Risk Sharing in the Supplier Relationship:
New Evidence from the Japanese Automotive Industry *

Hiroyuki Okamuro **
Graduate School of Economics, Hitotsubashi University, Tokyo

ABSTRACT

The Japanese corporate system is assumed to contain an implicit insurance mechanism in various aspects. Based on an alternative method to that of previous studies, this paper examines risk sharing in the supplier relationship, using a unique data set of Japanese automotive parts suppliers. The results of this study suggest that the carmakers partially absorb the business risk of the suppliers, despite of recent structural changes in the supplier system: The relative stability of the profit rate of the suppliers is significantly influenced by the intensity of business relations with the main customer.

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** The address of the author:
Hitotsubashi University, Graduate School of Economics, Kunitachi 186-8601 Tokyo Japan; Tel. +81-42-580-8593, Fax. -8882,
E-mail: okamuro@econ.hit-u.ac.jp

1. Risk Sharing in the Japanese Corporate System

Japanese large corporations have quite stable ownership structures as well as long-term relations with banks, suppliers, and customers. Such arrangements enable flexible terms of business in order to stabilize prices and business performance. In this sense, the Japanese corporate system is often assumed to include an insurance or risk sharing mechanism[1].

Aoki (1988), for example, explains the insurance mechanism in the supplier relationship as follows. If there is a difference in the degree of risk aversion between the business partners, it is more efficient as a whole that the larger part of risk is taken by the less risk-averse firm in return for some risk premium such as a greater share of the common rent made by efficient risk sharing between the business partners. It may be assumed that, in general, large customers (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 for them to take a larger part of the business risk and so to insure their suppliers against profit fluctuation in return for obtaining a larger share of the profit from the business relationship.

The results of previous empirical studies [Kawasaki and McMillan (1987), Asanuma and Kikutani (1992)] seem to support this idea of risk absorption by large customers. However, these results cannot be readily

[1] Empirical analysis on this topic shows contrasting results. While Nakatani (1984), Osano/Tsutsui (1986) and Tsuji (1993) provide evidence for the insurance function of the main bank, Horiuchi/Packer/Fukuda (1988) do not support this argument. Nakatani (1984)'s further argument of risk sharing in corporate groups through

accepted because of some serious problems in the estimation method, as discussed below. It is therefore the purpose of this paper to reexamine in an alternative way if the Japanese supplier relationship really involves an insurance mechanism for suppliers, namely, if the customers absorb a part of the business risk of their suppliers.

The Japanese supplier system has been undergoing structural and strategic changes since the late 1980s. Carmakers and other final assemblers are restructuring their supplier relations by intensively seeking for new purchasing sources including overseas suppliers. Suppliers, on the other hand, have decreased the ratio of subcontracting business and the dependence on the main customer[2]. Such a "flexibilization" of the supplier system may weaken risk sharing, while globalization of economic activities and the increasing importance of R&D under rapidly changing market conditions are supposed to enhance business risk in general. It would therefore be of great interest to reexamine if risk absorption by large customers was in function until recently despite of these structural and strategic changes.

The next section provides a critical survey of previous empirical studies on risk sharing in the supplier relationship. In Section 3 the risk sharing will be reexamined in an alternative way using a unique firm-level data set from the Japanese automotive industry. Discussion and concluding remarks follow in Section 4.

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a mutual insurance mechanism was not supported by Odagiri (1992).

[2] According to the Small and Medium Enterprise Agency (1997, p. 147 ff.), the ratio of subcontracting firms which completely devote themselves to the subcontracting business declined from 82% in 1987 to 48% in 1996. Within the same period, the ratio of subcontracting firms that concentrate more than a half of their sales on their main customer decreased from 71% to 53%.

2. Critical Survey of Previous Empirical Studies

Kawasaki and McMillan (1987) attempted the first econometric analysis of risk sharing in the supplier relations based on the principal-agent theory, taking into account the practices of price adjustment during the contract term in the Japanese automotive industry, as reported by Asanuma (1985). They used industry-level data from the period 1973-1982 to prove, 1) to what extent large customer firms share the risk of production cost fluctuation with subcontractors, and 2) which factors determine the ratio of risk absorption by the customers. Hereby subcontractors are defined as small and medium firms in the industry sectors with intensive subcontracting. In their study the ratio of risk absorption α by customers was formulated as,

$$\alpha = 1 - S/\sigma \qquad (1)$$

where S and σ are the respective standard deviations of profit and production cost (of a supplying industry).

If the profit of a supplying industry is directly influenced by any fluctuation in costs, or alternatively expressed, if the customers do not accept any adjustment of purchasing price to changes of production cost, α is assumed to be equal to 0 and so all the risk of cost fluctuation is burdened by the supplier. 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, α is assumed to be equal to 1 and so all the risk of the cost fluctuation is absorbed by the customer. This case corresponds to the cost-plus contract[3].

The estimated values of α in 5 classes by firm-size in 9 industry sectors are distributed between 0.39 and 0.89, and the majority of the values are over 0.5, with the simple average being 0.69. This result suggests, according to the authors, that contracts with suppliers are designed more like a cost-plus contract rather than a fixed price contract, so that the customers bear more than half of the risk of cost fluctuation of the suppliers. They furthermore found that the purchasing price reacts more sensitively to the cost fluctuation of suppliers (i.e., the value of α is higher), 1) the more risk averse the suppliers are, 2) the bigger the cost fluctuation is, and 3) the less serious the problem of moral hazard is. The last statement indicates the risk for the customers that the suppliers might overstate their costs, taking advantage of the information deficiency on the customers' side.

While Kawasaki and McMillan (1987) analyze aggregated data from industry statistics, Asanuma and Kikutani (1992) use firm level data for the period 1977-1987 to prove risk sharing in the automotive industry with the same method as the former. Their study shows interesting results that the average value of the estimated risk absorption ratio α is over 0.9 for all groups of carmakers. The regression results on the influence

[3] In this model, they do not take quantitative changes of demand into account, as Asanuma and Kikutani (1992) remark. This limitation induces serious problems in the estimation of the risk absorption, as will be discussed later.

factors of the value of α correspond largely to those of Kawasaki and McMillan (1987). Recently, Yun (1999) applied this method to the supplier relationship in the Korean automotive industry and obtained similar results, where the estimated average value of α was 0.85.

Can it then simply be concluded from their results that the Japanese and Korean automotive manufacturers absorb almost all the business risk of their parts suppliers? And do these results justify rejecting the hypothesis that the carmakers shift risk to their suppliers?

I hesitate to accept readily the estimation results in these studies because of some serious problems in the estimation method. Furthermore, even if it is proved that the carmakers absorb the risk of cost fluctuation of their suppliers, it does not exclude the possibility that, at the same time, the former shift the risk of demand fluctuation to the latter, as the traditional hypothesis remarks. Now let us explain this critique in more detail.

It is a serious problem in the estimation of the risk absorption ratio that one cannot distinguish the unit cost from the total cost because of restricted data availability. In the estimation period, the production of parts and the purchase of raw materials, along with the production of cars, increased remarkably and almost continuously until the beginning of the 1990s. In this case, even if there is no change in the unit price of raw materials, the standard deviation of production costs becomes bigger as total cost increases. Thus the fluctuation of production costs will be overestimated. In fact, in the 1980s, total cost along with sales increased sharply, though the input price index

shows a slight decline of the prices of raw materials in the same period.

Secondly and more importantly, the value of α is clearly influenced by the level of the profit rate. In the Japanese industry, cost is usually more than ten times bigger than profit (operating income). Suppose both total profit and total cost increase the same in proportion to sales because of increasing demand, while there is no change in the unit price of parts. The standard deviation of cost would then be more than ten times bigger than that of profit, so the ratio of risk absorption exceeds 0.9 in this example, though there is in fact no risk absorption at all. The estimated value of α will be higher the lower the profit rate is[4].

Thirdly, it can be assumed that production cost and profit both increase and decrease rather in the *same* direction, if the possibility of derived demand is taken into account. In previous studies, it is implicitly assumed that the price of raw materials is an exogenous variable, but in fact it can be influenced by demand fluctuation. Thus,

there can also be the following sequence of causality[5]: A decrease in demand for cars leads to a decrease in demand for auto parts, which further induces a decrease in demand for raw materials, which finally causes a drop in material prices. In this case, the decrease in profit of suppliers and the drop in material prices will occur at the same

[4] This may explain why the estimated ratio of risk absorption in Asanuma/Kikutani (1992) is much higher than that of Kawasaki/McMillan (1987). The former study calculates the profit rate as the ratio of operating income to sales, while the latter measures it as the price-cost margin, which is much higher than the other.
[5] Yamazaki (1994) points out in his study on risk sharing in the construction sector that the price of construction materials and labor costs are rather endogenous variables and so are influenced by the fluctuation of demand for, and unit price of, the construction.

time, contrary to the assumption of the risk absorption hypothesis. In previous studies, fluctuations in cost and profit are measured by their standard deviations, where the direction of change (increase or decrease) is paid no attention, thus failing to estimate the extent of risk sharing correctly.

Moreover, previous studies assume that there is no quantitative change in demand during the period, thus completely ignoring the risk of demand fluctuation, which may be substantial for suppliers. They therefore reject the hypothesis of risk shifting in regard to the demand fluctuation without considering this type of risk at all.

Let us now estimate, as a trial, the ratio of risk shifting from the carmakers to the suppliers in regard to the demand fluctuation, applying the method employed by Kawasaki and McMillan (1987). Here the risk shifting ratio β is formulated as

$$\beta = 1 - S^*/\sigma^* \qquad (2)$$

where S^* and σ^* are the standard deviations of profit and sales of the carmakers respectively. 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 the carmakers shift most of the risk of demand fluctuation to the suppliers. The estimated values of β for the 11 carmakers in the same period as Asanuma and Kikutani (1992) are between 0.91 and 0.98, suggesting that the carmakers shift the largest part of the risk of demand fluctuation to the suppliers (or to the dealers), even to a higher extent than when they absorb the risk of cost fluctuation

from the suppliers.

However, such a high ratio of risk shifting does not seem to reflect the reality, but is supposedly due to an enormous difference between the total amount of profit and sales, as discussed above. At any rate, this trial shows how difficult and inappropriate it can be to measure risk sharing in this way.

It should now be obvious that the analysis of risk sharing in the previous studies has serious problems. Furthermore, it was proved that they fail to provide ample evidence to reject the traditional view of risk shifting, since they do not consider the risk of demand fluctuation at all, which may be at least as essential for parts suppliers as that of cost changes[6]. In order to conduct a more thorough analysis of risk sharing in the supplier relationship, the above-mentioned problems must be avoided and risk of demand fluctuation appropriately taken into account.

In the next section risk sharing in the supplier relationship will be reexamined in an alternative way.

3. Empirical Analysis of Risk Sharing

(1) Analytical Method and Model

An alternative way to prove the existence of risk sharing in the

[6] According to the Small and Medium Enterprise Agency (1999, p.155), 75% of the surveyed suppliers regard stable demand as a merit of the subcontracting business, with this percentage being the highest among 12 choices in the questionnaire. This result suggests that the stability of demand is too important for most suppliers

supplier relationship is to test if the relative stability of the profit rate of the suppliers, which is regarded as the measure of risk absorption by their customers, differs significantly according to the intensity of business relations. Hereby it is assumed that, other things being equal, the customers can and will absorb risk of the suppliers the closer the business relations with them are, as will be discussed later in more detail. Therefore, if the relative stability of the profit rate of the suppliers depends on the business intensity with their customers, it will be evidence for risk absorption by the customers[7].

Moreover, some proxy variables for risk aversion of the suppliers will also be put into the model, to control the variables of business intensity and to see if the profit stability also depends on the degree of risk aversion, as the risk absorption hypothesis suggests.

This method, which is related to what was applied by Nakatani (1984) and Odagiri (1992) to test the insurance function of corporate groups in Japan, is not based on the principal-agent theory, as it ignores an essential type of risk for the suppliers, namely the risk of demand fluctuation. An advantage of this simple way is that it enables us to examine the risk sharing as a whole, regardless of its particular types. In this way, the problems in estimating the risk absorption, as observed in previous studies, can be avoided.

As mentioned above, it is assumed that the extent of the risk absorption by the customer depends on the intensity of business relations, especially

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to be neglected.

[7] We should take it into consideration that the suppliers could disperse the risk by themselves through diversification and absorb it through adjustment of the labor force, as discussed later.

when the risk of demand fluctuation matters. A carmaker can absorb the larger part of the risk of its suppliers, the higher their dependence on it in sales is. It will also be the more ready to protect the suppliers against demand fluctuation, the closer the business relationship is. The carmaker will do so in order to keep them capable of further innovation and customer-specific investments, and not to lose the "relational quasi-rent" (Aoki 1988) from the relationship with them through their closure or bankruptcy. The suppliers will also be in need of risk absorption the higher their dependence on the main customer is, because they will then be less able to disperse the risk by themselves.

The model includes a couple of variables for business intensity and those for the risk aversion as well as some control variables. The influence of the business intensity and the risk aversion of suppliers can be tested and compared in this way. The basic regression model is given by:

$$SDPR = a0 + a1\ AVPR + a2\ (LNLAB, LISTED, OWNER) + a3\ MCR + a4\ MCR2 + a5\ SH20 + a6\ CVLAB + a7\ (MCAVP, MCCVP) + \varepsilon \quad (3)$$

where ε is the error term (See Appendix for the definition of the independent variables).

The dependent variable *SDPR* is the standard deviation of annual profit rates (the ratio of operating income to sales[8]) of the suppliers in the

[8] The ratio of *operating* profit to sales is used because it reflects directly the results of business transactions and is not disturbed by financial trans- actions like the ordinary profit ratio. In this paper the ratio of profit to *assets* is not used to avoid possible distortions by extreme asset price fluctuation during

period 1985-1997, which indicates the extent of fluctuation of the profit rates. It should be controlled by *AVPR*, the average profit rate in the period, to estimate the relative stability of the profit rate[9]. *AVPR* might be regarded as an endogenous variable. However, as for this sample, this is not the case since regression trials show that *AVPR* can hardly be explained by the other independent variables in the model (adjusted R-squares are at most 0.05).

We then have to find out some applicable proxy variables for the risk aversion of the suppliers. The method is to work out some variables that possibly reflect the degree of the risk aversion and then test if they really reflect it by comparing the estimated degree of the absolute risk aversion between the sub-groups of the sample.

A first proxy is the firm size. Larger firms are assumed to have greater risk-bearing capability than smaller ones because of their relatively higher degree of diversification and stronger financial power. It may also be understood intuitively that a firm will be less risk-averse the lower the weight of a project relative to its size. In fact, Kawasaki and McMillan (1987) as well as Asanuma and Kikutani (1992) found out that the bigger a supplier is in size, the lower the degree of the absolute

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and after boom periods. Use of the capital intensity (assets/sales ratio) as a control variable in the model had to be avoided because of very high correlation with the other variables. The profit/asset ratio of the carmakers and the sample suppliers shows a similar trend as that in Figure 1, where the capital intensity of the sample suppliers is on the whole not significantly lower than that of the carmakers during the period (0.694 and 0.724 respectively).

[9] We can use variance, standard deviation (STDEV) and coefficient of variation (CV) to measure the extent of fluctuation. Since the average value can influence the standard deviation, in general it would be desirable to use CV to compare the degree of fluctuation, when the averages differ remarkably from each other. However, in case of the analysis of the profit rate, the average value can be negative or near to zero and so the CV can also be negative and/or take extremely high values, which induces difficulties in estimation. Therefore, in this paper STDEV controlled by the average value is used, relying on Nakatani (1984).

risk aversion is.

It can be further assumed that the financial structure of a firm affects the degree of its risk aversion. Here the ratio of debt to equity especially matters.

> "When a firm has too much debt compared to its equity, the owners may be too ready to undertake risky investments. This is because the shareholders enjoy virtually all the benefits if returns on the risky investments turn out to be high, but the lenders suffer a major portion of the losses if the returns turn out to be low" (Milgrom/Roberts 1992, p. 495).

This problem will, however, in turn increase the incentive of the lenders to monitor the management of the borrowing firms to prevent risky projects.

Moreover, this problem occurs only when shareholders control management (do. p. 528). Nor does it necessarily apply to the Japanese situation, where many firms listed on the stock market are controlled by their main banks, and the owners of unlisted firms get bank loans in return for offering their private assets as security, as mentioned below. In this case, the higher the debt ratio of a firm is, the higher will be the risk of the default of obligations, and so the more risk averse the firm will be.

Thus the ownership structure of the firm must be taken into consideration. The firms listed on the stock market may be less risk averse than unlisted ones, because the ownership is usually dispersed under a lot of shareholders to a large part, who can appropriately diverse their portfolio. Moreover, some unlisted companies are owned at least partly by private persons, who run the business as founders or their

successors. Some of these owner-managers may be willing to take risks, but largely they may be more risk averse than the managers of listed companies, as they should often give their private assets as security and stand surety for the debt of their firms.

Now let us examine if these proxies do reflect the degree of risk aversion. Relying on Kawasaki/McMillan (1987) and Asanuma/Kikutani (1992), the degree of the absolute risk aversion λ can be calculated from the equation:

$$\mu = \lambda/2 \; S^2 + k \qquad (4)$$

where μ is the average value of the profit, S^2 is the variance of the profit, and k is the profit after removing the risk premium. Using the profit data of the sample firms (a brief explanation of the sample firms will be given in the next section), the value of $\lambda/2$ (x 10^4) and of k can be estimated for each subgroup of the sample. If then a subgroup (for example larger firms or listed companies) shows a significantly lower degree of risk aversion, as would be expected, than another one (smaller firms or unlisted companies), the relevant proxy could be regarded as a variable for the risk aversion of the suppliers.

The results of the estimation are summarized in Table 1. As anticipated, smaller firms in regard to the number of employees are significantly more risk averse than larger ones. Unlisted companies and those controlled by owner-managers have a significantly higher degree of risk aversion than listed companies and those under separated control respectively.

As for the financial structure, the result that firms with relatively higher equity capital ratio is more risk averse seems to support the argument of Milgrom and Roberts (1992), but the difference between the sub-groups is not so striking compared to the other proxies. Table 1 shows further that the carmakers are highly significantly less risk averse than the suppliers as a whole. This is a necessary condition for the risk absorption hypothesis to be valid.

So the following three proxy variables will be used for the risk aversion of suppliers: The first one is *LNLAB*, the log-transformed value[10] of the average number of employees during the period 1985-1997. The next one is a dummy variable *LISTED*, taking the value of 1 if the firm has been listed on the stock market since 1985 or earlier. Another one is *OWNER*, a dummy variable taking the value of 1 if the main shareholder or his/her family member is in the top management of the firm. Because of the high degree of correlation among these variables, they will be put into the regression model alternatively.

Business intensity with the main customer is measured by two variables: 1) the proportion of sales to the main customer to total sales (*MCR*)[11] and 2) a dummy variable for affiliation, taking the value of 1 if the

[10] The number of employees is logarithmically transformed to bring data distribution closer to the normal distribution. The estimation results are also improved by this transformation.

[11] A similar dummy variable is used as a proxy for risk aversion in Asanuma/Kikutani (1992). They argue that if the suppliers are aware of the risk absorption by the main customer, they will be more dependent on him the more risk averse they are. But, when the problem of moral hazard is taken into account, one may as well argue as follows: If the suppliers know that there is such an insurance, those who are highly dependent on the main customer may become less risk averse. A negative correlation between the degree of risk aversion and the dependence on the main customer can therefore be assumed. For this reason regarding sales dependence on the main customer as a proxy for risk aversion is not considered an agreeable interpretation.

main customer holds at least 20% of the total shares of the supplier during the period (*SH20*)[12].

Here, intensive business relations involve active and regular information exchange over cost and quality as well as cooperative joint problem solving based on the mutual long-term commitment. According to Sako (1992, p. 11-12 and 241), such "obligational contractual relations", as compared to the "arm's-length contractual relations", are characterized among others by a greater transactional dependence on trading partners and a greater degree of sharing of risks associated with business fluctuations. In fact, a recent survey in Japan (Shoko Chukin Bank 1995, p.85) shows that the suppliers are more likely to obtain financial aid from the main customers and exchange with them engineers and other employees for technology transfer and training more often, the higher their dependence in sales on the main customers is.

Intensive supplier relationship in this sense corresponds to the "voice"-based relations rather than the "exit"-based ones (Hirschman 1970). Odagiri (1992, p. 12) argues as follows why such a "voice" option is consistent with a relatively high sales dependence:

> "… a free rider problem may make the voice option less effective because any service improvement attained as a result of one customer's voice may benefit all the customers. (…) Obviously, the free-rider problem is more serious when each participant's share in the market is smaller. (…) In the market for intermediate goods, such as automobile components, the buyers, namely, the assemblers, tend to use the voice option more frequently because

[12] Many firms in the sample have no or little affiliation with the main customer, and so the ratio of shareholding by the main customer shows a disproportional distribution. I draw a line at 20% percent because it is near the mean and median of the sample, so it can be divided into sub-groups with comparable size, and because the Japanese corporate law regards a company as related to another one, which holds 20% or more of the shares of that company.

they have a large share in the supplier's sales."

Some control variables must also be placed into the regression model. At first, it should be taken into consideration that the suppliers might absorb the profit fluctuation of them through adjustment of the employment. With decreasing sales, the firms will usually shorten working hours, reduce or stop new employment, or even lay the employees off, to save labor costs. To control the influence of the employment adjustment, the variable *CVLAB*, the coefficient of variation of the number of employees in each supplier, will be added to the model[13].

Another factor to be considered is the profitability of the main customer as well as its stability[14]. A customer in crisis would be less able and willing to help its suppliers. In general, the more profitable the main customer is, the more capable he will be of absorbing the risk of the suppliers. The stability of the profit rate will also affect that of the suppliers, but the larger part of risk of the suppliers he absorbs, the less correlated will be the profit stability of the business partners. Thus the variables *MCAVP* (average profit rate of the main customer) and *MCCVP* (coefficient of variation of the profit rate of the main customer) will be placed alternatively into the model[15].

[13] It would be more appropriate to use the fluctuation of the total labor cost rather than that of the number of employees. Unfortunately, however, data on the total labor cost are not available for a major part of the unlisted companies. Also, the coefficient of variation, rather than the standard deviation of the number of employees, is used to avoid the problem of the multicollinearity with the other variables.

[14] The author is grateful to the anonymous referees for making suggestions on this point.

[15] The average value and the fluctuation of the profit *volume* can be used alternatively to the profit *rate* of the main customer as the control variables. As noted later, regression results using profit volume and rate show almost no differences. Moreover, the standard deviation (STDEV) could have been used instead of the coefficient

With these variables the risk of business fluctuation can be taken more explicitly into consideration.

(2) Hypotheses

The hypotheses in regard to the stability (or fluctuation) of the profit rate are as follows:

As for the variables for risk aversion, coefficients of *LNLAB* and *LISTED* should have positive signs and that of *OWNER* negative sign if the customer absorbs the risk of the suppliers (thus stabilizes their profit rates) in proportion to their risk aversion, as the previous studies indicate.

In regard to business intensity, it is assumed that the carmakers absorb the risk of their suppliers in proportion to the intensity of business relations with them. Then, other things being equal, the profit rate of the suppliers will be the more stable the more sales is concentrated on the main customer and the more shares are held by it. At this stage the signs of the coefficient of *MCR* and *SH20* are all expected to be negative.

However, suppliers may also be able to disperse business risk by themselves through diversification, and there may be a certain degree of sales dependence on the main customer under which risk dispersion through diversification overcompensates for a shortage of risk

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of variation (CV), as done for the dependent variable of this model. However, as for the carmakers, CV seems to reflect more properly their actual profit instability, as measured by STDEV, Toyota and Honda should have less stable business than Nissan and Mazda.

absorption by the business partner. In this case, the curve of profit fluctuation will be convex upwards; the fluctuation of the profit rate will increase to a certain point along with the sales dependence on the main customer and then decrease continuously. The coefficients of *MCR* and its square term will have positive and negative signs respectively.

In regard to the control variables, the fluctuation of the number of employees is expected to reduce the fluctuation of the profit rate if the suppliers try to maintain profitability by reducing labor costs when the sales fall. However, it can also be assumed that both the profit rate and the number of employees are similarly affected by the fluctuation of demand, or even the fluctuation of the profit rate induces that of the number of employees. The coefficient of *CVLAB* can therefore be either negative or positive.

Finally, as mentioned above, the main customer is considered to be more capable of absorbing the risk of its suppliers, the more profitable it is[16]. The coefficients of *MCAVP* are therefore expected to be negative. The coefficient of *MCCVP* may be positive but will not be significant, as long as the main customer effectively stabilizes the profit rate of the suppliers.

(3) Data Sources and Data Set

We use a unique data set at the firm level for the analysis. Annual

[16] We will later test this argument by comparing the sub-samples of Toyota and Nissan suppliers.

financial data as well as the number of employees were obtained from the “Nikkei Needs” Financial Database and supplemented by "*Kaisha Nenkan* (Annual Corporation Reports for Listed Companies)" and "*Kaisha Sokan* (Annual Corporation Reports for Unlisted Companies)" published by Nihon Keizai Shinbunsha (Nikkei). Data on the business relationship (the identity of main customers and main shareholders and their percentage) were provided by the yearbook of the Japanese automotive parts industry ("*Nihon no Jidosha Buhin Kogyo*") edited by JAPIA (Japanese Auto Parts Industry Association). Combining these two data sources, a unique data set can be obtained, which enables us an empirical analysis of risk sharing in the supplier relationship.

The sample consists of 74 suppliers in the automotive industry, for which both annual financial data in the period 1985-1997 and the data on business relations with their main customers at the beginning and the end of this period are available. Those that went through mergers and acquisitions during the period were excluded to avoid possible deterrence. Since the sample firms have different settlement terms, and many firms changed them during the period, the financial data were adjusted to the settlement term in March for all sample firms.

Sample characteristics are summarized in Table 2. Among the sample firms, 39 (53%) were listed companies at the beginning of the period. Among 35 unlisted companies, 13 firms are controlled by owner-managers. Firm size (annual average value from 1985 to 1997) varies from 175 to 10,306 employees (1,712 on the average) and from 5.5 to 464 billion yen in annual sales (65 billion on the average). Moreover, most firms

(68) are first tier suppliers (including 19 Toyota and 24 Nissan suppliers) in the sense that their steady main customer is a carmaker. Thus, it cannot be denied that the sample is biased towards the upper group and large corporations because of the restricted availability of data.

Only 5 firms (7%) changed the main customer during the period of 13 years. Among these, in 3 cases a change between the two biggest customers took place, with the "old" main customer remaining the biggest shareholder. A direct supplier to Nissan fell into a second-tier supplier in the Nissan group, with Nissan remaining the main shareholder. Only a firm had a dispersed and continuously changing customer structure. The average ratio of sales concentration to the main customer remained during the period as stable (from 53.2% in 1985 to 50.8% in 1997) as the average ratio of shareholding by the main customer (from 22.2% in 1985 to 22.0% in 1997). 61 suppliers (82%) have a capital relationship with the main customer. So the business relationship with the main customer may be regarded as quite strong and stable for the sample firms.

Figure 1 shows the profit rate of 74 sample firms in the period 1985-1997 in relation to that of 11 carmakers. It demonstrates that the former achieved on the average higher and more stable profit rates than the latter. Similar trends can be observed in Figures 2 and 3 in regard to Toyota and Nissan with their suppliers, though Toyota achieved higher profit rates than its suppliers during the boom years.

(4) Estimation Results

Table 3 shows the results of the OLS regression analysis with the whole sample.

As for the proxies for risk aversion, all the coefficients have unexpected signs. Those of *OWNER* and *LISTED* are moreover insignificant. Only those of *LNLAB* are significant, but have wrong signs. This result does not support the argument that risk absorption by the main customer depends on the risk aversion of the suppliers. It may also imply that large suppliers can stabilize their profit rate by themselves somehow or other because of their relatively strong financial power and the diversification of product programs.

In regard to the variables of the business intensity, estimated coefficients have always expected signs. Those of *MCR-square* are all negative and significant, while those of *MCR* have positive and significant values. Without the square term, the coefficients of *MCR* are always negative but hardly, or at most weakly, significant, which is not shown in the tables. Thus the reversed U-form model fits better to the data than the linear model, suggesting that the relative fluctuation (stability) of the profit rate increases (decreases) to a certain point along with increasing sales dependence on the main customer and then decreases (increases) continuously. It can be estimated that the profit fluctuation is highest when the ratio of sales concentration on the main customer is around 50% (47.6 ~ 52.7 %). The effect of *SH20* is negative as expected and also significant (though weaker compared to the sales dependence), unless combined with *LNLAB* or *OWNER*. These variables may induce the problem of multicollinearity because of the high correlation

with *SH20*.

As for the control variables, *CVLAB* shows a clearly positive and significant effect, suggesting that the fluctuations of the profit rate and of the employment increase and decrease together. The coefficients of *MCAVP* and *MCCVP* have always expected signs, but only the former is significant. This result implies that better performing main customers are more likely to absorb the risk of their suppliers and is inconsistent with the argument that the main customer shifts the risk of demand fluctuation to the suppliers. The result hardly changes when the average value and the coefficient of variation of the profit *volume* are used instead of *rate* in the regression model (not shown in the tables). The effect of sales dependence on the profit stability remains robust and becomes even stronger after introduction of these control variables.

These results suggest as a whole that the Japanese carmakers absorb a part of the business risk of their suppliers depending on the intensity of the relationship, despite the structural and strategic changes in the supplier system in recent years. However, the closeness of the business relationship with the main customer explains only a small part of the profit stability (or instability) of the suppliers, as the values of adjusted R-squares in Table 3 indicate.

Finally, a test will be made to see if these results apply to all the carmakers similarly. As mentioned above, the effect of *MCAVP* in Table 3 suggests that better-performing customers are more likely to absorb the risk of their suppliers. Table 4 shows the results of the analysis for the sub-samples with the suppliers for Toyota, for Nissan

and for the others respectively. It demonstrates that this model fits excellently to the group of Toyota-suppliers, whereas the business intensity has no effect on the profit stability of the Nissan-suppliers.

4. Discussion and Concluding Remarks

The purpose of this paper was to examine risk sharing or absorption in the recent Japanese supplier relationship under structural and strategic changes, in a different way from previous studies that have been illustrated to show serious estimation problems.

In this paper it was tested if the relative stability of the profit rate of the suppliers is significantly influenced by business relationship intensity. The main findings are as follows.

1) The degree of sales dependence on the main customer influences the fluctuation of the profit rate significantly, whereby the fluctuation increases to a certain point after which it then decreases.
2) Affiliation with the main customer also contributes to stabilize the profit rate, though the effect is weaker compared to sales dependence.
3) The profit stability of the suppliers is significantly influenced by the profitability of the main customer, but not by its profit stability. This result is not consistent with the risk-shifting hypothesis.
4) While larger firms show significantly more stable profit rate than smaller firms, which is contrary to the previous studies, the other variables for risk aversion have no significant effects on the

stability of the profit rate. Larger suppliers may be able to stabilize the profit rate by themselves.

5) The model presented in this paper explains only a minor part (at most one-third) of the profit fluctuation of the suppliers. So the carmakers absorb only a small part of the business risk of their suppliers.

6) The model applies very well to the suppliers for Toyota, but not to those for Nissan, suggesting that there are significant differences in risk absorption among the carmakers.

These results suggest as a whole the risk absorption by the main customer and support in this respect the risk absorption hypothesis in previous studies. However, contrary to this hypothesis, according to which the risk absorption by the main customer mainly depends on the degree of risk aversion of the suppliers, the intensity of the business relationship is the main factor for risk absorption in this analysis.

These results imply that risk absorption is provided to suppliers selectively. It is also intuitively acceptable that the carmakers, trying to build up efficient business relations with their suppliers while selecting superior ones continuously, provide for the stabilization of corporate performance of the selected firms with which they have intensive relations. The results are in this respect also consistent with the traditional view that the main customers actively bring up and support the selected suppliers.

Some limitations in this analysis should be remarked upon explicitly. Firstly, the sample consists of relatively small numbers of firms, where

large "upper-class" suppliers are over-represented. Therefore it would be inappropriate to generalize the results directly to smaller firms in lower tiers. It is possible that the risk absorption by the carmakers is limited to a small circle of selected firms. Secondly, as far as unlisted companies are concerned, the sample includes only those that report their financial data voluntarily. Thus the profit rate of the suppliers may be overestimated and financial crisis underestimated, as those with poor performance would not be eager to disclose this. Thirdly, this analysis is limited to the automotive industry, therefore caution is heeded in applying them to other industries. Finally, attention was concentrated on the role of the main customer on the assumption that it plays a decisive role in the risk sharing, and also because exact data on the other customers are not always available. So far the role of the other customers remains unexplained.

To finish this paper, a few questions that still remain will be pointed out and an attempt to shed light on them will be made. Firstly, it remains unclear why the ratio of sales to the main customer is concentrated on the middle range (52% on the average), where one would expect a higher fluctuation of the profit rate. Suppliers should select either the lowest or the highest end of the dependence ratio on their main customer, if they will minimize the fluctuation of the profit rate, but the distribution of *MCR* of the sample firms remained almost unchanged from 1985 to 1997. Maybe there are other advantages of "taking the golden mean", which would compensate for the relative instability of the profit rate. However, a more accurate look at the distribution of the sales dependence (Figure

4) reveals that there are rather two sub-groups in the sample with higher and lower values of *MCR*, centered on the range of 60-70% and 20-30% respectively. According to a survey cited in the Small and Medium Enterprise Agency (1999, p. 157), 37% of the subcontractors intend to reduce the dependence on the main customer, while 23% will increase it. Thus the Japanese suppliers may gradually diverge into more independent and dependent groups in the long run.

Moreover, the question also remains why the Japanese carmakers are willing to stabilize the profit rate of their suppliers, while allowing them a higher profit rate on the average (even though there is a clear difference between Toyota and Nissan in this respect).

One possible answer is, as briefly mentioned above, that the carmakers want to keep their suppliers capable of innovations and customer-specific investments which are of great importance for their future development, and avoid losing their own specific investments in their suppliers through closure or bankruptcy. Another answer is that the risk premium is not necessarily paid in the way that the customer takes a larger share of the joint profit or the "relational quasi-rent". It may take other forms, such as devotion and loyalty of the suppliers to the main customer including the formation of the "relation-specific skill" (Asanuma 1989). Then the customer may expect its suppliers to comply flexibly with its specific requirements.

An alternative explanation is that the results are not due to the main customer's benevolence, but rather to the suppliers' selection

of the customer who offers most stable business[17]. This perspective is very appealing, but seems to be inconsistent with the facts that only a few sample firms changed the main customer in the period from 1985 to 1994 and that the sales dependence on the main customer remained remarkably stable in the same period. Moreover, a result (not shown in the tables) suggests that changes of the main customer do not contribute to stabilize the profit rate at all[18]. Maybe many suppliers for Nissan would have converted to Toyota if they could, but the Nissan-specificity of assets including the relation-specific skill may have prevented them from the conversion. However, as Nishiguchi (1994) argues, since 1960 the customers have continuously selected relatively well qualified suppliers and encouraged them to invest in relation- specific assets, rather than the suppliers selecting the best customers. More qualified (and supposedly more profitable) suppliers may have had better opportunities for choosing customers with more stable business, but the results of this paper show no significantly positive (in fact negative) correlation between the profitability and the profit stability of the suppliers.

This last issue is tightly related to the trade-off problem between risk sharing and incentive. If the supplier is insured against business failure, he may make fewer efforts to achieve good performance than he otherwise would do. However, as for the risk of demand fluctuation, the problem of moral hazard may be less serious compared to the case

[17] The author is grateful to an anonymous referee for suggesting this explanation.

[18] The coefficient of correlation between *SDPR* and a dummy variable for changing the main customer is only 0.06.

for the risk of cost changes. This is because the main customer can better monitor the managerial efforts of their suppliers, as he is better informed of the risk sources, i.e. demand fluctuation, than the suppliers. Furthermore, as far as the analysis shows, the customers absorb only a small part of the suppliers' business risk. This pattern is consistent with the prediction of the economic analysis of contracts (Milgrom/Roberts 1992).

Moreover, the intensity of the business relationship with the main customer itself may be regarded as an important factor to reduce the problem of moral hazard. This is because the customer may possibly gather the more and better information from the suppliers and monitor their operations the better, the more concentrated and more customer-specific their production activity is. Affiliation with the suppliers would also help the customer to get private information and monitor them properly.

Sako (1992) provides evidence that Japanese customers require and obtain very detailed information about cost structure and quality control of the suppliers through intensive information exchange, while promoting the competition among them over the long run through their ranking by regular performance reviews. Odagiri (1992) argues that in Japan the competition in the long run, by "voice" option reinforced by the threat of "exit", and in form of rank-order tournaments is characteristic. These forms of competition "all provide mechanisms for encouraging effort on the part of the participants and for correcting bad behaviour" (do., p. 18). Suppliers are thus highly motivated to do their best to improve

their performance. In this way, the Japanese supplier relationship seems to be quite successful in coping with the problem of moral hazard.