An Economic Exposition of a Traditional *Kye* System in an Eastern Coastal Fishery Village in Korea

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1. Introduction

A *kye* system has been an important private financial system in the recent Korean economic history. Often it has played roles of social insurance as well as economic cooperatives, and has laid a basis of forming an economic institution in a community or regional district.[1] There are a number of studies on the economic functioning of a *kye* system, and these studies, in some way or another, have contributed to disseminating details about this unique economic system of Korean societies. The present study has a dual purpose; it aims, first, to introduce a maritime *kye* system, which so far has been neglected by the interested economists and economic historians, and second, to investigate some interesting, but intuively derivable, properties of the *kye* system under study.

In general, it is believed to be a private long-term financial organization when a *kye* system is referred to. However, the present *kye* system under question is organized on somewhat different purposes by the regional district in which the *kye* members have a geographically and geneologically a unique feature. This aspect of the *kye* system gives a researcher a

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1) For detailed expositions of a *kye* system, refer to K.C. Oh, "Two Essays on the Economics of *Kye*," *The Journal of the Korean Statistical Society* Vol. 3, No. 1. (June 1974), pp.31~57. For the social functions of a *kye*, in general, refer to S.S. Kim, *Sahoe Kyungjesa Yunku: Kye eui Yonku*, 4th Edition, Seoul: Bakyungsa, 1974.

special interest in expounding further hitherto neglected subjects. Since most of kyes concerned with private financing have been already adopted and, with some revisions, extensively utilized by urban households and small-size firms in their unofficial financing, it does not seem to be worthwhile to describe every details about their organization, institutional characteristics, functioning, etc., though economic investigation has by no means been exhaustively achieved. This study, however, shares a fairly large proportion in introducing the *kye* system, since the nature of the *kye* is quite different from ones usually prevailing in private financial markets.

The interview with the *kye* members was made in October 1977 in their location, and a general survey of the economic and social situation of the maritime village where the kye is organized was previously reported by the survey team including the author.[2] The present study naturally confines its report within a range of characteristics and operations of the *kye*.

2. Description of the Maritime *Kye*

The fishing village, which adopts the *kye* to be described in this section, is located approximately 23 km southeast of Kangneung city, Kangwon province on the eastern coast of Korean peninsula, about the same latitude with Seoul. The administrative name of the village is Shimkok-ri Kang-dong-myun Myongju-kun Kangwon-do, and *ri* is divided into two naturally formed villages. The *kye* has its main organization in the larger village, which is situated in a narrow and long valley leading to the sea. The *ri* consists of 75 households as of 6 October 1977, out of which only six households are engaged totally in non-fishery industries and these six households are not members of the *kye*. The village has a peculiar social aspect in the sense that the most of the wealthy households are headed

2) For other aspects of the *kye*, refer to S.K. Kim et. al., "An Economic Analysis of the Traditional Fishery Community," *Yonsei Business Review*, Vol. 15, No. 2, (August 1978), pp. 37~47.

by two families with last names, Won (元) and Choi (崔). In this sense the villagers are believed to be descendants of one or two tribal families, which are known to have migrated to this area approximately seven or eight generations ago. This characteristic seems to have primarily enabled the villagers to form a tight *kye* system, which is rarely found in other fishing areas.

The member households of the *kye* supply necessary labour force for production. Since the most important production activity is reaping seaweed (*Undaria Pinnatifida*) twice in a year when it is ripe in sea water, the required labour input is evenly allotted to each of the *kye* member households throughout the production period. The *kye* commonly possesses 214 ha of fishery ground, which is mainly composed by a sea area encirled by the small harbour in the entrance of the village from the sea. The *kye* also commonly possesses 44 vessels, out of which only two vessels are motorized and over 15 tons in dead weight. Production is jointly performed on a commonly possessed fishery ground with joint application of commonly possessed capital equipment. Labour input is collectively made with a fair portion alloted to each member household. The membership may be inherited but not transferable to a non-member household. The conventions and regulations adopted by the *kye* is warranted by the National Fishery Cooperative, and the property right of the *kye* is protected by the law. In addition to fishery activities, the villagers are also engaged in agriculture, mostly farming. The agricultural land and other agricultural equipment are privately possessed, and neither cooperative nor *kye* is organized for agricultural activities.

When fishery products ard jointly harvested, these products are marketed in peculiar way by the *kye*. Prior to the beginning of the production, one half of the total product of seaweed is sold to a successful bidder, in advance, who pays the highest lump-sum price disregarding the actual quantity of the product. In another words, the advance sale of one half of the seaweed product is not made in unit price auction but in lump sum price basis. The remaining seaweed product is sold after production to the successful bidder at the current unit market price. The buyer who succeeded in auction in purchasing one half of seaweed product in advance retains an exclusive right to purchase non-seaweed product harvested in the village, such as abalone (genus *Haliotis*), wild laver (genus *Porphyra*), sea-urchins (class *Echinoidea*), etc. Non-seaweed products occupy a varying share of the total fishery product in the village, mainly depending upon the total product of seaweed.

We may rewrite the main features of economic activities of the *kye* in functional forms. Let the production function of seaweed be

$$x=f(w) \qquad \frac{dx}{dw}>0 \tag{1}$$

where x is the amount seaweed produced and w is a weather variable expressed in index number, which affects seaweed production. Assume w has a distribution as $x \sim N\ (0\ \sigma^2)$ i.e. normal with mean zero and variance σ^2. Since the seaweed production largely depends upon climatic factors, the production function takes a particular form. Labour and capital input do not alter the output very much. In this case, the production is merely extracting naturally grown seaweed and, therefore, labour and capital input over a certain optimal level result in practically zero marginal productivity. In other words, how much is to be produced does not depend upon how much labour and capital input are made, but inversely, how much of seaweed can be extracted dictates labour and capital input. The level of employment in seaweed production is determined by the amount of extractable seaweed grown naturally on the seabed in the fishery ground area. Now we have employment function as

$$L_1=g(x) \qquad \frac{dL_1}{dx}>0 \tag{2}$$

where L_1 indicates labour input made in the seaweed production. Let us define the remainder of labour force L_2 defined as

$$L_2=\bar{L}-L_1 \tag{3}$$

where L_2 means labour available in non-seaweed production and $\bar{L}$ the total labour force available for fishery production in the village. Since most of non-seaweed production depends upon labour input made in the production, we have the non-seaweed production function as

$$y=h(L_2) \qquad \frac{dy}{dL_2}>0 \tag{4}$$

where y denotes the amount of non-seaweed production. The total revenue of the *kye* is finally obtained as

$$R=\frac{1}{2}P_1x+P_2y+C \tag{5}$$

where R denotes the total revenue from the fishery product, P_1 the market price of seaweed, P_2, the exclusive buyer's price of non-seaweed product and C the lump-sum price advanced to the *kye* by the successful bidder for the one half of the seaweed product.

3. An Economic Analysis of the *Kye*

From the process of deriving a total revenue function in the previous section, Equation (1) through Equation (5), we may easily detect that the total revenue of the *kye* is a function of a random variable and, consequently, itself a random variable, too. Now it seems proper to investigate stochastic natures of the total revenue. Prior to the investigation, we may postulate a set of assumptions, at the first stage, primarily for simplification of the analysis.

Assumption 1 : Equations (1), (2) and (4) are linear.

Assumption 2 : Two prices P_1 and P_2 are in no way correlated each other and independently decided without being influenced by the amount of products x and y.

Assumption 3 : A fixed amount of labour input is set aside for agricultural production and is in no way influenced by the amount of fishery production.

Assumption 4 : The lump-sum price for the one half of seaweed production, C, is a long-run average price.

Based on Assumption 1, Equation (1), (2) and (4) may be rewritten as

$$x=\alpha+\beta w \tag{1—1}$$

$$L_1=\gamma+\delta x \tag{2—1}$$

$$y=\epsilon+\zeta L_2 \quad (3-1)$$

where greek letters deonte coefficients of the functions, that obey characters described in each of original equations. Then, it is clear that Equation (5) is rewritten as

$$R=\eta+\theta w \quad (5-1)$$

where η and θ are defined as Equations (5—2) and (5—3).

$$\eta=\frac{1}{2}P_1\alpha+P_2(\epsilon+\zeta\bar{L}-\zeta\gamma-\zeta\delta\alpha)+C \quad (5-2)$$

$$\theta=\frac{1}{2}P_1\beta-P_2\zeta\delta\beta \quad (5-3)$$

It is also clear that based on the property of w, the total revenus of the *kye* R, takes the following distribution:

$$R\sim N(\eta \quad \theta^2\sigma^2) \quad (6)$$

which means that means that R is normally distributed with mean η and variance $\theta^2\sigma^2$.

Let us suppose that the *kye* did not mainatain the forward-selling system and it entirely depends upon the total revenue from selling of the entire production of seaweed at a current unit market price after harvest. The total revenue function in this case will be obtained as

$$R'=P_1x+P_2y \quad (7)$$

Rearranging Equation (7) we now have

$$R'=\lambda+\mu w \quad (7-1)$$

where λ and μ are defined as Equations (7—2) and (7—3).

$$\lambda=P_1\alpha+P_2(\epsilon+\zeta\bar{L}-\zeta\gamma-\zeta\delta\alpha) \quad (7-2)$$

$$\mu=P_1\beta-\rho_2\zeta\delta\beta \quad (7-3)$$

We have the dstribution of R' as Equation (8).

$$R'\sim N(\lambda \quad \mu^2\sigma^2) \quad (8)$$

We can easily see that η and λ are the same in quantity based on Assumption 4. However, we may easily distinguish the difference between θ^2 and μ_2. In terms of standard deviation $\mu\sigma$ is greater than $\theta\sigma$ by $\frac{1}{2}$ $P_1\beta$. This tells us that, by adopting an advance sale convention the *kye* is able to maintain relatively stable total revenue. We may easily conjecture that this convention may have been adopted mostly owing to erratic climatic conditions in seaweed production. Then, why is only one half of the seaweed production sold in advance instead of all? The answer is simple. If the entire amount of seaweed production is sold in advance at a lump-sum price, there would be minimum labor input in the seaweed production since no incentive is given to the *kye* members to increase production of seaweed. In addition, the advanced lump-sum price for the one half of the production usually covers minimum level of subsistance for the *kye* members.

Let us further consider what will be the result when some of the assumptions are changed.

Suppose we have changed Assumption 2 as follows:

Assumption 2′: Each of the two prices, P_1 and P_2 are negatively correlated with each of the two products x and y, respectively.[3]

Now, we add too more equations, assumed linear, to our system.

$$P_1=\nu+\xi x,\quad \nu>0,\quad \xi<0 \tag{9}$$

$$P_2=\pi+\rho y,\quad \pi>0,\quad \rho<0 \tag{10}$$

Rearranging Equations (9) and (10) as a functions of w and substituting P_1 and P_2 in Equations (5—2), (5—3), (7—2) and (7—3), we have a new total revenue function as Equation (11).

$$R_p=\tau+\upsilon w+\phi w^2 \tag{11}$$

where τ, υ and ϕ are defined as Equations (11—1), (11—2) and (11—3), respectively.

$$\tau=\frac{1}{2}\alpha(\nu-\xi\alpha)+[\epsilon+\zeta(\bar{L}-\gamma-\delta\alpha)]\{\pi+\rho[\epsilon+\zeta(\bar{L}-\gamma-\delta\alpha)]\} \tag{11—1}$$

$$\upsilon=\frac{1}{2}\beta\nu+\beta(\alpha\xi-\rho\zeta\delta)-\{\pi+\rho[\epsilon+\zeta(\bar{L}-\gamma-\delta\alpha)]\zeta\delta\beta \tag{11—2}$$

$$\phi=\beta^2\left(\frac{1}{2}\xi-\rho\zeta^2\delta^2\right) \tag{11—3}$$

Since R_p defined as Equation (11) is a nonlinear function of a normal random variable, it is not easy to derive the density function of R_p.

3) This assumption is not plausible, since the share of the production of the *kye* out of the national total is very negligible.

However, we may easily obtain the mean and variance of R_p as Equations (12) and (13).

$$E(R_p)=\tau+\phi\sigma^2 \tag{12}$$

$$var(R_p)=\sigma^2 v^2+2\phi^2\sigma^4 \tag{13}$$

Suppose again that the *kye* did not maintain the forward-selling system. The total revenue function in this case will be changed as

$$R_p'=P_1x+P_2y \tag{14}$$

Recalling that P_1 and P_2 are functions of x and y, respectively, we may rearrange the total revenue function as

$$R_p'\chi=+\psi w+\omega w^2 \tag{15}$$

where χ, ψ and ω are defined as

$$\chi=\alpha(\nu+\xi\alpha)+[\epsilon+\zeta(\bar{L}-\gamma-\delta\alpha)]\{\pi+\rho[\epsilon+\zeta(\bar{L}-\gamma-\delta\alpha)]\} \tag{15—1}$$

$$\psi=\beta(\alpha\xi-\rho\zeta\delta)+\beta(\nu+\xi\alpha)-\{\pi+\rho[\epsilon+\zeta(\bar{L}-\gamma-\delta\alpha)]\}\zeta\delta\beta \tag{15—2}$$

$$\omega=\beta^2(\xi-\rho\zeta^2\delta^2) \tag{15—3}$$

Again we can easily derive the mean and variance of R'_p as

$$E(R_p')=\chi+\omega\sigma^2 \tag{16}$$

$$var(R_p')=\psi^2\sigma^2+2\omega^2\sigma^4 \tag{17}$$

Now, let us compare two means obtained as Equations (12) and (14). When $E(R_p')$ is subtracted from $E(R_p)$ we have the following relation:

$$E(R_p)-E(R_p')=C-\frac{1}{2}[\xi(\beta^2\sigma^2\alpha^2)+\alpha\nu] \tag{18}$$

Since $\xi<0$ holds, the difference expressed by Equation (18) will be hardly negative or zero unless the value of ν is very great. Even though it would be difficult to draw a decisive conclusion, we may safely state that it is highly probable that $E(R_p)$ is at least the same with $E(R_p')$. As for the difference between the two variances, it is very hard to draw a conclusion at this stage, since the value primarly depends upon the values of coefficients.

Now, returning to the original set of assumptions, we have to inquire into the possible reasons why the non-seaweed products are exclusively sold to the successful bidder. Suppose the successful bidder's total profit function is defiend as

$$H = j_1(x) + j_2(y) \qquad d[j_1(x)]/dx > 0 \qquad d[j_2(y)]/dy > 0 \tag{19}$$

where H, the total profit, is defined as a function of x and y. Since x and y are functions of w eventually, we may establish the following relations based on Equations (1), (3), and (4).

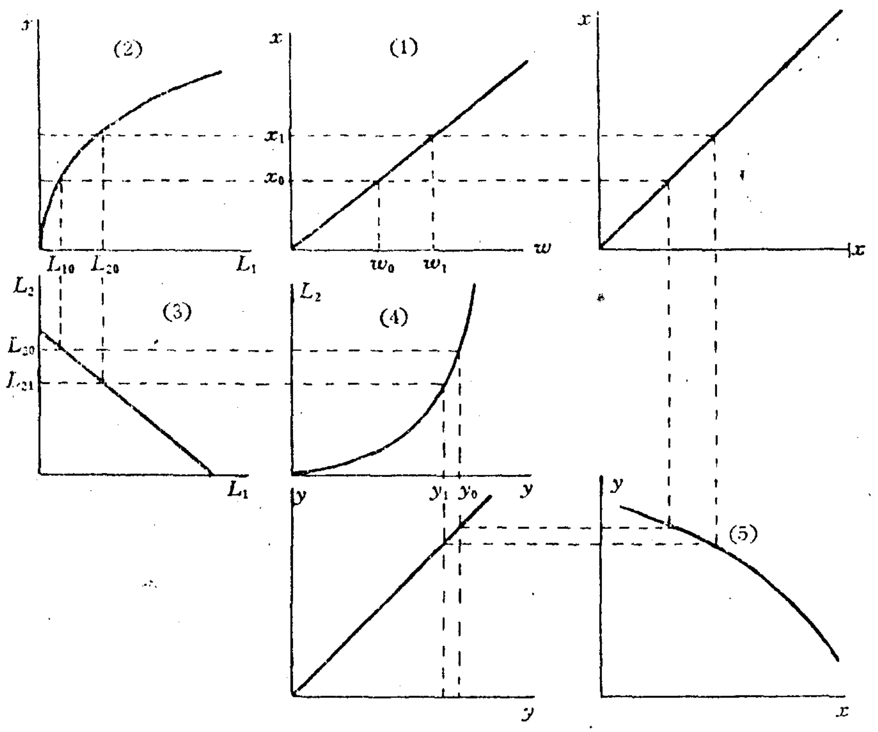
$$\frac{dH}{dw} = \left\{ \frac{d[j_1(x)]}{dx} + \frac{d[j_2(y)]}{dy} \cdot \frac{dy}{dL_2} \cdot \frac{dL_2}{dx} \right\} \frac{dx}{dw} \tag{20}$$

Since the first term in the parenthesis on the right-hand side of equation is positive and the second term negative, we know that with a change in climatic factors the total profit of the successive bidder may not be so versatile as we expected. Of course, the change in the profit is primarily affected by value of each of the first derivatives that constitute Equation (20). This fact may be further expounded by a disgramatic presentation. In Diagram 1 we have each of Equations (1)—(4) drawn as (1)—(4). Equation (1) is drawn as a linear function in (1), in which the origin of the line is not in this case necessarily (0, 0). And the remaining equations are drawn in order as in (2) through (4). Once climatic conditions are given, say w_0, we have the production level of seaweed at x_0. This level of x_0 will absorb L_{10} of labour input and the available labour for non-seaweed production is determined at a level L_{20}, L_{20} of available labour produces y_0 of non-seaweed production. Transforming x and y into a new quadrant and establishing y as a fuction of x, we have production possibility frontier as (5). With given amount of labour, the *kye* possibly produces seaweed and non-seaweed products as shown in (5). This frontier has a somewhat different nature from a general production possibility frontier in the sense that the *kye* as a producer is not able to choose any point on the frontier, at which the total revenue of the kye is maximized since the production of x is determined by climatic factor.[!]

Once the production possibility is obtained, it is not difficult to derive the profit of the successful bidder based on Equation (18). The x-H plane in Diagram (2—1) shows the first term of the right-hand side of Equation (18) and the y-H plane the second term. When climatic conditions are given such that the entire labour is absorbed by the production of x, the

DIAGRAM 1

DERIVATION OF PRODUCTION POSSIBILITY FRONTIER

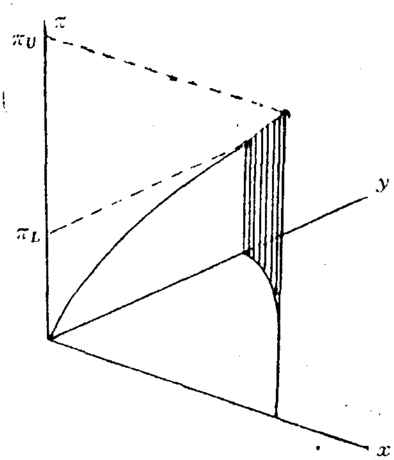


profit of the bidder will be determined at Π_U, and when the entire labour is put into the production of y, the profit will be set at Π_L. The range between Π_U and Π_L may be termed the profit possibility range, the magnitude of which will be dictated by the sizes of the first derivatives of two terms at the right-hand side of Equation (18) with respect to the weather variable. In an extreme case when

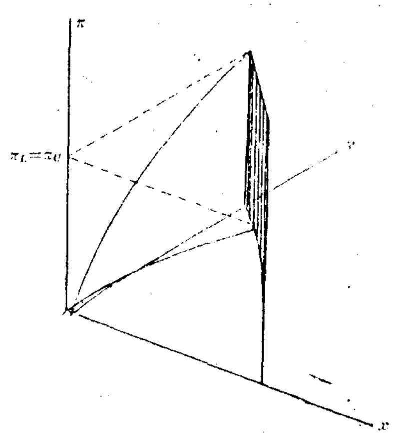
$$\left|\frac{d[j_1(x)]}{dx}\right|=\left|\frac{d[j_2(y)]}{dy}\cdot\frac{dy}{dL_2}\cdot\frac{dL_2}{dx}\right|$$

holds, the profit possibility range is set as a point as shown in Diagram 2—2, in which $\Pi_U=\Pi_L$ is designated at point. Along this conjecture, we may easily derive that without having the exclusive right to purchase non-seaweed product by the successive bidder the profit possibility range will be widened, and the stability of the bidder's income will be drastically lessened. This sort of a diagramatic presention is analogously applicable also in an analysis of the *kye*'s revenue. However, it is omitted since the presentation will be too obvious. And we may also postulate, in the analysis, the revised set of assumptions, in which two prices are not fixed. However, the reault will be too complicated.

DIAGRAM 2-1
PROFIT POSSIBILITY RANGE



DIAGRAN 2-2
PROFIT POSSIBILITY RANGE



4. Concluding Remarks

The maritime *kye* organization found prevailing in the eastern coast area of the Korea peninsula seem to have been originated in order to preserve a maximum stability of the village income, which, if left to nature's whim, would be hardly maintained. Even though the *kye* has been maintained and operated primarily based upon experiences of the village *kye* members, its economic implication may be closely viewed in a framework of well-designed theoretical basis.

First, under a set of assumptions, the application of *kye* system to the entire operation of the village's economy is found to guarantee a maximum stability of the village income and a maximum incentive to the kye members to engage in production. A change in the assumptions does not necessarily violate what the *kye* guarantees for the village economy.

Second, the *kye* system is operated in such a manner that it is not only beneficial for the village economy but also rewarding to the buyer of the *kye* product, who succeeds in the advance-sale bidding.

Third, the model may be further exploited in order to investigate additional characteristics of the *kye*, but it would entail another full-fledged seperate study. Moreover, it seems desirable that an econometric modelling and estimation may be conduct in order to establish an actual framework of the economy. But series of statistical data may be possibly collected only with hardship.

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