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INCENTIVE, PERFORMANCE, AND CHOICE OF STRATEGY IN CONTRACT BROILER FARMING

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Introduction

Broiler farming is often considered as a risky agribusiness because it is accompanied by systemic production risks with respect to weather fluctuations, strain of chicks, feed quality, and input and output price fluctuations. In view of this, the contract system has played an important role in the development of broiler farming not only in Indonesia but also in other countries. Although contract farming has proved to be an effective mode of organizing the poultry industry, there still exist some controversial issues regarding factors affecting the performance of a contract and the choice of strategy between a poultry company as an integrator and broiler farmers as growers.

A common feature of contract broiler farming is that growers exchange control over production and marketing management decisions for a guaranteed price, while integrators bear the risks related to changes in the relative prices of inputs and outputs. Non-labor inputs such as day-old chicks (DOC), feed, OVK (medication, vaccine, and other chemical inputs), and technical services are completely controlled by integrators. The labor input becomes the growers' responsibility. However, when growers enter into a contract, they have to make a significant amount of investment in broiler

houses and other facilities (fixed factors). Integrators may implement several types of contracts such as tournament, fixed performance standard, and profit sharing as well as provide incentives and/or compensation in order to improve the performance of growers. The contract is usually a short-term contract based on flock and holds for a certain period. It is renewed regularly based on the market conditions.

Although the input and output prices and the structure of the payment provided to growers are explicitly declared in the contract between integrators and growers; the quantity and quality of inputs are not. In a short-term contract, integrators can evaluate the ability of growers and may classify them by allocating varied quantities and/or qualities of inputs. Integrators may provide sufficient inputs, thus providing an incentive to growers for investing more efforts and improving the performance of the contract. Alternatively, integrators may handicap high-quality growers with more flocks or may discriminate the quality of inputs provided to the growers. As investigated in Leemonchai and Vukina (2005), two possible strategies may be practiced by integrators: (1) career concern strategy (high-performance growers are allocated high quality of inputs and low-performance growers are allocated low quality of inputs) and (2) ratchet strategy (high-performance growers are allocated low quality of inputs and low-performance growers are allocated high quality of inputs)[1]. Previous studies provide inconsistent results regarding the presence of career concern strategy and/or ratchet strategy in contract broiler farming. Leemonchai and Vukina (2005) examined whether integrators involved in contract broiler farming in the U.S. differentiate between growers by providing different qualities of chicks. However, the results suggested that career concern and ratchet effect were absent. Knoeber and Thurman (1994) revealed that the number of chicks, their grow-out length, growers' ability, and type of contract affect the contract performance. They indicated that integrators handicapped growers by allocating more flocks to high-performance growers, thus suggesting the presence of career concern strategy.

This paper reinvestigates whether or not integrators implement career concern strategy and/or ratchet strategy in contract broiler farming. The following two alternative proxies representing growers' ability are considered: (1) individual fixed effect and (2) feed conversion rate (FCR). The former is commonly used in econometric analyses to evaluate individual growers' unobservable ability, while the latter is practically applied by local integrators to assess growers' performance. The qualities of feed and DOC are considered as two possible instruments by which integrators can control growers' incentives as well as the risks associated with broiler production. An empirical analysis was conducted by using farm-level data in Sleman District, Yogyakarta.

Overview of Contract Broiler Farming

Structure of poultry industry

In Indonesia, contract broiler farming was previously conducted only by large poultry companies such as PT Japfa Comfeed Indonesia and PT Charoen Phokpand Indonesia. Recently, poultry shops, such as shop "J" in Mlati Sub-district, Sleman District, Yogyakarta, also commenced contract farming. This poultry shop established contract farming in 2002 and has branch offices in Bogor and Kalimantan. The rapid progress of contract farming conducted by this poultry shop in Sleman District indicates that contract farming is considered attractive. Figure 8.1 shows the structure of poultry industry in Yogyakarta.

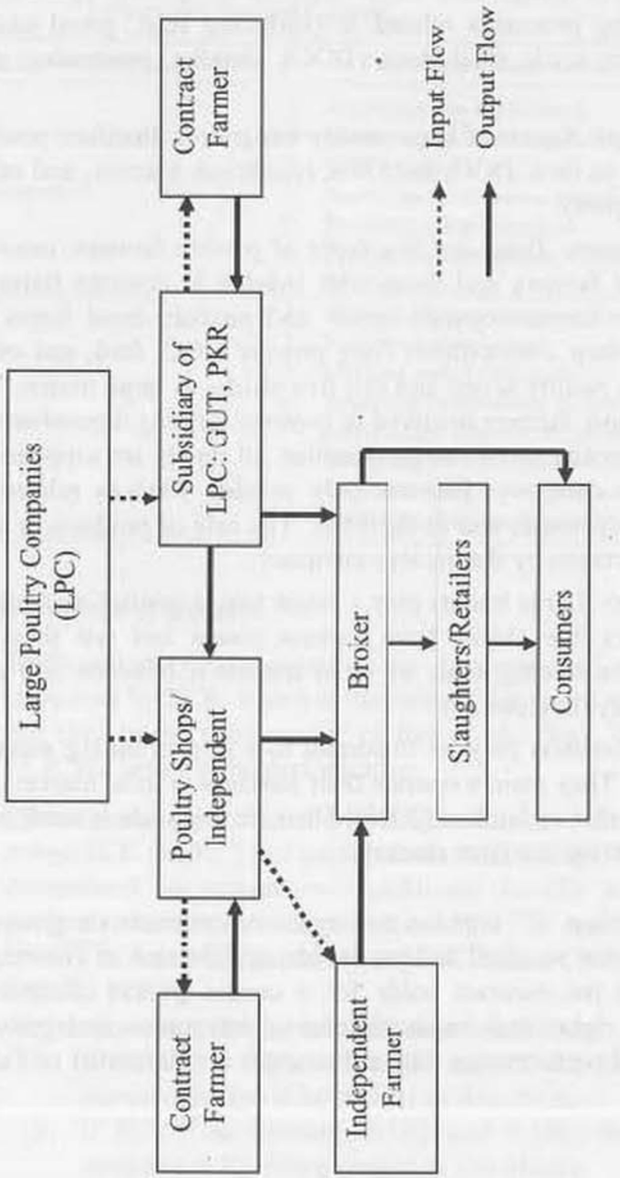

Figure 8.1 Structure of Poultry Industry in Yogyakarta
Source: Jamhari (2005)

1) Large poultry integrators: Large poultry companies operate by implementing processes related to producing feed, grand parent stock, parent stock, final stock (DOC), farming, processing, and marketing.
2) Poultry shops: Agents of large poultry integrators distribute poultry inputs such as feed, DOC, and OVK (medicine, vaccine, and other chemical inputs).
3) Poultry farmers: There are two types of poultry farmers, namely, independent farmers and those who indulge in contract farming. Independent farmers operate small- and medium-sized farms by employing their own capital. They procure DOC, feed, and other inputs from poultry shops and sell live chicks to large traders. On the other hand, farmers involved in contract farming depend on the nucleus company. As mentioned earlier, all inputs are supplied by the nucleus company. Farmers only provide services related to labor, poultry house, and its facilities. The sale of products is also solely undertaken by the nucleus company.
4) Large traders. Large traders play a major role in poultry marketing. They collect live chicks from various places and sell them to retailers. The trading scale of large traders is between 500 and 3,000 kg /day (live chicks).
5) Retailers: Retailers play an important role in distributing meat to consumers. They mainly operate their business in local markets, as analyzed earlier in Jamhari (2008). Their trading scale is small, i.e., less than 500 kg/day (live chicks).

Poultry shop "J" imposes two types of contracts on growers: fixed performance standard and profit sharing. The unit of contract is the flock, and the contract holds for a certain period (short-term contract). The rights and responsibilities of integrators and growers under the fixed performance standard contract are presented in Table 8.1.

Table 8.1 Rights and Responsibilities of Integrators and Growers in Fixed Performance Standard Contract

Rights and Responsibilities of	Fixed Performance Standard Contract
Integrators	1. Supplying non-labor inputs 2. Guaranteeing inputs and output prices 3. Selling output 4. Providing performance incentives 5. Providing price incentives 6. Providing compensation to growers when they face loss
Growers	1. Providing broiler houses and other facilities 2. Providing labor inputs 3. Utilizing inputs efficiently 4. Receiving performance incentives when their performance is above the standard level 5. Receiving price incentives when the output price in market is higher than that in the contract 6. Receiving compensation when they face loss

Performance of growers

1) Performance measurement[2]: The performance of growers is measured by FCR, which is the ratio of the total amount of feed in use (kg) to the total weight of live chicks (kg). The smaller the FCR, the better is the performance.
2) Performance incentive: Performance incentive is based on the actual FCR (FCR^{act}) and performance standard (FCR^{std}) of growers determined by integrators. Additional benefit in the form of performance incentives is provided if FCR^{act} is smaller than FCR^{std}. FCR^{diff} is the difference between FCR^{std} and FCR^{act}, i.e., $FCR^{diff} = FCR^{std} - FCR^{act}$.

   The performance incentive is calculated as follows:
   (i) If FCR^{diff} is between 0.000 and 0.100, the performance incentive is Rp 65/kg weight of live chicks.
   (ii) If FCR^{diff} is between 0.101 and 0.150, the performance incentive is Rp 80/kg weight of live chicks.

(ii) If FCR^{diff} is more than 0.150, the performance incentive is Rp 100/kg weight of live chicks.

3) Price incentive: Price incentive is provided to growers if the output price in market is higher than that in the contract, and if $FCR^{act} < FCR^{std}$. The level of price incentive depends on the mortality rate as follows:
   (i) If the mortality rate is between 0.00 and 0.29, the price incentive is 30% of the selling value difference.
   (ii) If the mortality rate is between 3.00 and 3.49, the price incentive is 25% of the selling value difference.
   (iii) If the mortality rate is between 3.50 and 3.99, the price incentive is 22.5% of the selling value difference.
   (iv) If the mortality rate is between 4.00 and 4.49, the price incentive is 20% of the selling value difference.
   (v) If the mortality rate is between 4.50 and 4.99, the price incentive is 17.5% of the selling value difference.
   (vi) If the mortality rate is between 5.00 and 10.00, the price incentive is 15% of the selling value difference.

4) Compensation: If growers face loss, integrators provide full compensation to them.

Quality of feed and DOC

Local integrators apply the similar FCR^{std} to all growers for measuring their performance. However, the combination of chicks (strain of chicks) and feed provided by local integrators are highly different among growers (see Tables 8.2 and 8.3). The field observation encourages us to hypothesize that local integrators implement career concern or ratchet strategy by using the qualities of DOC and feed as instruments to improve growers' performance. Since the quality of inputs is difficult to measure, the prices of DOC and feed are used as variables representing the quality.

Table 8.2 Combination of DOC

No	DOC combination	Flocks	Price (Rp/head)
1	AS	24	2.521
2	AS+CIP	1	2.914
3	AS+JUM	1	2.885
4	CIP	8	2.623
5	CP	14	2.628
6	CP+JUM	1	2.725
7	EL	3	2.838
8	IIB+CP	1	2.659
9	JUM	1	2.850
10	MAL	3	2.633
11	MANGGIS+AS	1	2.812
12	MBAI	328	2.489
13	MBAI+AS	2	2.430
14	MBAI+ML	1	2.850
15	SMD	1	2.850
16	WON	5	2.830

Source: Poultry Shop "J"

Table 8.3 Combination of Feed

No	Feed Combination	Flocks	Price (Rp/kg)
1	BRISP	231	2,554
2	BRISP+BRAVO	5	2,699
3	BRISP+CARGIL	12	2,568
4	BRISP+CARGIL+BRAVO	2	2,557
5	BRISP+CARGIL+PC100	2	2,559
6	BRISP+CARGIL+SIIB	1	2,644
7	BRISP+PC100	35	2,662
8	BRISP+RN42	4	2,665
9	BRISP+SIIB	1	2,652
10	BRISP+WON	2	2,473
11	DBI	26	2,512
12	DBI+BRISP	63	2,546
13	DBI+BRISP+CARGIL	2	2,630
14	DBI+BRISP+CARGIL+PC100	2	2,556
15	DBI+BRISP+PC100	4	2,635

Source: Poultry Shop "J"

Empirical Model

Production function approach

The econometric approach employed to examine the presence of career concern and/or ratchet strategy involves two steps (Leemonchai and Vukina, 2005). In the first step, broiler production (Q) is estimated as a function of quantity (y) and quality (q) variables of production inputs.

$$Q_{it} = \alpha_0 + \sum_{k=2}^{n} \delta_k d_{i,t}^k + \sum \beta^y \cdot y_{i,t}^k + \sum \beta^q \cdot q_{i,t}^k + e_{i,t}$$

(i = flocks, t = time, k = growers) (1)

Individual growers' ability, often referred to as growers' fixed effect, can be measured by the estimates of growers' dummy variable ($d_{i,t}^k$). The fixed effect estimates are used as proxy of growers' ability in the second step. β^y is assumed to be positive since a larger volume of quantity inputs normally leads to an increase in broiler production. The estimates of β^q indicate a relationship between quality inputs and broiler production. When integrators supply higher quality inputs to growers with higher ability in order to increase broiler production, β^q is positive. On the other hand, if integrators strategically allocate production inputs of varying qualities to manage growers' incentives and production risks, the sign could be negative. It should be noted that all quantity (y) and quality (q) inputs are managed under the control of integrators.

In the second step, the presence of career concern strategy and/or ratchet strategy is examined by employing the following production inputs equation.

$$q_{i,t}^k = a_0 + a_1 \cdot \hat{\delta}_k + \varepsilon_{i,t} \qquad (2)$$

$q_{i,t}^k$ represents the quality of inputs supplied by the integrator to grower k and $\hat{\delta}_k$, the individual grower's ability that is estimated as the fixed effect in Equation (1). The estimation of $a1$ would reveal whether or not integrators' quality choice in production inputs is dependent on the individual growers' ability. The expected sign of $a1$ is positive when the career concerns type of implicit incentives exists, which implies that higher quality of inputs are supplied to growers with higher ability and vice versa.

FCR criterion approach

Previous studies such as Knoeber and Thurman (1994) and Leemonchai and Vukina (2005) have used the fixed effect estimates obtained from the regression of production function equation as proxy of grower's ability. However, the fixed effect does not appropriately reflect growers' ability from a practical standpoint. Measuring such inherent ability is arduous for local integrators. Moreover, it is difficult for local integrators to incorporate such measurement into the decision-making process with respect to the allocation of production inputs.

As an alternative, this study uses the FCR to measure growers' ability. This measurement is more appropriate since the performance incentives of growers depend on the difference between FCR^{act} and FCR^{std}. In addition, both performance and price incentives require FCR^{act} to be lower than FCR^{std} (hereafter referred to as the FCR criterion). Therefore, the FCR criterion provides strong incentives to growers for increasing broiler production as well as lowering the FCR^{act}. Furthermore, the FCR criterion is simple, observable, and coherent for both growers and integrators and is expected to play a pivotal role in contract broiler farming.

The FCR criterion could be incorporated into broiler farm management in two ways[3]. First, the FCR criterion could be used as integrators' goal. Integrators may help growers to achieve the FCR criterion by differentiating between the qualities of inputs. This hypothesis is tested by using the following equation:

$$Pr(FCR^{act} < FCR^{std}) = Pr(d = 1) = EXP(\beta' q^{k}_{i,t}) / [1 + EXP(\beta' q^{k}_{i,t})] \quad (3)$$

Equation (3) indicates that the probability of meeting the FCR criterion is a function of the quality of inputs provided. The left hand side variable (d) is a dummy variable representing the case wherein $FCR^{act} < FCR^{std}$. The right hand side variables represent the quality of production inputs determined by integrators. Since the left hand side variable is binary, the likelihood function of Equation (3) is estimated by conducting a logit analysis. If the production inputs are strategically allocated to improve FCR^{act} over FCR^{sd}, one of the parameters would be estimated to be significantly positive.

Second, the FCR criterion may be used to determine the quality of inputs provided. It is possible that the quality of inputs is differentiated simply based on whether or not growers meet the FCR criterion. The relationship between the FCR criterion and the quality of production inputs is evaluated by using Equation (4).

$$q^{k}_{i,t} = b_0 + b_1 \cdot d^{k}_{i,t} + \varepsilon_{i,t} \quad (4)$$

Similar to Equation (2), $q^{k}_{i,t}$ is the quality of inputs supplied to grower k. The dummy variable ($d^{k}_{i,t}$) on the left hand side takes one when grower k achieves the FCR criterion, otherwise, 0. If the level of production inputs is determined by the FCR criterion, $b1$ would turn out to be statistically significant.

Data

The data used in this paper is provided by a poultry shop integrator in Sleman District, and it includes the production information of growers under the contract for one year from January 1, 2005 to December 31, 2005. Overall, we obtained the data for 472 flocks. While 12% of the flocks (56 out of 472) are produced by integrators, 88% of them (416 out of 472) are produced by growers. The total number of growers is seventy-six. While 4% of the growers (3 out of 76) are treated to practice profit sharing contract with integrators, the rest (96%) practice fixed performance standard (see Table 8.4). The flocks and growers are located in Sleman, Bantul, Kulonprogo, Gunungkidul, and Klaten District. In a profit sharing contract, integrators do not provide incentives to growers; however, in fixed performance standard contract, they do.

Table 8.4 Number of Flocks and Growers by Type of Contract

Item	Type of Contract			Total
	Fixed Performance Standard	Profit Sharing	Direct Management by Integrator	
Flock	395	21	56	472
Grower	73	3	1	77

This paper focuses on growers' flocks under the fixed performance contract. A limited number of growers under the profit sharing contract preclude us from further statistical analysis. For a brief understanding of the different performances among the three types of contracts, Table 8.5 summarizes the data from these three types of flocks.

Table 8.5 Summary of Data by Types of Flocks

Data	Type of Contracts			Average
	Fixed Performance Standard	Profit Sharing	Direct Management by Integrator	
Number of chicks	5,339	8,574	10,684	6,115
Feed (kg)	14,215	22,733	30,405	16,515
Grow-out length (day)	37	37	37	37
Mortality rate (%)	4.88%	4.94%	5.20%	4.92%
Weight of live chicks (kg)	8,401	13,234	17,630	9,711
FCR*	1.705	1.710	1.721	1.708

Note: FCR is feed conversion ratio (total feed divided by total weight of live chicks)

Table 8.5 shows that the performance of flocks under the fixed performance standard contract is relatively better than that under the profit-loss sharing contract as well as under direct management. It is evident that effective implementation of the incentive system by integrators effectively encourages growers to increase their farm efficiency.

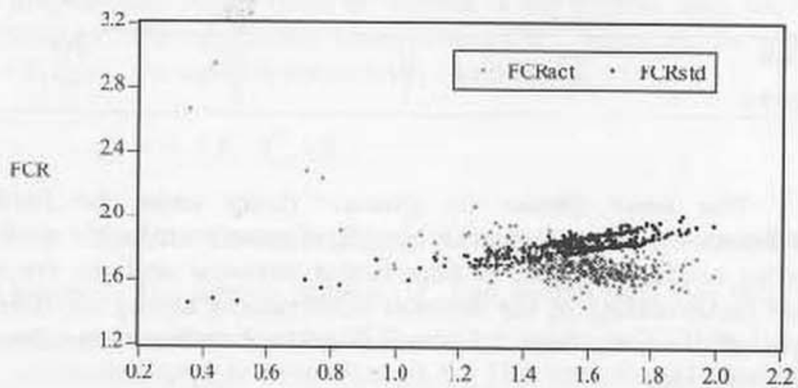

Figure 8.2 Growers' Performance Measured by FCR

Figure 8.2 illustrates growers' performance evaluated by the FCR. The Y-axis indicates both FCR^{act} and FCR^{std}, while the X-axis represents the body weight of harvested chicks per head. Figure 8.2 demonstrates that most flocks (87%) under the fixed performance contract meet the FCR criterion. This is understood by the observation that most of the FCR^{act} are plotted in the range below the FCR^{std}. In contrast, 13% of the flocks, located above the FCR^{std}, do not qualify for performance incentives. They need either increasing per head body weight of harvested chicks (Q/CN) or decreasing FCR^{act} for meeting the FCR criterion. Although none of the quality inputs appear in Figure 8.2, it is possible that the quality inputs such as feed and DOC are strategically used to maintain growers' performance and incentives.

Results of Analysis

Production function approach

A production function in the form of Equation (5) is estimated with growers' fixed effect. Six explanatory variables and one seasonal dummy variable are included. The estimation results are summarized in Table 8.6.

$$Q_{i,t} = \alpha_0 + \sum_{k=2}^{n} \delta_k d_{i,t} + \sum \beta_1 \cdot CN_{i,t} + \beta_2 \cdot FEED_{i,t} + \beta_3 \cdot L_{i,t} + \beta_4 \cdot MR_{i,t} + \beta_5 \cdot DOC\_COMB_{i,t} + \beta_6 \cdot FEED\_COMB_{i,t} + d_S D_S \quad (5)$$

Q_{it}	=	Weight of live chicks of flock i harvested in time t (kg)
d_{it}	=	Growers' dummy variable of flock i harvested in time t
CN_{it}	=	Number of chicks of flock i harvested in time t
$Feed_{it}$	=	Amount of feed provided to flock i harvested in

time t (kg)

L_{it} = Grow-out length of flock i harvested in time t (day)
MR_{it} = Mortality rate of flock i harvested in time t (%)
DOC_COMB = quality of DOC as measured by its price (Rp/head)
FEED_COMB = quality of feed as measured by its price (Rp/kg)
Ds = Dummy variable for harvesting season; 1 if flock i was harvested during August–December and 0 otherwise.

Table 8.6 Estimation Result of Production Function

Variable	Coefficient	Std. Error	t-Statistics	Prob.
CN	0.271	0.037	7.372	0.000
FEED	0.491	0.014	36.070	0.000
L	–9.906	7.857	–1.261	0.208
MR	–10770.72	877.148	–12.279	0.000
DOC_COMB	0.698	0.304	2.295	0.022
FEED_COMB	–1.188	0.633	–1.877	0.062
D_S	–31.522	60.384	–0.522	0.602
R-squared	0.999	Mean dependent var		10449.84
Adjusted R-squared	0.999	S.D. dependent var		12113.45
S.E. of regression	465.454	Akaike info criterion		15.303
Sum squared resid	68243972	Schwarz criterion		16.109
Log likelihood	–2942.274	Durbin-Watson stat		1.949

Note: Fixed effect estimates are suppressed for brevity.

As expected, the performance of growers is significantly affected by quantity variables such as number of chicks (CN) and feed quantity provided (FEED). The grow-out length (L) negatively affects the performance. This implies that if the time needed to grow the chicks is more, the total broiler production decreases. This sign of grow-out length, however, is not statistically significant. The reason for the negative sign may be that we measure the grow-out length by subtracting the final catching with the placement date of chickens. On the other hand, chicks are usually harvested over a period of several days. It may be better to use a weighted average to calculate the grow-out length. The mortality rate (MR) turns out to be negative, which is consistent with the results of Knoeber and Thurman (1994). The quality of DOC (DOC_COMB) is positive and significant. It suggests that higher the quality of DOC (expensive DOC here), the higher is the production. This result is intuitively understandable and signifies career concern type of implicit strategy with respect to DOC quality. It is, however, contrastive to observe the negative relationship between the quality of FEED and broiler production. A negative sign of FEED_COMB indicates that expensive feed does not necessarily increase broiler production. In another way, it is evident that integrators provide lower quality of inputs strategically in order to increase broiler production by applying ratchet strategy with respect to feed quality.

Table 8.7 Estimation Results of Production Inputs Equation

	DOC_COMB	FEED_COMB	MR	L
$a1$	–0.003	0.004	0.00001	0.0006
t-Statistics	–0.249	0.554	1.342	–0.949

As the second step, the quality input variables are regressed on growers' fixed effect obtained from the production function. The estimated coefficients of $a1$ in Equation (2) are summarized in Table 8.7. None of the coefficients is statistically significant. It suggests that when the fixed effect is used as growers' ability, career concern or ratchet strategy does not exit, which is consistent with Leemonchai and Vukina (2005). This result further validates the use of the FCR for measuring growers' performance, as observed below.

FCR criterion approach

Table 8.8 summarizes the estimation results of the logit analysis in Equation (3). It shows that the coefficient of FEED_COMB is positive and significant irrespective of the explanatory variables included. Although the estimation results of the production function indicated that the quality of feed did not contribute to increasing the broiler production, the quality of feed turns out to be effective in lowering FCR^{act}. Thus, local integrators uses higher quality of inputs to help growers meet the FCR criterion rather than to increase broiler production. In this vein, local integrators are likely to implement ratchet type of strategy on feed quality. The effect of FEED_COMB on the FCR criterion becomes more evident when other production attributes such as MR and L are considered.

DOC_COMB turns out to be less efficient in explaining the FCR criterion. As suggested by the estimation of the production function, DOC_COMB has a positive effect only on the broiler production. The negative sign of MR suggests that the possibility of meeting the FCR criterion significantly decreases when the growers face higher MR.

Table 8.8 Estimation Results of Logit Analysis

Variable	Coefficient	t-Statistics	Coefficient	t-Statistics
C	−23.061	−1.791	−29.873	−1.831
DOC_COMB	−0.000	−0.189	0.002	0.485
FEED_COMB	0.010**	2.213	0.012**	2.057
L			0.011	0.214
MR			−29.002***	−5.710
Ds	−1.105***	−3.088	−1.137***	−2.769
McFadden R-squared	0.034		0.236	
Log likelihood	−144.864		−114.570	
Restr. log likelihood	−150.036		−150.036	
Probability (LR stat)	0.016		0.000	

Note: **=5%, ***=1% significant levels.

Similar to the second step of the production function approach, the quality inputs variables are regressed on the dummy variables of the FCR criterion ($d = 1$ if $FCR^{act} < FCR^{std}$). The results of the analysis are summarized in Table 8.9.

Table 8.9 Estimation Results of Production Inputs Equation

	DOC_COMB	FEED_COMB	MR	L
*b*1	−0.943	13.412**	−0.067***	1.343**
t-Statistics	−0.085	2.487	−9.608	2.370

Note: **=5%, ***=1% significant levels.

Most of the parameters (*b*1) turn out to be statistically significant. It means that local integrators decide the quality of production inputs based on the FCR criterion. For example, a higher quality of feed is provided when growers meet the FCR requirement. This analysis clarifies that integrators decide the quality of inputs on the basis of the FCR criterion rather than the fixed effect estimates.

Conclusions

This analysis explains why integrators completely control the input and output prices. Theoretically, the income of integrators comes from distributing inputs and the difference between the output price in the market and that in the contract. The income of integrators from the output side is uncertain. In order to increase income from the output side, integrators implement the incentive system. Incentives increase growers' efforts as well as the performance of broiler farming. The better performance of farming eventually increases integrators' income. Merely controlling the output prices is beyond the risk that integrators can bear. By controlling inputs, integrators can ensure their income from the margin of inputs that can be used to guarantee the income of growers in case of risks.

Our analysis shows that integrators control the quality of inputs to maximize broiler production while meeting the FCR criterion. The DOC combination is used to increase broiler production, thus suggesting a career concern type of strategy. On the other hand, feed combination is used to improve the FCR rather than broiler production. Ratchet type of strategy is likely to be applied on feed combination. Thus, local integrators strategically mix the quality and the combination of production inputs in order to make the contact farming system effective.

While previous studies used the fixed effect estimates as the growers' ability, this study suggests that management decisions are likely to be implemented on the basis of the FCR criterion. The use of the FCR criterion is simple and coherent for both growers and integrators. It is also incentive compatible because meeting the FCR criterion provides additional income not only to growers but also to integrators in the long run. We conclude that integrators are not concerned about growers' ability; they need to supervise the FCR and use two quality inputs strategically in order to improve the FCR criterion.

Notes

1. Career concern and/or ratchet strategy is often refereed to as career concern and/or ratchet *effect*, respectively. Both strategies provide implicit incentives wherein future rewards depend on the present performance (Kaarboe and Olsen, 2008).
2. Alternatively, settlement cost is also often used as a means of perfomance measurement, which is calculated by the total cost of feed, chicks, and medication divided by the weight of live chicks.
3. In fact, growers' performance and the inputs allocation mechanism are likely to involve a dynamic adjustment process. The problem of simultaneous determination in the performance and input allocation is also not considered. Due to the limitations in the availability of data, this paper only examines the static relationship between growers' performance and quality inputs.

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