# Risk Sharing in Poultry Contracts

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**Abstract**

In previous literature it was found that 84% of risk in poultry grow-out farms is transferred to the processing company, an integrator. A major reason for such a high risk transfer is the absence of a market price variable in determining compensation. We find that more recent contracts, which include a market price clause do not have such high risk transfer. Using welfare analysis we also conclude that the new contracts with market price clause are welfare improving for the growers. We attribute this to the fact that the growers are compensated for the additional risk they endure.

# 1 Introduction

## 1.1 The Role of Risk

Risk is uncertainty that affects an individual's welfare and is often associated with adversity and loss (Bodie) . One measure of risk inherent in an activity is the variability of expected returns from the said activity. So managing risk involves choosing among alternatives to reduce the effects of risk. A risk averse individual, such as a farmer, chooses an alternative which maximizes his expected utility. There are many risk management strategies such as enterprise diversification, contracts and insurance available to farmers. Which strategy is chosen, in large part, depends on the particular form of risk faced by the farmer. Price variability is the largest risk faced by a farmer in the broiler industry (Knoeber and Thurman) . Prior to 1994, in order to reduce the price variability a broiler grower could contract with a processing company, known as an integrator. The contract based payment was independent of the market price of broilers. After 1994 the payment scheme included a market price clause which transferred some of the risk back to the grower. Over 90% of production in the broiler industry is conducted through such contracting while the other 10% is produced on integrator-owned farms (Rogers).

In this paper we address the question: Does the inclusion of a market price clause (MPC) enhance the welfare of broiler growers? With a MPC, a broiler grower faces additional risk and thus would expect a higher mean return, so as to at least maintain the previous level of expected utility (under a no MPC (NMPC)). The second section discusses the payment schemes, while the third section describes the data. Section four looks at the risk transfer present in poultry contracts. Section five deals with the welfare analysis of contracts with MPC and section six concludes.

## 1.2 The Broiler Industry: A Background

A broiler is a young chicken grown exclusively for meat rather than for eggs (Rogers). Broiler production is concentrated in the "broiler belt" of states, which encompasses the Delmarva (Delaware, Maryland, Virginia) region through the Southeast and Texas. Broiler processing is highly integrated, with the processors controlling the vertical stages in the broiler industry by either owning or contracting each stage of the vertical system -from breeding stock to market-ready products. The integrator sends day-old chicks to grow-out farms, where they are grown to market weight before being sent to the processing plant to be slaughtered and shipped to the market. Including a one to two week period for cleaning the chicken houses, the duration of the entire process is between eight to nine weeks.

## 1.3 Contracts

Under the usual contract arrangement, the integrator retains ownership of the birds, supplies the feed and medication, and provides supervisory field personnel. In return the

grower is provided a payment for managerial skills, labor costs, and investment in housing and equipment. The contract often has incentives to encourage the production of quality broilers with minimal feed. The major integrators typically own feed mills and customize the feed to their needs. The birds reach market weight in six to eight weeks and are loaded and transported by the integrator's employees. The timing of the next batch of chicks delivered to the grower is also determined by the integrator.

# 2 Contract Grower

Over the last few decades contracts have replaced every other mode of production in the broiler industry, especially in the grow-out phase of production. Most contracts have similar payment structures based on a two-part piece rate tournament, consisting of a fixed base payment per pound of output, and a variable bonus payment based on the grower's relative performance (Vukina and Tsoulouhas) . Every grower who sells his output within a period of one week is entered into a tournament (known as a settlement). Whereas tournaments are always held on the same day every week, their composition may vary from week to week. All chargeable costs for each grower are taken into account to arrive at a per-pound cost which is then compared to the average for the settlement week in order to calculate the bonus. The producer's bonus is the difference between the settlement group average per-pound cost of raising the broilers to market weight ($\bar{\omega}$) minus the individual grower's average cost, $\omega_i$. The growers' average cost consists of the linear sum of chargeable amounts, such as medication, sanitation, cost of the chicks, fuel,vaccination, litter and feed. $\bar{\omega}$ is the weighted average cost of all growers in the settlement group. If a producer is above the average (i.e. higher cost) then he is penalized according to his

relative performance. If on the other hand he is below the average (i.e. lower cost) then he receives a bonus equivalent to the difference. The payment for grower $i$, $R_i$, then takes the following form:

$$R_i = \left[\beta + (p - \left(\frac{\bar{\omega}}{\gamma}\right) - c) \times 0.05 + (\frac{1}{n}\sum_{j=1}^{m}\omega_j - \omega_i)\right] \times Q_i \tag{1}$$

where $\beta$ is the base payment; $p$ is the market price (the simple average of the composite whole bird selling price for poultry delivered to New York City as quoted on the Monday of the Settlement Week); $\bar{\omega}$ is the average group settlement cost for the week;$\omega_i$ is the settlement cost for grower $i$; $\gamma$ is the processed meat yield factor; $c$ isthe processing cost; $Q_i$ is the weight of producer $i$'s output; $n$ is total weight of all output from settlement week; $m$ is number of growers in tournament. In equation (1), the factor $(p - \left(\frac{\bar{\omega}}{\gamma}\right) - c)$ is known as the *market clause*and $(\frac{1}{n}\sum_{j=1}^{m}\omega_j - \omega_i)$ is the *bonus*..

# 3 Data

We use data from an integrator with 75 growers under contract[1] . The data spans the period from November 27, 1981 to December 17, 1985. There are a total of 1174 observations (flocks). The number of settlements on each grower over the four year span ranges from 3 to 24. The average number of settlements is about 16. About half of the growers have 20 or more flocks thus generating a time series long enough to make inferences regarding the variance. Market prices for the broilers are provided by the USDA.

[1]thanks to Chuck Knoeber and Wally Thurman for graciously providing the data

# 4 Risk Transfer

In some previous literature on risk in the broiler industry, Martin questions whether contract farming reduces income variability relative to independent production . Knoeber and Thurman have empirically estimated the sources of risk in the broiler industry and the extent of risk sharing under contract farming. .

Knoeber and Thurman find that 84% of the risk inherent in broiler production is price risk. In the contracts they analyze, the market price is absent from payment calculations, hence transferring the risk from growers to the integrator. The payment formula for contracts without a market price clause is as follows:

$$R_i = \left[\beta - \left(\frac{\bar{\omega}}{\gamma}\right) \times 0.05 + (\frac{1}{n}\sum_{j=1}^{n}\omega_j - \omega_i)\right] \times Q_i \tag{2}$$

Modern contract payments include market price of broilers.Following methodology used by Knoeber and Thurman, we find that with the inclusion of a market price clause [$p - \left(\frac{\omega}{\gamma}\right) - c$ of equation 1], we now have a reduced risk transfer of 79% back to the integrator [2].

# 5 Welfare Analysis

In the previous section it was shown that with the inclusion of a MPC, there is more risk transferred back to the grower. This additional risk is solely a result of inducing more variability in the payment via the variability of the market price of broilers. But the question is: Are the growers necessarily worse off compared to the NMPC contract?

[2] methodology available from author upon request

Welfare analysis will answer this question.

We define risk to be the variability of the expected returns faced by the grower. As such a natural measure of this risk would be the actual variance of the expected returns. As was seen in section 4, the growers take on additional risk with the inclusion of a market clause in their payment formula. With higher risk involved in the new contract arrangement, the grower expects higher returns. We would like to study both the risks taken and the returns faced by growers under the two contract payment schemes.

## 5.1 Expected Utility Maximization

We appeal to Expected Utility Theory in order to take into account both risk and return simultaneously and allows for the comparison of the two alternative payment schemes, with and without a market price clause. With a certain set of axioms it can be shown that the optimum investment criterion is the maximum expected utility criterion and all investments should be ranked by their expected utility[3] (Levy).

Under assumptions that the expected returns are normally distributed and constant absolute risk aversion (CARA), the expected utility maximization collapses into a mean-variance framework. The expected utility (EU) is then estimated as follows:

$$EU = \mu - \frac{\lambda}{2}\sigma^2 \tag{3}$$

where $\mu$ is the mean of expected returns; $\lambda$ is the Arrow-Pratt measure of risk aversion; $\sigma^2$ is the variance of expected returns.

[3]also available upon request

### 5.2 Methodology and Results

We calculate the mean and the variance of expected returns based on the average of the past returns, or flock payments. We choose the past six flocks because a few contracts use the performance of the previous six flocks (approximately one production-year) in calculating payments. We also vary the Arrow-Pratt measure of risk aversion in order to study the sensitivity of EU . We report results on the means and variances of expected returns under the two payment schemes as a ratio of the value with MPC over the value without (NMPC). Table 1 shows the ratios of the mean and variance of expected return and expected utility for $\lambda = 0.01$. A ratio greater than 1 indicates that the new measure (with market price clause) is higher than the old measure (without the market price clause). We find that the ratios do not vary a great deal for different values of $\lambda$ , as such, we choose to report only the largest value of $\lambda$ chosen for sensitivity analysis, 0.01. For values of $\lambda$ less than 0.01, the mean of the expected return plays a more dominant role in determining expected utility and as such the hypothesis of the welfare enhancing nature of the new contracts is still maintained. For all but one grower, the ratio of the variances is greater than 1, indicating that the new payment scheme is riskier. The ratio of the mean of expected returns is also greater than one for all growers, showing higher expected returns under the new scheme. This concords with our earlier hypothesis that with increased risk the grower will expect higher returns.

## 6 Conclusion

Based on these results we can conclude that the expected utility is higher under a payment formula involving a market price clause. As was calculated earlier, compared to the old

Table 1: Number of growers with ratio of estimates (MPC / NMPC) and their ranges

| *Range* | *Var Ratio* | *Exp Util Ratio* | *Mean Ratio* |
|---|---|---|---|
| 0.60 - 0.79 | 3 | 0 | 0 |
| 0.80 - 0.99 | 7 | 2 | 0 |
| 1.00 - 1.19 | 7 | 1 | 1 |
| 1.20 - 1.39 | 8 | 7 | 0 |
| 1.40 - 1.59 | 4 | 4 | 11 |
| 1.60 - 1.79 | 8 | 30 | 41 |
| 1.80 - 1.99 | 6 | 5 | 0 |
| 2.00 - 2.19 | 4 | 2 | 0 |
| 2.20 - 2.39 | 5 | 1 | 0 |
| 2.40 - 2.59 | 1 | 1 | 0 |
| 2.60 - 2.79 | 0 | 0 | 0 |

values when $\lambda = 0.01$

scheme, the new payment scheme is in fact riskier, which is demonstrated by the fact that the ratio of variances (MPC/NMPC) is greater than 1 for all growers except three. With a higher variance, in order to maintain the same level of utility, the farmer would have higher expected returns. This is also demonstrated by the table with the ratio of the mean of expected returns being greater than 1, for all the growers. With equation 3, and the numbers we get for the variance and mean of expected returns, all growers experience higher expected utility. Thus it can be said that the new payment scheme is welfare enhancing.

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