Regulating Broiler Contracts: Tournaments versus Fixed Performance Standards

Theofanis Tsoulouhas and Tomislav Vukina

Grower discontent with tournaments as mechanisms for settling poultry contracts can largely be attributed to the group composition risk that tournaments impose on growers. This article focuses on the welfare effects of a widely advocated regulatory proposal to prevent integrator companies from using tournaments and replace them with schemes that compare performance to a fixed standard. The analysis shows that the mandatory replacement of tournaments with fixed performance standards, absent any rules that regulate the magnitude of the piece rate, can decrease grower income insurance without raising welfare. However, replacing tournaments with fixed performance standards can simultaneously increase income insurance and welfare, provided that the magnitude of the piece rate is also regulated.

Key words: contracts, tournaments, moral hazard, multiple agents, regulation.

In the last few decades the broiler industry has experienced tremendous growth accompanied by technological progress and organizational innovations. The finishing stage of broiler production (i.e., raising chicks to market weight) is now overwhelmingly organized via contracts between companies, called integrators, and independent growers. Judged by their prevalence, contracts have proven to be a successful mode of organizing poultry production. Virtually all modern broiler contracts have a similar payment structure based on "two-part piece rate tournaments" consisting of a fixed base payment per pound of output and a variable bonus payment based on the grower's relative performance. Tournaments are used by almost all broiler companies and by a significant number of turkey companies.

This article focuses on the welfare effects of the proposal to ban relative performance payment mechanisms (tournaments) in the settlement of poultry contracts and replace them with "fixed performance standards." These are schemes that compare the individual performance of a grower to a predetermined standard rather than to the average performance of the entire group. The existing literature on tournaments emphasizes their role in reducing moral hazard on the grower side and other contracting costs (Knoeber). In fact, it has been shown that, absent bankruptcy concerns, a two-part piece rate tournament provides a linear approximation of the optimal incentive scheme (Tsoulouhas and Vukina) and alleviates the integrator's moral hazard problem as well (Tsoulouhas). Despite their favorable properties, many broiler growers are dissatisfied with the existing payment mechanisms. Growers are opposed to a system that bases their payments on how well or how poorly their neighbors perform. They also claim that tournament outcomes can be biased because the initial quality and the distribution of production inputs are exclusively under the control of the integrators.

Out of concern for such grower discontent, a number of states have considered legislation to protect growers. In Southern states such legislative proposals generally failed as integrators voiced strong opposition. For example, in 1993, the North Carolina

Theofanis Tsoulouhas is associate professor in the Department of Economics and Tomislav Vukina is associate professor in the Department of Agricultural and Resource Economics, both at North Carolina State University.

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Legislature introduced a bill that would have restricted the types of contracts that growers and integrators could sign. The bill specifically prohibited payments to a grower based on his performance relative to other growers (Vukina). Legislations with provisions that protected the rights of growers to organize and create associations were also defeated in Alabama and Louisiana. However, various forms of legislation aimed at regulating contracts without explicitly targeting tournaments were passed in Minnesota, Wisconsin, and Kansas in the early 1990s (Lewin). On the Federal level, in 1997 the Grain Inspection, Packers and Stockyards Administration (GIPSA) of the U.S. Department of Agriculture in an advanced notice of proposed rulemaking announced that it was considering "the need for issuing substantive regulations to address concerns in the poultry industry with respect to contract payment provisions tied to the performance of other growers" (Federal Register, p. 5935). An interesting part of the proposal was the agency's opinion "that there would be little increased burden on live poultry dealers resulting from new regulations prohibiting grower flock comparisons for settlement purposes" (*ibid.*). Furthermore, in 1998, the National Commission on Small Farms recommended that the Secretary of Agriculture evaluate the need for Federal legislation to provide uniform contract regulations for all growers engaged in agricultural production contracts. In reference to poultry contracts, the recommendation specifically focused on the factors used in ranking growers and determining performance payments (USDA). No concrete regulatory actions have been taken so far, but the pressure from the growers' circles to do something continues.

The objective of this article is to shed light on the controversy surrounding the widely advocated, yet poorly understood, proposal to regulate poultry contracts. As seen from GIPSA's questions about of the need for government intervention, the crux of the growers' complaints about tournaments is the problem of group composition risk. "Under this system of determining grower payment, consecutive flocks grown by the same grower having similar production costs could receive substantially different payment amounts because of the results of other growers in the settlement group. Growers have expressed exasperation over this form of settlement because they have no way of estimating in advance how much to expect in payment" (Federal Register, p. 5935). The essence of contract settlement through tournaments is the transfer of common production risk from the growers to the integrators. Because of that, tournaments require that the calculation of the group average performance includes growers whose flocks were harvested at approximately the same time, so that they are all exposed to the same influence of common stochastic factors including weather, disease, feed quality, genetic strains, etc. Therefore, the group composition changes on a flock by flock basis due to the unequal rotation lengths of flocks grown on different farms, logistical considerations related to the transportation of feed and chicks, and the management of production volumes. Thus, given the integrator's control of the group composition, a grower's payments can vary from one flock to the next even if all else is constant.

The alternative payment scheme that seems to be drawing considerable support from the National Contract Poultry Growers Association and its state and local chapters is the "fixed performance standard." An obvious attraction to this scheme is that it eliminates the group composition risk because the performance of a grower is no longer compared to the average performance of his peers, but rather to a predetermined technological standard. Another reason is that fixed performance standards have been successfully used for quite some time in the technologically similar turkey industry.

The literature on the economic impact of integrator practices and procedures on poultry growers, and consequently the need for government regulation of contracts, is minimal. In a related paper Vukina and Foster assess how optimal input decisions by growers change with the adoption of alternative contract designs. The closely related literature on franchising has generally been very critical of government regulation, on the grounds that any regulation will interfere with the ability of economic parties to negotiate efficient agreements (Beales and Muris; Brickley, Dark, and Weisbach). More recently, Lewin argued that by requiring growers to make large specific investments in chicken houses, integrators can increase grower incentives without increasing grower compensation, since the risk of losing his investment will increase a grower's fear of low performance. She concludes that because

asset specificity has such an effect on distribution, integrators have an incentive to insist on investments that are unnecessarily specific. Lewin is in favor of regulation to allow the unionization of growers that would increase their bargaining status; she also favors the regulation of contract duration.

Our goal in this article is to investigate whether the mandatory replacement of tournaments with fixed performance standards would (*a*) increase grower welfare and (*b*) increase or decrease the social surplus. As it turns out, these welfare comparisons critically depend on the relative magnitudes of two risks: the group composition risk and the common production risk. We rule out the possibility that the magnitude of group composition risk exceeds that of common production risk because, in this case, regulating tournaments in favor of fixed performance schemes would produce a Pareto improvement. This would be in striking contradiction to the widespread use of tournaments by poultry companies. Instead we focus on the situation where common production risk dominates group composition risk. In this case, the analysis shows that whereas the mandatory replacement of tournaments with fixed performance standards, absent any other rules, will decrease grower income insurance without raising grower welfare, income insurance and grower welfare can simultaneously be increased provided that the slope of the bonus payment scheme, the so-called "piece rate," is also regulated. Moreover, the enforcement of fixed performance standards absent any rules for the magnitude of the piece rate will result in an unambiguous reduction in (net) social surplus, but regulation accompanied by a rule determining the magnitude of the piece rate may or may not reduce social surplus, depending on the technology and preferences. This is so because integrator welfare is reduced, but grower welfare is increased.

The article is organized as follows. In the next section we present the model of broiler contracts with tournaments. The results obtained here will serve as a benchmark for the subsequent analysis of the regulatory impact. In the third section we analyze broiler contracts under fixed performance standards and the impact of the proposed regulation on growers' welfare and aggregate social surplus. In the final section we summarize the results and discuss their policy implications.

The Contracts Absent Regulation

Virtually all broiler contracts have a similar payment structure based on two-part piece rate tournaments. The compensation scheme consists of a fixed base payment per pound of live meat produced, and a variable bonus payment based on the grower's relative performance. The performance is measured by the so-called "settlement cost" which is obtained by combining feed with other costs to the integrator (chicks, medication, etc.) divided by the total pounds of live weight produced. The calculation of the group's average performance includes all growers whose flocks were harvested at approximately the same time (within a week). The total payment to grower i is given by

$$(1) \qquad r^i = \left[b + \beta \left(\frac{1}{n-1} \sum_{j \neq 1} \frac{x^j}{y^j} - \frac{x^i}{y^i} \right) \right] y^i$$

where b denotes the "base payment" and β denotes the "piece rate." For simplicity, settlement costs have been approximated by the simple feed conversion ratio x^i/y^i (pounds of feed used to produce a pound of live weight broiler meat).

Based on the earlier work of Tsoulouhas and Vukina and Tsoulouhas, we model the contractual relationship between a single integrator and a number of growers. We assume that each grower receives the same number of chicks that he is supposed to raise to the same target weight. Hence, the number of pounds produced is roughly the same for all growers and the performance differs depending only on the feed used. The amount of feed utilized by a grower depends on his own effort. By exerting effort, the grower can speed up the growth of animals that will reach market weight by consuming less feed. The integrator cannot directly observe the effort level of each grower; that is, there is "hidden action" moral hazard. The integrator can only observe the feed used and the output obtained by each grower.

The output target for each grower is set to $\bar{y}$. Feed x^i used by grower $i \in N = \{1, 2, \ldots, n\}$ is in the interval $[x_L, x_H]$. Let $\mathbf{x} \equiv (x^1, \ldots, x^n)$ and $\mathbf{x}^{-i} \equiv (x_1, \ldots, x^{i-1}, x^{i+1}, \ldots, x^n)$ denote the feed levels obtained by all growers including i and excluding i, respectively. Effort e^i exerted by grower i takes one of two values $\{e_L, e_H\}$ denoting low and high effort. Let $\mathbf{e} \equiv (e^1, \ldots, e^n)$ and $\mathbf{e}^{-i} \equiv (e^1, \ldots, e^{i-1}, e^{i+1}, \ldots, e^n)$ denote

the efforts exerted by all agents including i and excluding i, respectively. The integrator does not offer a customized contract to each grower because gathering information about individual grower characteristics or designing and implementing contract menus is prohibitively costly. Thus, *ex ante*, the principal treats all growers as identical in terms of the utility function and the distribution of feed and offers a take-it-or-leave-it contract to each grower. In the presence of common shocks, the feed distributions are dependent. Let $\chi(\mathbf{x} \mid \mathbf{e})$ denote the joint density function of $\mathbf{x}$ given the actions of the growers, let $h(x^i \mid \mathbf{e})$ denote the marginal density obtained from $\chi(\mathbf{x} \mid \mathbf{e})$, and let $H(x^i \mid \mathbf{e})$ denote the distribution function. The density $h(x^i \mid \mathbf{e})$ has full support; that is, $h(x^i \mid \mathbf{e}) > 0$ for all $\mathbf{e}$ and all x^i. We assume $H(x^i \mid e^i = e_L, \mathbf{e}^{-i}) \leq H(x^i \mid e^i = e_H, \mathbf{e}^{-i})$, for every x^i, with strict inequality for a set of values of x^i with positive probability, and for every $\mathbf{e}^{-i}$ and i. These are *first-order stochastic dominance* conditions saying that the probability that the feed used by a grower exceeds any given level decreases with his effort. They imply that expected feed used by a grower is smaller when he chooses the high effort over low effort:

$$\int_{x_L}^{x_H} x^i h\left(x^i \mid e^i = e_H, \mathbf{e}^{-i}\right) dx^i < \int_{x_L}^{x_H} x^i h\left(x^i \mid e^i = e_L, \mathbf{e}^{-i}\right) dx^i \qquad \forall\, \mathbf{e}^{-i}, \qquad \forall\, i. \tag{2}$$

The grower is assumed to have a von Neumann–Morgenstern utility function of the form $U(r^i) - c(e^i)$, where r^i is the grower's remuneration and $c(e^i)$ is his disutility of effort. The function $U(\cdot)$ is twice continuously differentiable, with $U'(\cdot) > 0$, $U''(\cdot) < 0$ (that is, growers are risk-averse with respect to income). The disutility of effort $c(\cdot)$ satisfies $c(e_H) > c(e_L) > 0$. Thus, there is potential tension between the interests of the integrator and those of the grower, because the high effort (which minimizes expected feed utilization) is more costly to the grower than the low effort. The principal is risk-neutral with respect to profit. The output market is assumed to be competitive, the price of output p is deterministic, and the price of feed is normalized to one.

We characterize the optimal contract $u^i(\mathbf{x})$ assuming that the principal always benefits by having the agents exert effort e_H. In accordance with the Grossman and Hart procedure, the principal offers each agent a contract that minimizes the principal's expected costs, subject to the agents' individual rationality and incentive compatibility constraints. This incentive-efficient scheme $u^i(\mathbf{x})$ solves the convex problem

$$\min_{u^i(\mathbf{x}), i \in N} n \int_{x_L}^{x_H} \cdots \int_{x_L}^{x_H} U^{-1}[u^i(\mathbf{x})] \chi(\mathbf{x} \mid \mathbf{e} = \mathbf{e}_H)\, dx^1 \cdots dx^n$$

subject to

$$\int_{x_L}^{x_H} \cdots \int_{x_L}^{x_H} u^i(\mathbf{x}) \chi(\mathbf{x} \mid \mathbf{e} = \mathbf{e}_H)\, dx^1 \cdots dx^n - c(e_H) \geq 0, \quad \forall\, i \tag{3}$$

$$\int_{x_L}^{x_H} \cdots \int_{x_L}^{x_H} u^i(\mathbf{x}) \chi(\mathbf{x} \mid \mathbf{e} = \mathbf{e}_H)\, dx^1 \cdots dx^n - c(e_H) \geq \int_{x_L}^{x_H} \cdots \int_{x_L}^{x_H} u^i(\mathbf{x}) \chi(\mathbf{x} \mid e^i = e_L, \mathbf{e}^{-i} = \mathbf{e}_H)\, dx^1 \cdots dx^n - c(e_L) \qquad \forall\, i \tag{4}$$

where the constraints in (3) are *individual rationality constraints*, and those in (4) are *Nash incentive compatibility constraints*. Since from conditional probability we know that $\chi(\mathbf{x} \mid \mathbf{e}) = h(x^i \mid \mathbf{e}) g(\mathbf{x}^{-i} \mid x^i, \mathbf{e})$, with $g(\mathbf{x}^{-i} \mid x^i, \mathbf{e})$ being a conditional density function, it can be shown that the optimal incentive efficient scheme satisfies

$$U'[r^i(\mathbf{x})] = \frac{1}{\lambda + \mu\left[1 - \frac{h(x^i \mid e^i = e_L, \mathbf{e}^{-i} = \mathbf{e}_H) g(\mathbf{x}^{-i} \mid x^i, e^i = e_L, \mathbf{e}^{-i} = \mathbf{e}_H)}{h(x^i \mid \mathbf{e} = \mathbf{e}_H) g(\mathbf{x}^{-i} \mid x^i, \mathbf{e} = \mathbf{e}_H)}\right]} \qquad \forall \mathbf{x}, \qquad \forall\, i \tag{5}$$

where λ and μ are multipliers for constraints (3) and (4) (see Tsoulouhas and Vukina and Tsoulouhas). Condition (5) implies that the optimal compensation rule for grower i must depend on the feed levels obtained by all growers. This is so because there is common production risk; hence, individual feed utilization is not a *sufficient statistic* for $\mathbf{x}^{-i}$ with respect to individual effort. The feed levels obtained by the rest of the group convey an informative signal about common production risk and, as a result, the effort choice of any given grower.

The above rule cannot be easily implemented because it requires a precise knowledge of distributional forms; however, there

exists a simplification that will not harm incentives or the integrator's profit.[1] If the number of growers is sufficiently large, the average feed used by all growers except i, $\bar{x}^{-i}$, can convey information about the common production risk, which suggests that the payment to each grower can depend only on the feed he utilized and $\bar{x}^{-i}$. This allows us to approximate the rule by a Taylor series expansion at $\bar{x}^{-i}$:

$$(6) \qquad r^i(\cdot) = b_0 + \beta_0(\bar{x}^{-i} - x^i).$$

The approximation is a two-part piece-rate tournament, where a grower is paid a base payment b_0 adjusted by a positive or negative amount that depends on his relative performance ($\bar{x}^{-i} - x^i$) and the magnitude of the "piece rate" $0 < \beta_0 < 1$. The base payment provides incentives to growers to participate, while the variable part provides incentives to exert effort. Common risk is removed from the grower's responsibility.

Alternative Contracts under Regulation

Consider now the compensation scheme based on a fixed performance standard: $r^i(x^i) = b_a + \beta_a(S - x^i)$, where S represents an average feed utilization level chosen *ex ante*. A critical difference between a tournament and a fixed performance standard is in the calculation of the benchmark against which the performance of an individual grower is compared. Whereas in the first case the benchmark is determined by a contest, in the second case it represents a predetermined technological standard. As argued above, tournaments provide insurance by filtering away common production risk without hurting individual incentives to perform. Insurance is provided by removing the implications of common shocks from the responsibility of a grower. Since the fixed performance standard scheme does not include the group average outcome, insurance against common risk is generally reduced; growers are not fully insulated from common shocks. Insurance can only be partially provided to the extent that the realized value of common production risk happens to be close to the predetermined standard. Yet, it is precisely the use of a fixed standard that shields the growers from risk emanating from the group composition. Therefore, the welfare results of the two schemes critically depend on the relative magnitude of two risks: the group composition risk and the common production risk.

In the remaining analysis, we employ the following definitions. *Common production risk* is the outcome risk that is not contingent on the actions of the growers. It refers to stochastic effects that are common to all growers regardless of their actions. The effects of weather, untried feed mixes, and newly introduced genetic stock are good examples of common production shocks. *Group composition risk* relates to the uncertainty regarding the average outcome of growers, when common stochastic and idiosyncratic stochastic shocks are given. This risk emanates from the imperfect knowledge of agent abilities. Not knowing a priori which one is larger, we have to analyze two possibilities: (*a*) group composition risk being larger than or equal to common production risk and (*b*) group composition risk being smaller than common production risk.[2]

In comparing risks we use the concept of *second-order stochastic dominance*. Take a group of growers and the associated idiosyncratic effects as given, and define $\bar{x}_g$ as the average feed utilization $\bar{x}$ when the common shocks on production are known but the abilities of the growers are not known, and define $\bar{x}_c$ as the average $\bar{x}$ when the abilities of the agents are known but the common stochastic effects are not known. Then we say that, from the perspective of a grower, the common production risk is larger than the group composition risk when the distribution of $\bar{x}_g$ *second-order stochastically dominates* the distribution of $\bar{x}_c$. Mathematically, let $m \in [m_L, m_H]$ denote the values obtained from $\bar{x}_g$ or $\bar{x}_c$. We say that $\bar{x}_g$ *second-order stochastically dominates* $\bar{x}_c$ when

$$(7) \qquad \int_{m_L}^{v} \text{Prob}(\bar{x}_g \le m)\, dm \le \int_{m_L}^{v} \text{Prob}(\bar{x}_c \le m)\, dm, \quad \forall\, v \in [m_L, m_H]$$

[1] The simpler rule leads to savings in transaction costs by not requiring precise knowledge of all grower characteristics.

[2] Knoeber and Thurman estimated the magnitude of the common production risk in broiler contract production at 3% of the growers' payment variability, and equal to idiosyncratic risk, whereas an additional 6% was found to be due to the combined effects of price and common production risks. Subsequent to the completion of our article, work in progress by Levy and Vukina provides preliminary evidence that common production risk is larger than group composition risk.

with strict inequality for a set of values of m with positive probability.

In what follows we analyze the impact of the proposed regulation on growers' welfare, integrator's expected profit, and aggregate social surplus. For the risk-averse growers, the increase in welfare can come about via the increase in expected compensation (payment) or via the reduction in the volatility of payment (the increase in insurance). Of course, the risk-neutral integrator cares only about the expected profit. In dealing with these issues, an important parameter is the de facto bargaining power of integrators, which is presumably quite large in the absence of grower unionization. While the integrators are big companies operating on a national level, growers are mainly farmers whose bargaining power is localized. Integrators have the power to design and propose contracts that are tailored to match their objectives while restraining grower rents. Thus, even though regulation can increase the income insurance of growers by eliminating the group composition risk, it does not immediately follow that growers' welfare will increase, because the integrators' bargaining power may allow them to extract all rents.

Notice that the integrator's expected profit from implementing effort levels $\{e_H\}_{i\in N}$ by offering the optimal incentive-efficient scheme $\{u^i(\mathbf{x})\}_{i\in N}$ is

$$\Pi_0 = np\bar{y} - n\int_{x_L}^{x_H} x^i h(x^i \mid \mathbf{e}=\mathbf{e}_H)\,dx^i - n\int_{x_L}^{x_H}\cdots\int_{x_L}^{x_H} U^{-1}[u^i(\mathbf{x})]\chi(\mathbf{x}\mid \mathbf{e}=\mathbf{e}_H)\,dx^1\cdots dx^n. \tag{8}$$

Moving away from the optimal scheme to the alternative scheme may reduce expected profit due to an increase in the feed costs $n\int x^i h(x^i|\cdot)\,dx^i$ when the growers shirk [see condition (2) which follows from first-order stochastic dominance]. However, it may also increase expected profit when the integrator lowers the growers' compensation $n\int r^i(x^i)h(x^i|\cdot)\,dx^i$ by an insurance premium because better insurance is provided. The integrator's expected profit under the alternative scheme is

$$\Pi_a = np\bar{y} - n\int_{x_L}^{x_H} x^i h(x^i|\cdot)\,dx^i - n\int_{x_L}^{x_H} U^{-1}[u^i(x^i)]h(x^i|\cdot)\,dx^i. \tag{9}$$

Thus, the change in expected profit can be separated into an *incentive component*

$$n\int_{x_L}^{x_H} x^i h(x^i \mid \mathbf{e}=\mathbf{e}_H)\,dx^i - n\int_{x_L}^{x_H} x^i h(x^i|\cdot)\,dx^i \tag{10}$$

(i.e., a change in expected feed costs when growers change their effort) and into an *insurance component*

$$n\int_{x_L}^{x_H}\cdots\int_{x_L}^{x_H} U^{-1}[u^i(\mathbf{x})]\chi(\mathbf{x}\mid \mathbf{e}=\mathbf{e}_H)\times dx^1\cdots dx^n - n\int_{x_L}^{x_H} U^{-1}[u^i(x^i)]\times h(x^i|\cdot)\,dx^i \tag{11}$$

(i.e., a change in expected compensation costs). Observe that because the integrator will aim at lowering expected grower compensation when he provides better insurance, in analyzing grower welfare and social surplus the link between grower income and his *coefficient of absolute risk aversion* $-U''(\cdot)/U'(\cdot)$ may be important. It is also possible that the integrator may benefit by raising the growers' expected compensation (i.e., by charging a negative insurance premium) to compensate them for worse insurance (in case the growers end up receiving worse insurance) or to provide them with incentives to perform (in which case the incentive component is null because growers do not change their effort).

We start by looking at the possibility that the group composition risk may be larger than (or equal to) the common production risk. From the growers' perspective, switching from a tournament to a fixed performance standard would eliminate the group composition risk but would add common production risk (which is smaller); hence the insurance provided by the compensation scheme would go up.[3] The increase in total insurance should not reduce growers' incentives to perform since the nature of the risk that has been removed is not contingent on the growers' own actions. If the integrator does not react, regulation will increase growers' welfare. However, given the allocation

[3] Note that, to the extent that the predetermined standard is some historical standard obtained from past average feed utilizations, and there is some serial correlation among the average feed utilizations, the common production risk that the fixed performance standard imposes on growers is smaller than the existing common production risk.

of bargaining power between the integrator and the growers, the integrator would lower the expected payment to the growers by a risk premium. Consequently, the regulation should leave the growers' welfare unchanged. In utility terms the increase in insurance would be exactly offset by the reduction in expected payments.

From the integrator's perspective, the incentive component is zero because growers do not change their effort, and the insurance component is positive; hence, the integrator's welfare (expected profit) would increase. Consequently, regulating tournaments in favor of fixed performance schemes would increase social surplus. Moreover, it would constitute a Pareto improvement since the integrator's expected profit would increase leaving the growers' welfare unchanged. The result, however, is strongly refuted by observed industry practices. If this situation were possible, all broiler companies currently using tournaments should have abandoned them in favor of the fixed performance standards. The fact that we are still observing tournaments in a great majority of all broiler contracts should imply only that the magnitude of the common production risk outweighs the magnitude of the group composition risk and that the observed contracts are Pareto efficient.

The second situation presents a more interesting and complicated case. If the group composition risk is smaller than the common production risk, switching from tournaments to fixed performance schemes will eliminate the group composition risk but will add common production risk (which is larger). Hence the overall insurance will go down. Growers' welfare can be maintained by either increasing expected compensation or by removing some of the idiosyncratic risk from the growers' responsibility. However, if the alternative scheme increases total insurance by removing some of the risk that is contingent on a grower's own actions from his responsibility, then it can reduce incentives to perform. The remaining analysis shows that if regulation aiming at increasing grower insurance simply imposes the fixed performance standard scheme without any specific rule for the piece rate, growers will receive worse insurance and their compensation will have to increase via a negative insurance premium, but with no overall improvement in their *ex ante* welfare. The insurance premium is negative because the growers must be paid more to accept the worse insurance. From the integrator's perspective, the insurance component will be negative and the incentive component will be null. The result may be summarized as follows:

RESULT 1. *Under regulation mandating the settlement of contracts via a fixed performance standard scheme with no specific rules governing the magnitude of the piece rate, growers will receive worse insurance, larger expected payments, and zero ex ante rents, regardless of the coefficient of absolute risk-aversion, and the social surplus will be unambiguously reduced.*

The rationale behind this result is that absent any rules determining the magnitude of the piece rate, the integrator will choose a β_a which is sufficiently high to ensure that growers exert effort. Since the fixed performance standard scheme eliminates the group composition risk but adds common production risk (which is assumed to be larger), the overall insurance will be reduced. With a greater variation in payments, a grower's expected utility of income would drop below his disutility of high effort if the expected payments $\int r^i(x^i)h(x^i|\cdot)\,dx^i$ were equal to the expected payments under the optimal scheme. For growers to participate, the integrator must increase the expected payments by a negative insurance premium (i.e., increase b_a) without providing them with *ex ante* rents. The increase in expected payments to the growers lowers the integrator expected profit, which in turn lowers the social surplus. The necessary increase in expected payments to growers is dependent upon their coefficient of absolute risk-aversion. In particular, it is larger if growers are increasingly risk-averse than if they are decreasingly risk-averse.

The presented result indicates that simple regulation mandating the use of fixed performance standards will not achieve the objective of increasing growers' welfare and will decrease integrator welfare. Instead, to increase grower welfare, the regulator will have to introduce a more elaborate scheme. In particular, the analysis shows that the piece rate will have to be lowered to provide some insurance against idiosyncratic risk in situations where less insurance against common risk is provided. The magnitude of the piece rate is crucial because this is where the implications of risk come into play via the scheme's sensitivity to outcomes.

Let $z \in [z_L, z_H]$ denote the variable payment obtained from $\beta_a(S - x^i)$ or $\beta_0(\bar{x}^{-i} - x^i)$. Given S and β_0, the value of the piece rate β_a should not exceed the largest β such that the distribution function of $\beta(S - x^i)$ *second-order stochastically dominates* the distribution function of $\beta_0(\bar{x}^{-i} - x^i)$; that is,

$$(12)\quad \int_{z_L}^{v} \text{Prob}\big(\beta(S - x^i) \le z\big)\, dz \le \int_{z_L}^{v} \text{Prob}\big(\beta_0(\bar{x}^{-i} - x^i) \le z\big)\, dz, \quad \forall\, v \in [z_L, z_H]$$

with strict inequality for a set of values of z with positive probability. The second-order stochastic dominance condition ensures that growers bear less risk overall under the fixed performance standard. Therefore, the mandatory use of fixed performance standards must be accompanied by a rule for determining the piece rate β_a depending on the value β_0 currently in use, namely, $0 \le \beta_a \le \beta^*(\beta_0)$. Relevant examples for the determination of β^* are presented at the end of the section.

The remainder of the analysis shows that if a specific rule for the determination of the piece rate is imposed, the grower welfare can increase along with the mandated improvement in the insurance provided. This is so because an increase in insurance can distort grower incentives to exert effort. The growers would shirk if they were not provided with *ex ante* rents, resulting in the insurance component being negative again. In this case growers must be paid more so that they do not shirk, unlike in the first case where they must be paid more to accept the worse insurance. Further, the social surplus may or may not be reduced, depending on the technology and preferences. This result is summarized below.

Result 2. *Under regulation mandating the settlement of contracts via a fixed performance standard scheme augmented to include a special provision for the piece rate requiring that* $0 \le \beta_a \le \beta^*(\beta_0)$*, with* $\beta^*(\beta_0)$ *being the largest* β *satisfying* (12)*, growers will receive better insurance and non-negative ex ante rents, regardless of the coefficient of absolute risk-aversion, while the social surplus may or may not be reduced.*

Since the agent will accept an offer only if his individual rationality constraint (3) is satisfied, consider the following cases regarding constraints (3) and (4) under the alternative scheme:

(*i*) (3) and (4) are nonbinding;
(*ii*) (3) is nonbinding and (4) is binding;
(*iii*) (3) is nonbinding and (4) is violated;
(*iv*) (3) is binding and (4) is nonbinding;
(*v*) (3) and (4) are binding;
(*vi*) (3) is binding and (4) is violated.

The third, the fourth, and the fifth cases are impossible. In case (*iii*), if the incentive constraint (4) is violated even when the grower receives rents, then there is no reason for the integrator to provide any rents to the grower. The integrator will cut his costs by reducing the grower's compensation in an amount equal to his risk premium so that the grower's rents are eliminated and his individual rationality constraint is binding, a contradiction because the individual rationality constraint is assumed to be nonbinding. In cases (*iv*) and (*v*), since the incentive compatibility constraints are satisfied, the growers will exert the high effort e_H; hence, the expected feed cost will be identical to the expected feed cost induced by the optimal scheme. But if the expected feed cost is the same, the expected compensation to the grower must be higher than the one induced by the optimal scheme because the alternative scheme is not optimal. However, if the expected compensation to the grower is higher and his income insurance is better then his expected utility will be higher regardless of his absolute risk-aversion rate. That is, expected utility payments will be in excess of the disutility of effort $c(e_H)$ and the agent will receive *ex ante* rents, a contradiction because the individual rationality constraints (3) are assumed to be binding in cases (*iv*) and (*v*).

Thus, the only possible cases are (*i*), (*ii*), and (*vi*). Under the alternative scheme, the grower either receives rents to exert effort as in cases (*i*) and (*ii*) or he shirks as in case (*vi*). Since integrators are allowed to choose among the fixed performance standard schemes satisfying $0 \le \beta_a \le \beta^*(\beta_0)$, the former case occurs if the integrator finds it profitable, by comparing the insurance component to the incentive component, to offer the alternative scheme $r^i(x^i) = b_a + \beta_a(S - x^i)$ with $0 < \beta_a \le \beta^*(\beta_0)$. The latter case occurs when the integrator benefits by offering the alternative scheme with $\beta_a = 0$. This is so because, absent the incentive compatibility constraint, the optimal scheme provides fixed payments to the grower regardless of outcome; that is, $r^i(x^i) = b_a = U^{-1}[c(e^i)], \forall\, x^i \in [x_L, x_H]$. Growers

always shirk if they receive flat payments, so that $r^i(x^i) = b_a = U^{-1}[c(e_L)]$.

If the integrator offers $r^i(x^i) = b_a + \beta_a(S - x^i)$, with $0 < \beta_a \leq \beta^*(\beta_0)$, his feed costs will be identical to the feed costs induced by the optimal scheme (the incentive component is null) but the expected compensation costs will be higher because the alternative scheme is not optimal (the insurance component is negative because growers must be paid more so that they will not shirk). The increase in expected payments will lower the integrator's welfare; hence, the alternative contract does not constitute a Pareto improvement. On the other hand, the grower will receive rents (i.e., his *ex ante* welfare will increase) because his expected compensation will be higher and his insurance will be better.[4] However, (net) social surplus may or may not decrease. To see this, observe that the change in social surplus is

$$
\begin{aligned}
&-n\int_{x_L}^{x_H}\cdots\int_{x_L}^{x_H} U^{-1}[u^i(\mathbf{x})] \\
&\chi(\mathbf{x}\,|\,\mathbf{e}=\mathbf{e}_H)dx^1\cdots dx^n \\
&+n\int_{x_L}^{x_H} U^{-1}[u^i(x^i)]h(x^i\,|\,\mathbf{e}=\mathbf{e}_H)dx^i \\
&+n\int_{x_L}^{x_H}\cdots\int_{x_L}^{x_H} u^i(\mathbf{x}) \\
&\chi(\mathbf{x}\,|\,\mathbf{e}=\mathbf{e}_H)dx^1\cdots dx^n \\
&-n\int_{x_L}^{x_H} u^i(x^i)h(x^i\,|\,\mathbf{e}=\mathbf{e}_H)dx^i \qquad (13)\\
=\ & n\Bigg[\int_{x_L}^{x_H}\cdots\int_{x_L}^{x_H} u^i(x) \\
&\chi(\mathbf{x}\,|\,\mathbf{e}=\mathbf{e}_H)dx^1\cdots dx^n \\
&-\int_{x_L}^{x_H}\cdots\int_{x_L}^{x_H} U^{-1}[u^i(\mathbf{x})] \\
&\chi(\mathbf{x}\,|\,\mathbf{e}=\mathbf{e}_H)dx^1\cdots dx^n\Bigg] \\
&+n\Bigg[\int_{x_L}^{x_H} U^{-1}[u^i(x^i)]h(x^i|\mathbf{e}=\mathbf{e}_H)dx^i \\
&\quad -\int_{x_L}^{x_H} u^i(x^i)h(x^i\,|\,\mathbf{e}=\mathbf{e}_H)dx^i\Bigg].
\end{aligned}
$$

Given the grower's risk-aversion, Jensen's inequality implies that the first term in square brackets is negative and the second term is positive. Hence, the social surplus may or may not decrease with the alternative scheme depending on the technology and preferences. Note that even though the social surplus may be higher under the proposed alternative scheme, the integrator would never implement it without government regulation. This is so because the integrator is worse off under this contract and the grower is better off. Further, the integrator could not transfer rents from the grower to himself, because the grower would then shirk.

If the integrator offers $r^i(x^i) = U^{-1}[c(e_L)]$, then the grower will shirk and receive no rents. However, with this scheme the grower will receive full income insurance against all uncertainties, because he will receive the same payment regardless of outcome. Because his expected utility of income will be reduced to $c(e_L)$ due to shirking, while he receives full income insurance, the expected payments he receives must be smaller than the payments under the tournament regardless of his coefficient of absolute risk-aversion. The social surplus may or may not decrease.

Regulation of the Piece Rate: Numerical Examples

In the remaining analysis we provide examples of stochastic functions of feed utilization to suggest a course for empirically investigating the rule for determining $\beta^*(\beta_0)$, the maximum β_a that regulation should allow. The feed functions are motivated by the output functions utilized in Lazear and Rosen, Holmström, and Nalebuff and Stiglitz. Let η denote the shock that is common to all growers and let ε^i denote the shock that is idiosyncratic to grower i. We assume that the distributions of η and ε^i are normal; $\eta \sim N(\mu, V(\eta))$ and $\varepsilon^i \sim N(0, V(\varepsilon^i))$, with $\mu > 0$. We consider three cases:

$$
\begin{aligned}
&(a) \quad x^i = (\xi - e_H)\eta + \varepsilon^i,\ \xi - e_H < 1 \\
&(b) \quad x^i = (\xi - e_H)(\eta + \varepsilon^i),\ \xi - e_H < 1 \\
&(c) \quad x^i = \xi - e_H + \eta + \varepsilon^i,\ -\mu < \xi - e_H < 0.
\end{aligned}
$$

In all cases by exerting effort the grower is expected to achieve a utilized feed level below the one that is due to the common shock. Assuming $S = E(\bar{x}^{-i})$,[5] it follows that

[4] Note that while the grower would shirk if he received full insurance (i.e., $\beta_a = 0$), the grower will not shirk under the fixed performance standard scheme with $0 < \beta_a \leq \beta^*(\beta_0)$, because insurance against common and idiosyncratic risk is not full (even though insurance against risk emanating from the group composition is offered). That is, the grower expects to receive higher rents by exerting effort.

[5] Notice that integrators always have an incentive to use the most accurate prediction of average performance for the value of the fixed standard S. By doing so they can charge the maximum premium for providing this type of insurance. Consequently, there is no need for regulating the magnitude of S as a part of the overall regulatory scheme.

in case (a)

$$\beta_0(\bar{x}^{-i} - x^i) \sim N\left(0, \beta_0^2 \frac{n}{n-1} V(\varepsilon^i)\right) \quad (14)$$

and

$$\beta(S - x^i) \sim N\big(0, \beta^2[(\xi - e_H)^2 \times V(\eta) + V(\varepsilon^i)]\big)$$

in case (b)

$$\beta_0(\bar{x}^{-i} - x^i) \sim N\left(0, \beta_0^2(\xi - e_H)^2 \frac{n}{n-1} V(\varepsilon^i)\right) \quad (15)$$

and

$$\beta(S - x^i) \sim N\big(0, \beta^2(\xi - e_H)^2[V(\eta) + V(\varepsilon^i)]\big)$$

and in case (c)

$$\beta_0(\bar{x}^{-i} - x^i) \sim N\left(0, \beta_0^2 \frac{n}{n-1} V(\varepsilon^i)\right) \quad (16)$$

and

$$\beta(S - x^i) \sim N\big(0, \beta^2[V(\eta) + V(\varepsilon^i)]\big).$$

Note that in all cases the issue is to determine the maximum value of β, denoted by $\beta^*(\beta_0)$, so that $\beta(S - x^i)$ stochastically dominates $\beta_0(\bar{x}^{-i} - x^i)$ in the second-order sense. Conditions (14)–(16) indicate that all distributions have the same zero mean; hence, the focus is on mean-preserving spreads. Given that $n/(n-1)$ converges to 1 for a sufficiently large number of growers, which is a necessary condition for using a tournament to begin with, it follows that $\beta_0(\bar{x}^{-i} - x^i)$ is a mean-preserving spread in risk provided that $\beta \leq \beta^*(\beta_0)$, where

$$\beta^*(\beta_0) = \beta_0 \sqrt{\frac{V(\varepsilon^i)}{V(\varepsilon^i) + (\xi - e_H)^2 V(\eta)}} \quad (17)$$

in case (a), and

$$\beta^*(\beta_0) = \beta_0 \sqrt{\frac{V(\varepsilon^i)}{V(\varepsilon^i) + V(\eta)}} \quad (18)$$

in cases (b) and (c). In all cases, $\beta^*(\beta_0) < \beta_0$. For instance, if the variance of η is equal to the variance of e^i, and assuming that $\beta_0 = 0.5$ and $(\xi - e_H) = 0.9$, then $\beta^*(\beta_0) = 0.37$ in (17) and $\beta^*(\beta_0) = 0.35$ in (18).[6] Note that the smaller the variance of η compared to the variance of e^i, the closer β^* gets to β_0, that is, the smaller the necessary reduction in the piece rate that is needed to ensure that growers receive at least as much insurance as before. For instance, if $V(\eta)/V(e^i) = 0.6$, then $\beta^*(\beta_0) = 0.41$ in (17) and $\beta^*(\beta_0) = 0.40$ in (18).

[6] Knoeber and Thurman have estimated that common production risk and growers' idiosyncratic risk are equal. The piece rate or 0.5 is actually used by many integrators.

Conclusions

Many poultry contract growers are dissatisfied with the existing contractual arrangements. Their complaints focus primarily on tournament schemes under which growers receive a fixed amount per pound of live meat produced plus a bonus payment for using integrator-provided inputs efficiently. Poultry growers have repeatedly expressed concern about tournaments because they believe that it is unfair to compare their production costs with those of other growers in determining payments. Consecutive flocks grown by the same grower, and having similar production costs, can receive substantially different payments depending on the performance of other growers in the settlement group. Growers have expressed exasperation over this form of remuneration because they have no way of anticipating how large their payments will be. In essence, they argue that current contractual arrangements ignore the implications of group composition risk. In addition, growers have also raised complaints about the quality of chicks, the way that live birds and feed are weighed, and the length of time between flock placements. They also complain about contract nonrenewal, contract terminations, requirements that facilities be modified or upgraded (excessively), their limited choice of integrators or their inability to change integrators, and about alleged integrator reprisals for joining grower associations and for seeking redress of grievances.

Out of concern for such grower discontent, a number of states and the Federal government have considered legislation to protect growers through the regulation of broiler contracts. This article deals with a widely advocated regulatory proposal to ban tournaments as a means of settling contracts and replace them with fixed performance standards. Although it has not been explicitly said, an implicit objective of such regulations is to increase the growers' welfare either through increased insurance or through an increase in expected payments, or both. Our objective in this article was to analyze the impact of replacing tournaments with fixed performance standards on the magnitude of the social surplus in general and on the growers' welfare in particular. The results are a first step toward a systematic analysis of welfare implications of the proposed regulation of poultry contracts. If public policy in this area is to receive sufficient guidance, it is

essential that more research be conducted on the economic impact of integrator practices and procedures on poultry growers.

The results can be summarized as follows. Regardless of the growers' absolute risk-aversion, the enforcement of fixed performance standards absent any rules for the determination of the piece rate will result in less insurance being provided to growers without any improvement in the *ex ante* grower welfare. Further, integrator welfare will be reduced. Thus, such a policy is Pareto inferior. If regulation aims at increasing grower income insurance, the enforcement of fixed performance standards must be accompanied by rules determining the magnitude of the piece rate. Without any rules specifying the magnitude of the piece rate, expected payments must increase so that the growers will accept the worse insurance. With rules regulating the magnitude of the piece rate, expected payments and welfare can increase so that the growers will not shirk when they receive better insurance. The enforcement of fixed performance standards absent any rules for the magnitude of the piece rate will result in an unambiguous reduction in social surplus, because integrator surplus is reduced and grower surplus is unchanged. The enforcement of fixed performance standards accompanied by rules determining the magnitude of the piece rate may or may not reduce social surplus, depending on the technology and preferences. This is so because grower welfare increases, while integrator welfare decreases, so that the result does not constitute a Pareto improvement. To conclude, even though the implementation of fixed performance standards with rules about the piece rate does not induce a Pareto superior move, and it may or may not reduce social surplus, it can raise grower welfare. Such a scheme will clearly have to be introduced and enforced via government regulation. The integrator companies would never initiate such a move by themselves, because they are worse off under this scheme. Fixed performance standards redistribute welfare in favor of the growers when accompanied by rules regulating the magnitude of the piece rate.

Obviously there are many other important facets of broiler contracts that were not addressed in this article. In addition to the issue of regulating the payment schemes, the need for government intervention in private contracts may or may not be justified on some other grounds. One of the more interesting issues is the problem of regional competition on the market for growers, and the related problem of a potential "hold-up." It is certainly conceivable that, by making growers incur large specific investments, integrators can increase grower incentives without increasing grower compensation, because the risk of losing his investment will increase a grower's fear of low performance. Because asset specificity has such an effect on distribution, integrators have an incentive to insist on investments that are unnecessarily specific. Thus, especially in geographical regions where the integrator enjoys market power, grower complaints about excessive investments may be theoretically justified.

A closely related issue is the question of termination and the associated grower demand to regulate contract length. Because growers must make relationship-specific investments, they can become vulnerable to opportunistic behavior once the investment is sunk. However, serious doubt can be cast on the enforceability of regulating contract length, and more importantly, efficiency can be hindered if integrators are unable to terminate their relationships with unproductive growers. If the integrator knows that he may be facing a "feather-bedding" problem, he may be reluctant to initiate a contractual relationship in the first place. Integrator opportunism is not a common occurrence anyway. We believe that grower provision of investments provides an efficient way for integrators to finance expansion, with a positive employment feedback to the growers. Productive growers typically enjoy a long-term relationship with an integrator. Grower provision of capital is the fee for entering a long-term relationship with an integrator, and an important device for screening out low ability growers. Relationship-specific investments have the added benefit of enhancing an integrator's ability to provide insurance to risk-averse growers by reducing grower opportunism.

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