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Kinoshita, Junko
Department of Food Policy Analysis, Policy Research Institute, Jpanese Ministry of Agriculture

Suzuki, Nobuhiro
Faculty of Agriculture, Kyushu University

Kaiser, Harry M.
Department of Applied Economics and Management, Cornell University

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The Degree of Vertical and Horizontal Competition Among Dairy Cooperatives, Processors and Retailers in Japanese Milk Markets

Junko KINOSHITA[1]*, Nobuhiro SUZUKI and Harry M. KAISER[2]

Laboratory of Quantitative Analysis of Agribusiness Organization, Division of Industrial Organization of Agribusiness, Department of Agricultural and Resource Economics, Faculty of Agriculture, Kyushu University, Fukuoka 812–8581, Japan
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In this paper, we present a conceptual bilateral oligopoly model for measuring the degree of "vertical power balance" or the comparative degree of market power between sellers and buyers in Japan's fluid milk market. The model also simultaneously measures the degrees of horizontal competition among sellers, as well as horizontal competition among buyers. We estimate the model based on available data and several simplifying assumptions, in order to illustrate how the model could be tested. The results presented here are tentative due mainly to data constraints, but they constitute the first econometric evidence supporting the general perception that retailers, though they face nearly perfect horizontal competition among each other, have extremely dominant vertical market power over fluid milk processors. Also, the results constitute the first econometric evidence that processors may have some vertical market power over dairy cooperatives.

INTRODUCTION

Some economists (e.g., Suzuki, 2002) have argued that supermarkets in developed countries such as Japan have very strong oligopsony power to control wholesale milk price over dairy processors. The degree of power balance between dairy farmer cooperatives and processors is also in question: cooperatives have argued that processors have too much market power to lower raw milk price, while processors have contended on the opposite that cooperatives have too much power to raise price. To our knowledge, there is no econometric evidence to support any of these perceptions. Therefore, we need to develop a theoretically reasonable and empirically applicable econometric framework that will determine the degree of "vertical power balance" or the comparative degree of market power between sellers and buyers in a vertical food chain.

Azzam (1996) and Schroeter *et al.* (2000) presented an excellent modeling idea for solving similar questions between packers (seller side) and retailers (buyer side) in the U.S. beef market. Its theoretical framework is as follows. At one extreme, if buyers have some vertical market power and sellers are price–takers (i.e., oligopsony), then the price should be at the minimum or lower–limit level that buyers can extract from sellers based on the degree of horizontal competition among buyers. Alternatively, if sellers have some vertical market power and buyers are price–takers, then the price should be at the maximum or upper–limit level that sellers can obtain from buyers based on the degree of horizontal competition among sellers. In reality, both sellers and buyers often likely have some degree of vertical market power (i.e., bilateral oligopoly). In this case, the price should be somewhere between these lower– and upper–limit levels. More specifically, if both sides' vertical market power exactly balances out, the price should be at the boundary level where neither sellers nor buyers is more advantageous over the other; if the either side has slightly more power than the other, the price should approach the lower– or upper–limit levels. In these situations, the degree of vertical power balance should be estimated simultaneously with the degree of horizontal competition among sellers, as well as the degree of horizontal competition among buyers.

It is difficult to find a unique solution in modeling such markets. Consequently, most previous studies have assumed that one side of the market is a price–taker while the other side has completely dominant vertical market power. Example of such studies include: Appelbaum (1982); Kawaguchi *et al.* (1997); Lopez (1984); Schroeter (1988); Azzam and Pagoulatos (1990); Suzuki *et al.* (1993, 1994); Suzuki and Kaizer (1997); Liu *et al.* (1995); Bhuyan and Lopez (1997); McCorriston *et al.* (1998); Sexton (2000); Sexton and Zhang (2001). However, because the actual observable price is often neither the minimum nor the maximum possible, such approaches could have biases.

In this paper, we propose a model similar to Azzam's to estimate the degree of vertical power balance at two stages of Japan's fluid milk market, i.e., dairy cooperatives versus processors, and processors versus retailers. Our model also simultaneously estimates the degree of horizontal competition in each stage of the market. Since proprietary detailed cost data is not usually available, empirical application of this model is often difficult. Therefore, we estimate the model based on available data and several simplifying assumptions to describe tentative estimation results, in order to illustrate how the model could be estimated.

[1] Department of Food Policy Analysis, Policy Research Institute, Japanese Ministry of Agriculture

[2] Department of Applied Economics and Management, Cornell University

* Corresponding author (E-mail: junkot@affrc.go.jp)

MODEL FRAMEWORK

We begin our model discussion from the farm level. The "dual structure" model developed by Suzuki *et al.* (1993, 1994) was one of the first to treat the farmer side of the industry as a price–setter. It made possible an estimation of the degree of horizontal competition among dairy cooperatives in the United States and Japan. However, a drawback of the model is the tacit assumption that fluid milk processors are price–takers. We adopt the notation "1:0" to denote that cooperatives have complete vertical market power and processors are price–takers. Accordingly, the raw milk price cooperatives receive under this assumption should be at the upper–limit level that cooperatives can extract from processors based on the cooperatives' degree of horizontal competition.

Like the United States, Japan uses classified pricing in its raw milk market in order to keep the price of fluid (beverage) milk higher than the price of manufacturing milk. The raw milk supply is segmented into fluid (relatively price–inelastic) and manufacturing (relatively price–elastic) milk markets according to how it is marketed by processors. The supply allocation between the two markets is decided by dairy cooperatives which sell 95 percent of the raw milk marketed in Japan. They are required to sell all milk consigned from their members and to pay a blend price (weighted average price of all milk usage) to members. Farmer members make production decisions taking the blend price as given, since no member is large enough to affect the price. Cooperatives, however, have price–discriminating market power wielded through the manipulation of their milk allocations; but they do not have the ability to restrict milk production. Hence, the Japanese dairy cooperative is not like a traditional monopolist firm, which wields its monopoly power by restricting supply below competitive levels. When this "dual structure" process (i.e., farmers as price–takers in producing milk and as price–setters in selling milk) is incorporated in the model, the necessary condition for optimal raw milk allocation between the fluid and manufacturing milk markets for sales maximization is equalizing marginal revenues of the two markets as:

$$(1)\quad PF^U\left(1-\frac{\theta^f}{\eta^f}\right)=PM+TC \qquad \text{or}$$

$$(2)\quad PF^U=\frac{PM+TC}{1-\dfrac{\theta^f}{\eta^f}},$$

where PF^U is the upper–limit fluid milk price cooperatives can extract from processors, since it is tacitly assumed that processors have no vertical market power over cooperatives, PM is the exogenously given manufacturing milk price set by the government (until the 2000 fiscal year), TC is the unit costs of milk transportation, η^f is the price elasticity of processors' fluid milk demand that cooperatives face (in absolute value), and θ^f is the cooperatives' degree–of–horizontal–competition parameter ranging from zero to one. When $\theta^f=0$, $PF^U=PM+TC$, which is the case of a perfectly competitive market. When $\theta^f=1$, $PF^U(1-1/\eta^f)=PM+TC$, as in the case of a monopoly or perfectly collusive market. Suzuki *et al.* (1993, 1994) estimated a value for θ^f by applying the observed fluid milk price to the values for PF^U in equation (1). However, the observed fluid milk price would be equal to its upper–limit level only if processors had no vertical market power relative to cooperatives. Unless this condition actually holds, the method used by Suzuki *et al.* (1993, 1994) has an inherent downward bias on this price.

Next, consider the processor (wholesale) stage of the industry. The profit–maximizing condition for processors can be expressed as:

$$(3)\quad PW^U\left(1-\frac{\theta^w}{\eta^w}\right)=PF^L\left(1+\frac{\lambda^w}{\varepsilon^w}\right)+MC^w,$$

where PW^U is the upper–limit wholesale milk price processors can extract from retailers assuming retailers have no vertical market power over processors, PF^L is the lower–limit fluid milk price processors can obtain from cooperatives assuming cooperatives have no vertical market power over processors, MC^w is the marginal costs for fluid milk processing and wholesaling other than raw milk price, η^w is the price elasticity of retailers' milk demand that processors face (in absolute value), θ^w is the processors' degree–of–horizontal–competition parameter in the processor versus retailer market (ranging from zero to one), ε^w is the price elasticity of cooperatives' fluid milk supply that processors face, and λ^w is the processors' degree–of–horizontal–competition parameter in the processor versus retailer market (ranging from zero to one). Rewriting equation (3) yields:

$$(4)\quad PF^L=\frac{PW^U\left(1-\dfrac{\theta^w}{\eta^w}\right)-MC^w}{1+\dfrac{\lambda^w}{\varepsilon^w}} \qquad \text{or}$$

$$(5)\quad PW^U=\frac{PF^L\left(1+\dfrac{\lambda^w}{\varepsilon^w}\right)+MC^w}{1-\dfrac{\theta^w}{\eta^w}}.$$

The actual fluid milk price determined by the transaction between cooperatives and processors in bilateral oligopoly should be somewhere between the upper– (PF^U) and lower– (PF^L) limit levels. Therefore, the actual fluid milk price (PF) can be expressed as:

$$(6)\quad PF=W^f PF^U+(1-W^f)\,PF^L,$$

where W^f is the cooperatives' degree–of–vertical–power parameter relative to processors ranging from zero to one, and $(1-W^f)$ is the processors' degree–of–vertical–power parameter relative to cooperatives. Substituting equation (2) and (4) into equation (6) yields:

$$(7)\ PF = W^f \frac{PM+TC}{1-\frac{\theta^f}{\eta^f}} + (1-W^f) = \frac{PW^U\left(1-\frac{\theta^w}{\eta^w}\right)-MC^w}{1+\frac{\lambda^w}{\varepsilon^w}}.$$

Next, consider the retailer stage of the industry. The profit-maximizing condition for retailers can be expressed as:

$$(8)\ PR\left(1-\frac{\theta^r}{\eta^r}\right) = PW^L\left(1+\frac{\lambda^r}{\varepsilon^r}\right)+MC^r,$$

where *PR* is the upper-limit retail milk price retailers can obtain from consumers or the actual retail milk price (since consumers likely have no market power to affect the price), PW^L is the lower-limit wholesale milk price retailers can extract from processors when processors have no vertical market power over retailers, MC^r is the marginal milk retailing costs, η^r is the price elasticity of consumers' fluid milk demand that retailers face (in absolute value), θ^r is the retailers' degree-of-horizontal-competition parameter in the retailer versus consumer market (ranging from zero to one), ε^r is the price elasticity of processors' fluid milk supply that retailers face, and λ^r is retailers' degree-of-horizontal-competition parameter in the retailer versus processor market (ranging from zero to one). Rewriting equation (8) yields:

$$(9)\ PW^L = \frac{PR\left(1-\frac{\theta^r}{\eta^r}\right)-MC^r}{1+\frac{\lambda^r}{\varepsilon^r}}.$$

The actual wholesale milk price (*PW*) determined by the transaction between processors and retailers in bilateral oligopoly should be somewhere between the upper- (PW^U) and lower- (PW^L) limit levels, or

$$(10)\ PW = W^w PW^U + (1-W^w)\, PW^L,$$

where W^w is the processors' degree-of-vertical-power parameter relative to retailers ranging from zero to one, and $(1-W^w)$ is the retailers' degree-of-vertical-power parameter relative to processors. Substituting equation (5) and (9) into equation (10) yields:

$$(11)\ PW = W^w \frac{PF^L\left(1+\frac{\lambda^w}{\varepsilon^w}\right)+MC^w}{1-\frac{\theta^w}{\eta^w}} + (1-W^w)\frac{PR\left(1-\frac{\theta^r}{\eta^r}\right)-MC^r}{1+\frac{\lambda^r}{\varepsilon^r}}.$$

Equation (11) and equation (7) have several common parameters. Therefore, simultaneous estimation of these two equations with parameter constraints provides for all values for degree of vertical and horizontal competition among cooperatives, processors and retailers (W^f, W^w, θ^f, θ^w, θ^r, λ^w and λ^r). However, variables PW^U in equation (7) and PF^L in equation (11) are unobservable since the actual observable price should be its upper- or lower-limit level only if one side of the market had completely dominant vertical market power. Consequently, while this approach is good in theory, it is not a practical way to estimate these vertical and horizontal competition parameters.

EMPIRICAL MODEL

Equations (7) and (11) may be treated separately under certain assumptions. First, consider the case of bilateral oligopoly between processors and retailers by adjusting equation (11). Assuming that processors' vertical market power against cooperatives is 1:0, the lower-limit fluid milk price (PF^L) can be replaced by the actual fluid milk price (*PF*). Since it is often said by dairy cooperatives that in Japan processors are dominant relative to cooperatives, the 1:0 assumption may be plausible.

Accurate insights into cost structure in each stage are important for estimation of market power, but proprietary detailed cost data is not usually available. Therefore, we assume that processors' cost function can be expressed by a simple linear equation $c = vQ + F$, where *c* is the total cost (yen/liter), *v* is the unit variable cost (yen/liter), *F* is the fixed cost (yen/liter), and *Q* is milk quantity (liter). In this case, processors' marginal cost (MC^w) is equal to the unit variable cost (*v*) in this case, or more specifically:

$$(12)\ MC^w = 7.37PK + 7PL + 15.6PT.$$

where *PK* is the price index for paper packaging (normalized to 1.0 for 2000), *PL* is the price index for labor in the processing sector (normalized to 1.0 for 2000), *PT* is the price index for storage and transportation services (normalized to 1.0 for 2000), and the coefficients represent the unit costs for each respective variable in 2000 based on data from the National Dairy Intelligence Center Japan (2003) and the Food Marketing Research and Information Center (2001). With respect to milk retailing costs, most of them can be considered as fixed costs, and therefore it is reasonable to assume that retailers' marginal cost (MC^r) is equal to zero.

In addition, we assume that price elasticities of fluid milk supply and demand are the same for cooperatives, processors and retailers, or $\varepsilon^w = \varepsilon^r \equiv \varepsilon$ and $\eta^f = \eta^w = \eta^r \equiv \eta$. Following Azzam (1996), we assume that both ε and η have independently given constant values, namely $\varepsilon = 0.7175$ (from Suzuki, 2002) and $\eta = -0.21$ (from Kinoshita *et al.*, 2004).

With these assumptions, equation (11) can be rewritten as:

$$(13)\ PW = W^w \frac{PF\left(1+\frac{\lambda^w}{0.7175}\right)+7.37PK+7PL+15.6PT}{1-\frac{\theta^w}{0.21}}$$

$$+(1\text{-}W^w)\frac{PR\left(1-\frac{\theta^r}{0.21}\right)}{1+\frac{\lambda^r}{0.7175}} \quad \text{or}$$

$$\text{(14)}\quad PW=\frac{W^w\left(1+\frac{\lambda^w}{0.7175}\right)}{1-\frac{\theta^w}{0.21}}PF+\frac{W^w}{1-\frac{\theta^w}{0.21}}(7.37PK$$

$$+7PL+15.6PT)+(1\text{-}W^w)\frac{1-\frac{\theta^r}{0.21}}{1+\frac{\lambda^r}{0.7175}}PR.$$

It is difficult to estimate values for parameters W^w, θ^w, θ^r, λ^w and λ^r directly with the parameter constraints in equation (14). Instead, one can estimate:

$$\text{(15)}\quad PW=aPF+b(7.37PK+7PL+15.6PT)+cPR.$$

Then, using the estimated parameters a, b and c, the following three equations emerge:

$$\text{(16)}\quad \frac{W^w\left(1+\frac{\lambda^w}{0.7175}\right)}{1-\frac{\theta^w}{0.21}}=a,$$

$$\text{(17)}\quad \frac{W^w}{1-\frac{\theta^w}{0.21}}=b,$$

$$\text{(18)}\quad (1\text{-}W^w)\frac{1-\frac{\theta^r}{0.21}}{1+\frac{\lambda^r}{0.7175}}=c.$$

A value for λ^w can be obtained by solving equation (16) and (17), or:

$$\text{(19)}\quad \lambda^w=0.7175\left(\frac{a}{b}-1\right).$$

For each value of W^w, θ^w, θ^r and λ^r, a unique solution does not exist, since there are only two equations (equation 17 and 18) for the four unknown parameters.[3] As an alternative, a range of values can be examined by adding the following constraints:

$$\text{(20)}\quad 0\leq W^w\leq 1,$$

$$\text{(21)}\quad 0\leq \theta^w\leq 1,$$

$$\text{(22)}\quad 0\leq \theta^r\leq 1,$$

$$\text{(23)}\quad 0\leq \lambda^r\leq 1.$$

Next, we consider the bilateral oligopoly between cooperatives and processors, by adjusting equation (7). When it can be assumed that processors' vertical market power against retailers is 0:1, the term $PW^U(1-\theta^w/\eta^w)$ in equation (7) can be replaced by the actual wholesale milk price (PW). It is often argued by some economists and dairy industry representatives that in Japan retailers are generally dominant relative to milk processors. So, the 0:1 assumption is plausible. Also, as we discussed above, it is assumed that $\varepsilon^w=0.7175$, $\eta^f=\eta^w=-0.21$, and $MC^w=7.37PK+7PL+15.6PT$ (equation 12).

With these assumptions, equation (7) can be rewritten as:

$$\text{(24)}\quad PF=W^f\frac{PM+TC}{1-\frac{\theta^f}{0.21}}$$

$$+(1\text{-}W^f)\frac{PW-7.37PK-7PL-15.6PT}{1+\frac{\lambda^w}{0.7175}} \quad \text{or}$$

$$\text{(25)}\quad PF=\frac{W^f}{1-\frac{\theta^f}{0.21}}(PM+TC)$$

$$+\frac{1\text{-}W^f}{1+\frac{\lambda^w}{0.7175}}(PW-7.37PK-7PL-15.6PT).$$

Instead of estimating values for W^f, θ^f and λ^w directly from equation (25), one can estimate:

$$\text{(26)}\quad PF=d(PM+TC)+e(PW-7.37PK-7PL-15.6PT).$$

Then, using the estimated parameters d and e, the following two equations emerge:

$$\text{(27)}\quad \frac{W^f}{1-\frac{\theta^f}{0.21}}=d,$$

$$\text{(28)}\quad \frac{1\text{-}W^f}{1+\frac{\lambda^w}{0.7175}}=e.$$

In this case, a unique solution for W^f, θ^f and λ^w does not exist, since there are only two equations for the three unknown parameters. As an alternative, a range of values can be examined by adding the following constraints:

$$\text{(29)}\quad 0\leq W^f\leq 1,$$

$$\text{(30)}\quad 0\leq \theta^f\leq 1,$$

$$\text{(31)}\quad 0\leq \lambda^w\leq 1.$$

DATA AND MODEL ESTIMATION

In order to illustrate how the model can be tested, we estimate the model using annual time series data from 1987 through 2000. The data is aggregated nationally and the number of observations is limited.

[3] Azzam (1996) also had an identification problem because in his model there were six equations for seven variables.

Consequently, using this data represents a substantial aggregation of conduct in Japan's milk market that may very well be local or regional in nature. Nevertheless, the following exercise sheds some light on the validity of recent claims made by cooperative and processor officials on the perceived vertical market power in the Japanese dairy industry.

The data for the wholesale milk price (*PW*) determined between processors and retailers is measured in yen per liter and is obtained from Food Marketing Research and Information Center (2001). The fluid milk price (*PF*) determined between cooperatives and processors is measured in yen per liter and comes from *Statistics of Prices and Wages in Rural Areas* and *Food Balance Sheet*, both reported by the Japanese Ministry of Agriculture. The manufacturing milk price that was set by the government (*PM*) is measured in yen per liter and is obtained from *Milk and Milk Products Statistics* reported by the Japanese Ministry of Agriculture. The price index for paper packaging (*PK*) is obtained from *Domestic Firm Price Indices*, reported by the Bank of Japan, and the price index for labor in the processing sector (*PL*) comes from *Monthly Labor Statistics*, reported by the Ministry of Welfare and Labor. The price index for storage and transportation services (*PT*) comes from *Firm Service Price Indices*, reported by the Bank of Japan, and the retail milk price (*PR*), measured in yen per liter, comes from *Fluid Milk Scanner Data*, published by the Agriculture and Livestock Industries Corporation. The unit transportation costs (*TC*) are for the handling from Hokkaido (the largest milk-producing and surplus area) to Tokyo (the largest milk-consuming and deficit area), and are obtained from interviews with the Hokkaido dairy cooperative.

The ordinary least squares (OLS) regression results for equation (15) are:

$$(32)\quad \underset{}{PW}=\underset{(-3.64)}{-0.0589PF}\;\underset{(-1.33)}{-0.0396\,(7.37PK+7PL+15.6PT)}$$
$$\underset{(75.22)}{+0.9163PR}\;\underset{(14.73)}{+2.5035\,D95}\;\underset{(-5.25)}{-0.8628\,D98}\;\underset{(-6.09)}{-1.0509\,(U^{PW})_{-1}}$$

Adjusted R-squared = 0.997
Durbin-Watson ratio = 1.84.

In this estimated equation, two dummy variables for the years 1995 and 1998 are introduced for unexpected large regression residuals in those two years. Also, a first-order autoregressive model was applied to improve the low Durbin-Watson ratio that indicated possible serial correlation of error terms, and the estimated serial correlation coefficient was significant at the one percent level. After the adjustment, the Durbin-Watson ratio rose to 1.84. The adjusted R-square was found to be high indicating the equation fit the data well. T-statistics showed that the two estimated coefficients on *PF* and *PR* were both significant at the one percent level. The P-value for the estimated coefficient on the term $7.37PK+7PL+15.6PT$ was 0.22, which is only marginally significant.

The ordinary least squares (OLS) regression results for equation (26) is:

$$(33)\quad PF=\underset{(1.98)}{0.4968\,(PM+TC)}+\underset{(2.40)}{0.3924\,(PW-7.37PK}$$
$$-7PL-15.6PT)\underset{(-2.68)}{-5.5141\,D96}$$

Adjusted R-squared = 0.745
Durbin-Watson ratio = 1.32.

In this estimated equation, a dummy variable for the year 1996 is introduced for an unexpected large regression residual in that year. All estimated coefficients were significant at the 5 percent level, the adjusted R-squared was reasonable, and the value of the Durbin-Watson ratio indicated a lack of serial correlation. The T-statistics showed that all estimated coefficients were significant at the five percent level.

CALCULATION OF MARKET POWER PARAMETERS

With the estimated coefficients in equation (32), values for W^w, θ^w, θ^r, λ^w and λ^r are calculated using equations or constraints shown in (17) to (23). With equation (19), a unique value of λ^w is:

$$(34)\quad \lambda^w=0.35.$$

With equation (17) and constraints (20) and (21), values of W^w and θ^w are found in the following ranges:

$$(35)\quad 0\leq W^w\leq 0.149,$$

$$(36)\quad 0.21\leq \theta^w\leq 1.$$

With equation (18) and constraints (22), (23) and (35), values of θ^r and λ^r are in the following ranges:

$$(37)\quad 0\leq \theta^r\leq 0.018,$$

$$(38)\quad 0\leq \lambda^r\leq 0.066.$$

The results indicate that the degree of vertical power balance between processors and retailers, or W^w: (1-W^w), potentially ranges from 0.149:0.851 to 0:1. That is, retailers' have considerably dominant vertical market power over processors. However, in the processor vresus retailer market, the retailers' degree of horizontal competition (λ^r) is quite small, or close to perfect competition, while the processors' degree of horizontal competition (λ^w=0.35) is much higher than retailers'. At the same time, the retailers' degree of horizontal competition in the retailer versus consumer market (θ^r) is also quite small, or close to perfect competition. This is an interesting result because no econometric evidence has been reported to support the recent general perception that retail supermarkets have dominant vertical market power over dairy processors in reducing the wholesale milk price they pay. Yet, supermarkets appear to face a lot of horizontal competition among retailers at both the wholesale and retail markets.

We should note that the results above rest on the assumption that processors have dominant vertical market power over cooperatives. This assumption can be tested by examining the cooperative versus processor relationship obtained from the estimated results (33). Again, the estimated results (33) rest on the assumption that processors have no vertical market power over retailers, which is well supported by the results obtained from the estimated results (32) discussed above.

With the estimated coefficients in equation (33), values for W^f, θ^f and λ^w calculated using equations or constraints shown in (27) to (31) are in the following ranges:

(39) $0.061 \leq W^f \leq 0.497$,

(40) $0 \leq \theta^f \leq 0.184$,

(41) $0 \leq \lambda^w \leq 1$.

These results indicate that the degree of vertical power balance between cooperatives and processors, or W^f: $(1-W^f)$, potentially ranges from 0.061:0.939 to 0.497: 0.503. In other words, processors have relative vertical market power over cooperatives, since cooperatives could reach only 50–50 power at best. These results mildly support the assumption that processors have relatively stronger vertical market power over cooperatives, which Japanese dairy cooperatives have often argued. Hence, both assumptions used to estimate the results of (32) and (33) are supported by the separate results derived above.

The cooperatives' degree of horizontal competition (θ^f) ranges from zero to 0.184. Hence, cooperatives appear to operate in a highly competitive market, as recently argued in Japan, among many local cooperatives with recent progress in the nationwide distribution network of raw milk. The range of the processors' degree of horizontal competition in the processor versus retailer market (λ^w) was not specified from estimated coefficients in equation (33). These results are conveniently summarized in Figure 1.

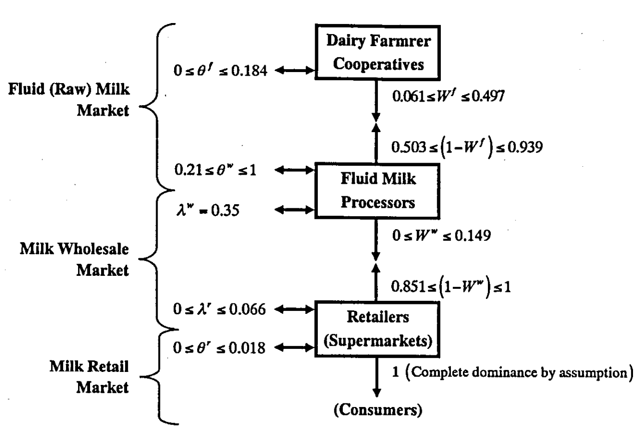

Fig. 1. Estimates of the degree of vertical and horizontal competition in Japan's milk markets

Notes: Parameters W^f and W^w indicate the degree of vertical power balance, that is, W^f : (1− W^f) ranges from 0.061:0.939 to 0.497:0.503, W^w : (1− W^w) ranges from 0:1 to 0.149:0.851. Parameters θ^f, θ^w, θ^r, λ^w and λ^r indicate the degree of horizaontal competition.

CONCLUSIONS

In this paper, we presented a conceptual bilateral oligopoly model for measuring the degree of vertical power balance at each stage of Japan's fluid milk market. The model also simultaneously measured the degrees of horizontal competition among sellers, as well as horizontal competition among buyers. We estimated the model based on available data and several simplifying assumptions, in order to illustrate how the model could be tested. The results presented here are tentative due mainly to data constraints, but they constitute the first econometric evidence supporting the general perception that retailers, though they face nearly perfect horizontal competition among each other, have extremely dominant vertical market power over fluid milk processors. Also, the results constitute the first econometric evidence that processors may have some vertical market power over dairy cooperatives. Since proprietary detailed cost data is not usually available, empirical application of this model is often difficult. However, with continuous efforts to obtain a more complete data set, the method would be a simple and useful way to analyze bilateral oligopoly in many situations.

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