of price adjustment during the contract term could be understood as a whole as a mechanism whereby auto makers absorb a part of the risk of the fluctuation of the production costs of suppliers.

Kawasaki and McMillan (1987) attempted the first econometric analysis of risk sharing in subcontracting relations based on the principal agent model, considering the actual practices in the auto parts trade in Japan as described above. They used industry and firm size data from the Census of Manufactures (Kogyo Tokeihyo) in the period of 1973–82 and found 1) to what extent the big assemblers bear the risk of the fluctuation of the production costs of the subcontractors (small and medium sized firms in the industry sectors with a high ratio of subcontractors), and 2) which factors determine the rate of risk absorption by the assemblers. In their study the rate of risk absorption, α, by trade partners was formulated as follows: $\alpha = 1-(S/\sigma)$, where S = standard deviation of profit (of a subcontracting industry) and σ = standard deviation of production costs (of a subcontracting industry).

If the profit of a subcontracting industry is completely influenced by any fluctuation of cost, or in other words, if the buyers do not accept any adjustment of purchasing price to changes of production cost, then α is equal to 0 and so all the risk of cost fluctuation is taken by the subcontractor. This case corresponds to the fixed price contract. On the other hand, if the cost fluctuation does not influence the profit at all, or in other words, if any fluctuation of cost is shifted to the purchasing price, then α is equal to 1 and so all the risk of the cost fluctuation is absorbed by the business partner. This case corresponds to the cost-plus contract.

The estimated values of α in 5 firm size classes of 9 industry sectors were distributed between 0.39 and 0.89, and the majority of the values were over 0.5, with an unweighted average of 0.69. This result suggests that the trade contract is designed more like a cost-plus contract rather than a fixed price contract, so that the buyers bear more than half of the risk of the cost fluctuation of the suppliers. They furthermore proved by a regression analysis that the purchasing price reacts more sensitively to the cost fluctuation of subcontractors (i.e., the value of α is higher), 1) the more risk averse the subcontractors are, 2) the bigger the cost fluctuation is, and 3) the less serious the problem of moral hazard is (in this case this means the risk for buyers that subcontractors declare a higher cost than it really is, taking advantage of the lack of information on the side of buyers).

While Kawasaki and McMillan (1987) analysed aggregated data from industry statistics, Asanuma and Kikutani (1992) used firm data to test risk sharing in auto parts trade in Japan with the same method as Kawasaki and McMillan. Their study showed the interesting results that 1) the average value of the estimated risk absorption rate α of the parts suppliers was over 0.9 for all groups of car makers, and 2) the difference between α values among the parts suppliers was very small (the variance was between 0.0043 and 0.0057, according to the group). The regression analysis on the influence factors of the value of α for each auto maker's supplier group provided results mostly corresponding to those of Kawasaki and McMillan (1987).

Can we just conclude from the results of Asanuma and Kikutani (1992) that the Japanese automobile manufacturers absorb over 90% of the business risk of the parts suppliers, and that the differences of the degree of risk absorption among the auto makers and among the parts suppliers are very small? And does their result totally reject the possibility that auto makers shift risk to parts suppliers?

We hesitate to accept directly the results of the estimation of α-values by Kawasaki and McMillan (1987), and Asanuma and Kikutani (1992), because of some serious problems in their estimation method. Furthermore, even if it is proved that auto manufacturers absorb the risk of cost fluctuation of parts suppliers, it does not exclude the possibility that at the same time the former shift the risk of demand fluctuation to parts suppliers, as the traditional hypothesis remarks. Now let us explain these critiques in more detail.

It is a most serious problem in the estimation of the risk absorption rate α that we cannot distinguish the unit production cost from the total production cost because of the restriction of data. In the estimation period, from the end of the 1970s to the end of the 1980s, the production of auto parts and the purchase of raw materials increased remarkably and almost continuously, together with the production of cars. In this case, even if there is no change in the unit price of raw materials, the standard deviation of production costs gets bigger as total cost increases. Thus the fluctuation of production costs will be overestimated. (In fact, through the 1980s, although the price of raw materials went down somewhat according to the input price index, total cost, along with sales, increased sharply.) Suppose there is also no change in the unit price of auto parts, and the total profit and total cost increase to the same extent in proportion to sales. The standard deviation of cost will be more than ten times bigger than that of profit, as the rate of operating profit to sales is usually at some percent, and so the amount of cost is usually more than ten times bigger than the amount of profit. As a result, the rate of risk absorption exceeds 0.9 in this example case, although there is no risk absorption at all. In such a case, the difference in the value of α among industries or firms might have some meaning, but the value itself will not be important.

Secondly, we may assume that production costs and profit increase and decrease in the same direction, when we take the fact of derived demand into consideration. In the previous studies it is implicitly assumed that the price of raw materials is an exogenous variable, but usually it is influenced by demand fluctuation except cases like the Oil Crisis. Thus, there can also be the following sequence of causality[2]: decrease in demand for cars ⇨ decrease in

[2] Yamazaki (1994) points out in his empirical study on risk sharing in the construction sector that the price of construction materials and labour costs are rather endogenous variables and so are influenced by the fluctuation of demand for, and unit price of, the construction.

demand for auto parts ⇨ decrease in demand for raw materials ⇨ drop in the material price. In this case the decrease in profit of parts suppliers and the drop in material price will occur at the same time, contrary to the assumption of the risk absorption hypothesis. In the previous studies the fluctuations of cost and profit were measured by standard deviation, where the direction of change is out of regard, so that we cannot preclude completely the suspicion that the risk sharing would not have been correctly estimated.

Moreover, we estimated with the data of our own sample firms (which will be used in the next section), also the rate of risk shifting from auto makers to suppliers in regard to the risk of demand fluctuation, applying the method of Kawasaki and McMillan (1987). Here the risk shifting rate β was formulated as follows: $\beta = 1-(S^*/\sigma^*)$, where S^* = standard deviation of the profit of auto makers and σ^* = standard deviation of the sales of auto makers. This rate was not estimated in the previous studies. If the demand (sales) for cars fluctuates remarkably while there is almost no change in the profit, the value of β is close to 1, meaning that auto makers shift most of the risk of demand fluctuation to suppliers. As it turned out, there was little difference between the estimated values of α and β, suggesting that auto makers shift the risk of demand fluctuation to suppliers to almost the same extent that they absorb from suppliers the risk of cost fluctuation. Therefore, we can not prove by the method of the previous studies that auto makers with a high capability of risk bearing absorb unilaterally the risk from the risk-averse parts suppliers.

We consider the risk of demand fluctuation to be much more important than that of cost fluctuation for parts suppliers in general. In fact, the price of raw materials, the increase of which can more easily be shifted to the unit price of parts than any other sort of production cost, decreased somewhat through the 1980s, as mentioned above. Then we come to the conclusion that the auto makers bear the rather less important risks of the suppliers among the many kinds of risks, while shifting to them the more essential ones.

From the discussions above, it is now obvious that the estimations of risk sharing in the previous studies have serious problems. Furthermore, it was proved that the results of these studies are neither enough nor appropriate evidence to reject the traditional view of risk shifting to parts suppliers, since they do not consider at all the risk of demand fluctuation, which is essential for parts suppliers. For a more correct analysis of risk sharing in business relations, we need to avoid the above-mentioned estimation problems and to take the risk of demand fluctuation appropriately into consideration.

In the next section we will prove the existence of risk sharing in the auto parts trade in an alternative way using two different data sets at the firm level.

III. *Empirical Analysis of Risk Sharing in the Auto Parts Trade*

(1) Analytical Method and Data Sets

An alternative way to prove the existence of risk sharing in the auto parts trade is to test if the profit rate of parts suppliers and its stability differ significantly according to the intensity and patterns of business relations. According to the insurance hypothesis of Aoki (1984), as mentioned above, parts suppliers pay a part of the profit from the subcontracting relation as a risk premium to auto makers to get in return an insurance service against fluctuation of the profit rate. If this is true, the profit rate of parts suppliers with a higher degree of risk sharing with auto makers should be, other things being equal, lower but more stable compared to other suppliers. On the other hand, the intensity and the patterns of business relations with car makers vary among suppliers. So we may assume that, if the auto makers absorb part of the risk of the suppliers, the extent of risk absorption would not be equal for all suppliers, but differ according to the intensity of the business relations. Therefore, if the profit rate of parts suppliers with relatively intensive relations with car makers is significantly lower but more stable compared to those with less intensive relations, the hypothesis of risk absorption by auto makers will be indirectly proved.

This method is basically the same as the one used in Nakatani (1984) and Odagiri (1992) to test the insurance function of corporate groups in Japan. An advantage of this method is that it is able to prove the risk sharing as a whole, regardless of the kind. In this way the complicated problems with the estimation of risk sharing, as observed in the previous studies, can also be avoided.

We used two data sets at the firm level for the analysis. Both samples consist of auto parts suppliers which report their yearly financial data continuously in the "Kaisha Nenkan" (Annual Corporation Reports for Listed Companies) and "Kaisha Sokan" (Annual Corporation Reports for Unlisted Companies) published by Nihon Keizai Shinbunsha.

The first sample consists of 84 firms with continuous yearly financial data for 8 years from 1985 to 1992, which also report in other data sources [Sangyo Shiryosha (1984)(1986)(1987)(1988a)(1988b)(1989)] the proportion of sales to the main buyer to whole sales, and that of the stocks held by the main buyer to total stocks. We used this sample to prove above all the influence of the trade intensity of suppliers in regard to the main buyer.

The second sample includes 60 firms with continuous yearly financial data for 16 years from 1977 to 1992, which also give information about the main buyers and the main shareholders, but without percentages. Most of them are included in the first sample. The main reason for using the second sample is to show if there was a change in the risk sharing from the first period 1977–1984 to the second period 1985–1992.

Both data sets include the average number of employees during the period as the variable of firm size. The samples do not include those firms which went through mergers during the period. Among the 60 firms in the first sample, 33 are listed and 27 are unlisted, and in the second sample of 84 firms, 34 are listed and 50 are unlisted. So, we cannot deny that the samples are biased towards the upper group, or large corporations, among parts suppliers. Since the sample firms have different settlement terms, and many firms changed the settlement terms during the period, we had to adjust the necessary financial data (sales and operating income) to the settlement terms in March for all sample firms.

(2) Regression Models

Using the data of the first sample we estimate the following regression equations:

1) $\sigma = a_0 + a_1 \ln SIZE + a_2 PROSAL + a_3 STHOLD + a_4 D(1st) + a_5 D(RANK)$

2) $\pi = b_0 + b_1 \ln SIZE + b_2 PROSAL + b_3 STHOLD + b_4 D(1st) + b_5 D(RANK)$

Here, the dependent variable π is the average profit rate (ratio of operating income to sales) over the period 1985–1992, while σ is the standard deviation of the profit rate and shows the extent of fluctuation of the profit rate over the period[3]. lnSIZE is the log-transformed value of the average number of employees during the period, and is the proxy for firm size. PROSAL is the proportion of sales to the main buyer to whole sales, and is the variable for trade intensity or the dependence on the main buyer. STHOLD is the proportion of the stocks held by the main buyer to the total stocks. D(1st) is a dummy variable for direct trade with a car maker (or for being a first-tier supplier to a car maker), taking 1 if the main buyer is a car maker and 0 otherwise. Finally, D(RANK) is the dummy variable for the ranking of the main buyer, taking 1 if the main buyer is one of the five biggest car makers (Toyota, Nissan, Mitsubishi, Honda and Mazda) and 0 if not.

For the second sample of firms we have the following regression models, which are quite similar to the first ones, but not exactly the same because some data are not available for this sample:

3) $\sigma = c_0 + c_1\mathrm{lnSIZE} + c_2\mathrm{D(STOCK)} + c_3\mathrm{D(1st)} + c_4\mathrm{D(RANK)}$
4) $\pi = d_0 + d_1\mathrm{lnSIZE} + d_2\mathrm{D(STOCK)} + d_3\mathrm{D(1st)} + d_4\mathrm{D(RANK)}$

Here all variables but D(STOCK) are the same as those in the first two equations. The dummy variable D(STOCK) takes 1 if one of the two main buyers is also among the two main stockholders and 0 if not.

We include firm size in the regression models, firstly to control the other variables for business relations, and secondly as a variable for the degree of risk aversion of parts suppliers. Asanuma and Kikutani (1992) found that the bigger a supplier is in size, the lower is the degree of risk aversion, and thus the lower also is the degree of risk absorption by business partners. According to this result, the sign of the coefficient of lnSIZE should be positive in all the equations.

The other explanatory variables are proxies for business intensity or trade patterns. At first, we may assume that if the car makers absorb the risk of suppliers, the absorption will be done more actively for the suppliers with which car makers have more intensive trade relative to the other suppliers. Then the profit rate of the suppliers trading more intensively with a car maker will be more stable, compared to those with less intensive trade. Also it will be on average lower, if the former pay more compensation for the risk absorption. So the sign of the coefficient PROSAL is expected to be negative in equations 1) and 2).

Likewise, car makers are assumed to be more active in risk absorption for affiliated firms than for those with no or little capital relations. For, as has been revealed by various studies, car makers usually hold only the stocks of those suppliers which are especially important for them. If those suppliers pay compensation for the risk absorption, their profit rate will be lower, other things being equal. So we may expect the sign of the coefficient of STHOLD to be negative in equations 1) and 2). The sign of the coefficient of the dummy variable D (STOCK) is assumed to be negative in equations 3) and 4), because it is like a mixture of the

[3] As the measure of the extent of the fluctuation, we may use variance, standard deviation and the coefficient of variation, which is given by dividing the standard deviation by the average. Since the size of the standard deviation is also influenced by the level of the average value, in general it is desirable to use, when the averages differ remarkably from each other, the coefficient of variation to compare the extent of fluctuation. However, in the analysis of the profit rate by means of firm data, the average can often be negative or near to zero, which gives rise to difficulties. Therefore, in this paper we use the standard deviation as the measure, just like Odagiri (1992).

variables PROSAL and STHOLD, as mentioned above.

Note here that the suppliers with capital relations to the car makers may also have particularly intensive trade with them. So there may be the problem of multicollinearity when we have the variables PROSAL and STHOLD at the same time in a regression model. Then they should be included alternatively in the equation.

We can expect the profit rate of the suppliers which have direct trade with auto makers to be more stable than that of the other suppliers, if auto makers absorb risk. And, if the suppliers then sacrifice a part of their profit as a risk premium, the average profit rate of the direct suppliers will be lower, other things being equal. However, according to "common sense", first-tier suppliers have higher profit rate than second-tier firms. Therefore, the sign of the coefficient of D(1st) in equations 1) and 3) is assumed to be negative, but it can be positive or negative in equations 2) and 4).

Finally, the profit rate of suppliers whose main buyer is a high-ranked car maker will be more stable compared to the other ones, since it is assumed that the ability of risk absorption is the higher the larger the size and the market share of a car maker is. If suppliers then pay a higher premium as compensation for a higher degree of risk absorption, their average profit rate will be accordingly lower, other things being equal. In regard to the rank of the car makers we may also assume that high-ranked car makers have stronger bargaining power with suppliers than the other car makers. On the other hand, however, suppliers might get more orders and support from high-ranked car makers which have more sales and a higher market share. Therefore, like D(1st), the sign of the coefficient of D(RANK) is expected to be negative in equations 1) and 3), but it can be positive or negative in 2) and 4).

(3) Empirical Results

Tables 1 and 2 show the estimation results of the regression equations 1) and 2) respectively. Because of the strong correlation between PROSAL and STHOLD (0.62) and between D(1st) and D(RANK) (0.83), these variables are alternatively included in the equations.

In regard to the stability (or fluctuation) of the profit rate (Table 1), the coefficients of all variables have negative signs. Those of PROSAL and STHOLD are significant even when

TABLE 1. ESTIMATION RESULTS ON THE FLUCTUATION OF PROFIT RATES
(Sample 1: n=84, 1985–1992)

	const.	lnSIZE	PROSAL	STHOLD	D(1st)	D(RANK)	$\bar{R}^2$
(1)	0.0393[a]	−0.0020	−0.0153[a]		−0.0033		0.100
	(4.001)	(−1.417)	(−2.986)		(−0.554)		
(2)	0.0386[a]	−0.0022	−0.0152[a]			−0.0013	0.097
	(3.960)	(−1.566)	(−2.959)			(−0.260)	
(3)	0.0306[a]	−0.0017		−0.0100[c]	−0.0031		0.034
	(3.155)	(−1.155)		(−1.706)	(−0.492)		
(4)	0.0299[a]	−0.0019		−0.0098[c]		−0.0012	0.032
	(3.116)	(−1.288)		(−1.677)		(−0.232)	

t-statistics in parentheses
a: significant at 1% level
b: significant at 5% level
c: significant at 10% level

TABLE 2. ESTIMATION RESULTS ON THE AVERAGE PROFIT RATES
(Sample 1: n=84, 1985–1992)

	const.	lnSIZE	PROSAL	STHOLD	D(1st)	D(RANK)	$\bar{R}^2$
(1)	0.0772[a]	−0.0065[a]	−0.0161[b]		−0.0123		0.163
	(6.022)	(−3.548)	(−2.406)		(−1.564)		
(2)	0.0771[a]	−0.0068[a]	−0.0160[b]			−0.0148[b]	0.189
	(6.182)	(−3.824)	(−2.423)			(−2.275)	
(3)	0.0682[a]	−0.0060[a]		−0.0163[b]	−0.0120		0.154
	(5.557)	(−3.185)		(−2.208)	(−1.507)		
(4)	0.0681[a]	−0.0063[a]		−0.0160[b]		−0.0144[b]	0.179
	(5.698)	(−3.450)		(−2.198)		(−2.199)	

Note: See notes of Table 1

controlled by firm size and trade patterns, although the influence of STHOLD is quite weak. This suggests that the profit rate of parts suppliers is more stable the larger the sales proportion to the main buyer, and the more intensive the capital relation with him is. Note that it is contrary to the results of the previous studies that the coefficients of lnSIZE have all negative signs, even if insignificant.

As for the average profit rate (Table 2), here also all the coefficients of lnSIZE, PROSAL and STHOLD are negative and significant, suggesting that large suppliers with a high sales proportion and an intensive capital relation with the main buyer have significantly lower profit rates than the others. While the coefficients of D(1st) are negative but not significant, those of D(RANK) are negative and significant, suggesting that suppliers trading mainly with a high-ranked car maker have a lower profit rate than the others. Combining the results in Table 1 and 2, we may conclude that intensive business and capital relations with the main buyer influence the profit rate negatively, but its stability positively. These results give support to the hypothesis that the auto makers absorb a part of the risk of the suppliers.

Now let us see if there are any changes in the risk sharing in recent years. As mentioned

TABLE 3. ESTIMATION RESULTS ON THE FLUCTUATION OF PROFIT RATES
(Sample 2: n=60, 1977–1984)

	const.	lnSIZE	D(STOCK)	D(1st)	D(RANK)	$\bar{R}^2$
(1)	0.0337[a]	−0.0023[b]	−0.0041[c]	−0.0072[c]	0.0044[c]	0.229
	(5.181)	(−2.061)	(−1.977)	(−1.755)	(1.690)	
(2)	0.0290[a]	−0.0021[b]	−0.0049[b]			0.193
	(4.714)	(−2.265)	(−2.327)			
(3)	0.0221[a]		−0.0056[a]	−0.0079[b]		0.188
	(6.494)		(−2.768)	(−2.171)		

Note: See notes of Table 1

TABLE 4. ESTIMATION RESULTS ON THE AVERAGE PROFIT RATES
(Sample 2: n=60, 1977–1984)

	const.	lnSIZE	D(STOCK)	D(1st)	D(RANK)	$\bar{R}^2$
(1)	0.0681[a]	−0.0056[c]	−0.0126[b]	0.0112	0.0139[b]	0.182
	(4.171)	(−1.953)	(−2.410)	(1.085)	(2.130)	
(2)	0.0711[a]	−0.0048[c]	−0.0120[b]		0.0159[b]	0.179
	(4.410)	(−1.725)	(−2.309)		(2.538)	

Note: See notes of Table 1

TABLE 5. ESTIMATION RESULTS ON THE FLUCTUATION OF PROFIT RATES
(Sample 2: n=60, 1985–1992)

	const.	lnSIZE	D(STOCK)	D(1st)	D(RANK)	$\bar{R}^2$
(1)	0.0330[a]	−0.0009	−0.0047	−0.0096	0.0017	0.118
	(3.166)	(−0.519)	(−1.324)	(−1.524)	(0.415)	
(2)	0.0332[a]	−0.0024	−0.0050			0.101
	(3.488)	(−1.610)	(−1.409)			
(3)	0.0283[a]		−0.0056[c]	−0.0122[b]		0.136
	(5.580)		(−1.771)	(−2.229)		

Note: See notes of Table 1

TABLE 6. ESTIMATION RESULTS ON THE AVERAGE PROFIT RATES
(Sample 2: n=60, 1985–1992)

	const.	lnSIZE	D(STOCK)	D(1st)	D(RANK)	$\bar{R}^2$
(1)	0.0809[a]	−0.0063[b]	−0.0109[c]	−0.0004	0.0101	0.178
	(4.986)	(−2.253)	(−1.981)	(−0.042)	(1.579)	
(2)	0.0807[a]	−0.0064[b]	−0.0109[b]		0.0100	0.193
	(5.122)	(−2.336)	(−2.016)		(1.643)	

Note: See notes of Table 1

in the first section, the Japanese auto makers began to reorganize their subcontracting relations in the mid-80s, caused by the continuously high appreciation of yen, and are recently even more active in reorganizing. Tables 3 to 6 show the comparative results of the regression analysis between the periods 1977–1984 and 1985–1992. There we find that the positive influence of the firm size (lnSIZE) and the intensity of business relations [D(STOCK)] on the stability of the profit rate became weaker (i.e., both the significance of estimated coefficients and the values of determination coefficients declined), while their negative influence on the average profit rate remains quite stable as a whole.

These results suggest that, although the auto makers basically maintain the risk absorption for large-size suppliers which have intensive business and capital relations with them, while getting a part of the profit from them as a premium, the effect of such an insurance mechanism is getting weaker in recent years. One reason for these changes may be the trend of "flexibilization" of business relations in recent years (increases in sales to new buyers or purchases from new suppliers)[4]. It is also assumed that recently the car makers cannot fulfill the function of an insurer for the suppliers to the same extent as earlier, perhaps because of the changing economic conditions. In fact, the profit rate of car makers became lower and less stable since the mid-80s, compared to the former period as well as to the suppliers[5].

[4] Also Aoki (1984) points out that the long-term mechanism of risk sharing will become difficult to maintain with the flexibilization of business relations. However, we can not judge directly from the results of our analysis if the flexibilization of business relations is in fact influencing risk sharing.

[5] According to our calculations, the average profit rate of the car makers was 4.0% in the period 1977–1984, and decreased to 2.7% in the period 1985–1992, while that of the parts suppliers (here the firms with less than 100 Million yen capital stock in the transportation machinery industry) was 3.0% in the former period and increased to 3.5% in the latter period. As for the stability of the profit rate, its standard deviation over the former period was for the car makers 0.4 and for the suppliers 0.7, but in the latter period it became 1.1 and 0.5 respectively. So it is clear that the car makers formerly had a higher and more stable profit rate compared to the parts suppliers, but now the situation is just the opposite.

IV. *Concluding Remarks*

The main objective of this paper was to prove the existence of and recent changes in risk sharing in Japanese subcontracting relations. Some scholars argue that the big assemblers absorb the risk of the more risk-averse small suppliers in return for a part of the profit as a premium, and that the efficiency of subcontracting relations in Japan is partly based on this implicit contract of risk sharing. The results of the previous empirical studies seem to support this viewpoint, but they are not persuasive enough, as there are some serious problems in the estimation of the risk sharing, and moreover they leave the essential risk for the parts suppliers, i.e. the risk of demand fluctuation, out of consideration.

So in this paper we proved the existence of risk sharing in the business relations in an alternative way using firm-level data sets of the Japanese auto parts suppliers: Namely, we tested if the average profit rate and its fluctuation of suppliers differ according to business intensity and trade patterns. The main findings are as follows: 1) The intensity of trade (measured by the proportion of sales to the main buyer to whole sales) decreases the profit rate but increases its stability significantly; 2) Affiliation with the main buyer (measured by the share of stocks held by the main buyer) likewise decreases the profit rate but increases its stability significantly (even if the latter effect is rather weak); 3) Also the firm size, direct trade with auto makers, and the trade with high-ranked auto makers are factors which influence the average level and the fluctuation of the profit rate of the suppliers, but not always significantly. By a comparison of the results in regard to different periods using the same data set it was affirmed that the risk sharing has been maintained basically, but with some changes suggesting the declining effect of this implicit mechanism on the stability of the profit rate.

The results of the analysis imply as a whole risk absorption by the auto makers, and support in this respect the risk absorption hypothesis in the previous studies. However, contrary to this hypothesis, in which the main buyers absorb risk of the suppliers according to their risk aversion and the extent of the risk they are faced with, in our analysis the main factors for risk absorption are rather trade intensity and affiliation to the main buyer.

Moreover, according to previous studies, all car makers provide most suppliers with almost the same extent of risk absorption (almost no difference in the risk absorption ratio among the suppliers), but the results of our analysis, which is mainly interested in the difference of the stability of the profit rate among suppliers, suggest rather that the risk absorption is provided to them selectively. It is also intuitively acceptable that the auto makers, trying to build up efficient business relations with the suppliers while selecting the superior ones continuously, provide for the stabilization of corporate performance of the selected firms with which they have intensive relations. Our results are in this respect also consistent with the traditional view that the main buyers actively bring up and support the selected suppliers.

To finish this paper we will point out some limitations of this study. Firstly, the samples consist of relatively small numbers of firms (60 and 84), because of the limited availability of the necessary data, and large upper-class suppliers are over-represented in the samples. Therefore it would be dangerous to generalize our results directly to small firms. Secondly, our analysis is limited to auto parts suppliers, so one should be careful in applying them to other industries. Thirdly, the estimation period in the analysis is up to the end of the fiscal year 1992

(March 1993). So the influence of the excessive appreciation of yen and the activation of restructuring after April 1993 is out of consideration. Anyway, it is quite difficult to seize each short-term change and its influence by measuring the risk by means of variance or standard deviation of time-series data over several years. The econometric study of subcontracting relations is now still in its beginning, so we expect more studies to be done in this direction.

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REFERENCES

Aoki, Masahiko (1984), "Innovative Adaptation through the Quasi-tree Structure: An Emerging Aspect of Japanese Entrepreneurship," *Zeitschrift für Nationalökonomie* (*Suppl.*), pp. 177–198.

Asanuma, Banri (1984), "Nihon ni okeru Buhin Torihiki no Kozo: Jidosha Sangyo no Jirei" [The Structure of the Parts Trade in Japan: A Case Study of the Automobile Industry], *Keizai Ronso* (Kyoto Univ.) 133–3, pp. 137–158.

Asanuma, B./T. Kikutani (1992), "Risk Absorption in Japanese Subcontracting: A Microeconometric Study of the Automobile Industry", *The Journal of the Japanese and International Economies* 6, pp. 1–29.

Kawasaki, S./J. McMillan (1987), "The Design of Contracts: Evidence from Japanese Subcontracting", *The Japanese and International Economies* 1, pp. 327–349.

Nakatani, Iwao (1984), "The Economic Role of Financial Corporate Grouping" in: Aoki, Masahiko (ed.), *The Economic Analysis of the Japanese Firm*, Amsterdam/New York/ Oxford (North-Holland), pp. 227–258.

Odagiri, Hiroyuki (1992), *Growth through Competition, Competition through Growth: Strategic Management and the Economy in Japan*, Oxford Univ.Press.

Yamazaki, Fukuju (1994), "Kensetsugyo ni okeru Motouke Shitauke no Risuku Shearingu ni tsuite" [on the Risk Sharing between the General Constractors and Subcontractors in the Construction Sector], *Jochi Keizai Ronshu* 40–1, pp. 35–45.

DATA SOURCES

Nihon Keizai Shinbunsha (ed.), *Kaisha Nenkan* [Annual Corporation Reports for Listed Companies], various years.

Nihon Keizai Shinbunsha (ed.), *Kaisha Sokan* [Annual Corporation Reports for Unlisted Companies], various years.

Sangyo Shiryosha (Sangyo Shuppan)(ed.),
(1984), *Sangyo Chosa Shiryo: Mazda*
(1986), *Sangyo Chosa Shiryo: Toyota Jidosha*
(1987), *Jidosha Buhin Gyokai: Chubu Hen* [Parts Industry in Middle Japan]
(1988a), *Jidosha Buhin Gyokai: Kansai Nishinihon Hen* [Parts Industry in West Japan]
(1988b), *Sangyo Chosa Shiryo: Nissan Jidosha*
(1989), *Sangyo Chosa Shiryo: Honda Giken Kogyo*