

## **ABSTRACT**

Leegomonchai, Poramet. Three Essays on The Problem of Hold-up in Broiler Industry (Under the direction of Tomislav Vukina).

This study examines the existence of the hold-up problem in the broiler industry. Under production contracts, broiler growers may be subject to market failures, and thus, may be held up by opportunistic broiler processors. We found no evidence that processors discriminate among growers by distributing inputs of varying quality in the sequences of repeated short-term contracts. We also found that market power does not affect the decision in the grower's relationship-specific investment which indicates that there is no manifestation of the hold-up problem from growers who rationally anticipate it. Hence, market failures are not significant. Furthermore, by using the interest group theory of regulation, we confirm that the broiler industry operates efficiently. Further regulation to protect growers is not needed in the broiler industry.

**Three Essays on The Problem of Hold-up in Broiler Industry**

by

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To Mom & Dad

## Biography

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Poramet 'Win' Leegomonchai

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# Chapter 1

## Introduction

### 1.1 The General Hold-up Problem

The best way to illustrate the hold-up problem is to consider a hypothetical situation. Assume that a builder constructs a building on a piece of land the builder does not own but only leases short-term. After the initial land lease expires, the land owner could hold up the builder by raising the rent to reflect the costs of moving the building somewhere else. This simple example illustrates the elements of the hold-up problem:

1. The builder has made an investment that is specific to that piece of land. It is specific in the sense that the building cannot be moved easily without incurring some costs.
2. The land owner has taken advantage of the incompleteness of the contract that governs the relationship between the builder and land owner. The incompleteness in this context means that the leasing agreement is short-term and does not cover future years of relationship.

3. The land owner expropriates the quasi-rents on the builder's investment. The quasi-rent is the difference between the current value of an asset to its current user and its next highest value user.

In general, the amount of quasi-rents to be expropriated by another party depends on the specificity of the asset: site specificity, physical asset specificity, and human asset specificity. The higher the degree of specificity, the higher the amount of quasi-rents that can be appropriated. Another party, realizing this, may behave opportunistically. From our simple example, the builder is in jeopardy to be expropriated because the building is now specific with the land under it. This is site specificity. It would be more costly to move the building to other area compared to not moving it. The land owner will benefit from the presence of the quasi-rent which is at stake. From the normative point of view, the builder, anticipating the potential problem would decide to own the land outright, or at least to design an appropriate contract prior to the construction of the building.

Another example of the hold-up is the following relationship between a firm and an employee. Prior to the production stage, a firm may provide special training for tasks specific to the production of the firm (i.e., human capital specificity). An employee may also buy a home that is located near the firm (i.e., site specificity). These investments by both parties are more valuable if the employment continues. However, either party can stop employment and reduce the return that another party receives from the employment. The inability of both parties to write a contract to

prevent such behavior (due to incomplete information) will result in the reduction of incentives to invest. Both parties will invest less compared to the investment level where the long-term employment contract could be written.

Anticipation of being expropriated and the ability to write a contract to prevent the opportunistic behavior will prevent hold-up from occurring. Specifically, if these two conditions are satisfied, then the hold-up problem will not occur. As a result, the naivetè of parties play an important role in the hold-up problem. However, explaining the hold-up as resulting from the naivetè or ignorance of the opposite party is unsatisfactory. Obviously, economics subscribes to a paradigm where human beings are rational. Therefore, in the absence of naivetè, the hold-up problem will occur if parties cannot write a contract to prevent the opportunistic behavior from occurring.

## **1.2 The Problem of Hold-up in the Broiler Industry: Motivation for Study**

In this study, we investigate hold-up problem in the contractual relationship in the broiler industry. Contractual arrangements between corporate agribusinesses and farmers are becoming increasingly common in U.S. livestock production. Today, around 99% of broiler chickens are raised under contract. Broiler companies are commonly called integrators. Normally, the integrator controls every aspect of the

operation from egg to the market shelf. Raising of chickens is almost always carried out via contracts with independent broiler growers who are required to make specific investments in broiler houses.

Within the contractual relationship, growers encounter several potential causes of the hold-up problem. First of all, a grower's provision of a specific asset (broiler houses) creates appropriable quasi-rents which can be expropriated by opportunistic integrators. Once the broiler houses are constructed, an integrator might hold up growers by not sufficiently compensating them for their services. Growers are also subjected to site-specificity. Unlike products that can move freely, live broilers are rather immobile. That is, integrators must locate nearby growers. If within a specific area there are few integrators with which to contract, growers may be held up since they will have little choice but to accept the contract terms from possibly opportunistic integrators. Opportunistic integrators may also hold up some growers by discriminating among them since growers have no information about the inputs provided by integrators. For example, integrators may give some growers sick baby chicks or poor feed which affects the performance index of growers, and the growers' income.

The objective of this study is to investigate whether broiler growers are exposed to the hold-up problem. Our investigation will be divided into three essays. The objective of the first essay (Chapter 2) is to explain why there is no regulation in broiler contracts even if the broiler industry exhibits a potential hold-up problem. From the

contractual arrangements, we can identify two main sources of market failures that lead to the hold-up problem in a contractual relationship: market power of integrator and imperfect information. We found no evidence that those market failures are strong enough to warrant the need for regulating the broiler contracts. Using the interest group theory of regulation, we found that the competition between different pressure groups (integrators and growers) will result in an efficient contractual arrangement, so no further regulation is needed.

The objective of the second essay (Chapter 3) is to test whether an integrator discriminates among growers of different abilities. Since growers have imperfect information on inputs, opportunistic integrators might favor some groups of growers while still offering uniform contracts to all growers. We found that even though there is an incentive for an integrator to discriminate, discrimination in favor of a particular group of growers is not detected empirically.

The objective of the third essay (Chapter 4) is to test whether the integrator market power can explain different investment levels. We focus on the ex-ante manifestation of the hold-up problem (i.e., the problem of under-investment). We hypothesize that the degree of under-investment is related to the number of integrators competing for grower services in a given area. The stronger the competition, the smaller the under-investment problem. We also hypothesize that the possibility of ex-post manifestation of the hold-up problem decreases when the number of integrators increases. We found that the integrator market power cannot explain a grower's investment level

and possibility of being held up.

## Chapter 2

# The Political Economy of Regulation of Broiler Contracts

The broiler industry has been one of the success stories of American agriculture during the last century. It has been an example of how the use of contracts changes the basic structure of agriculture. It cannot be denied that contracts provide many benefits to broiler producers. However, some problems are apparent. Specifically, the use of contracts expose broiler growers to possible processor's opportunistic behavior. These kinds of problems have led to many attempts to regulate broiler contracts.

In this chapter, we present the history of regulation of broiler contracts. The common characteristic of many attempts to regulate the production contracts that have been pushed through federal and states legislatures is that virtually all of them failed. We searched for the explanation for this outcome by comparing the public interest theory with the interest group theory of regulation and found more support for the latter.

## 2.1 The U.S. Broiler Industry

### 2.1.1 History

The broiler industry has evolved from millions of small backyard flocks of dual-purpose (eggs and meat) chickens in the early 1900s to highly specialized, mostly vertically integrated agribusiness firms. Broiler meat has been improved and is now a healthy, nutritious, convenient product available at a relatively lower price compared to that of 50 years ago. Presently, broilers have the best feed conversion ratio of any domesticated land-based animal.

In 1920, chicken meat was considered a luxury meal consumed on special occasions. Chickens were considered a by-product of egg production, as cockerels and unproductive hens were culled from the laying flock. Efforts to raise chickens for meat had been short-lived and unsuccessful until the mid 1920s when the take off of the production of chickens for meat began. Since then, scientists have developed ways to meet the nutritional needs of chickens and to keep them in protective environments which made large-scale, year-round production possible.<sup>1</sup> At that time, broilers were being grown on a fairly extensive scale in the Delmarva region (Delaware, Maryland and Virginia).

Broiler production emerged in the 1930s as a separate industry that operated

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<sup>1</sup>The first broiler operation were produced in Ocean View, Maryland by Mrs. Wilmer Steele in 1923 (Lacy, 2000). She started with a small flocks of 500 birds, only 387 of which survived to a market weight of barely two pounds. However, the profit she made off these few birds was enough to encourage her to invest in an additional flocks. In the beginning of 1926, she had constructed a broiler house with a capacity of 10,000 birds.

year-round, rather than seasonally, since chickens did not seem to fare well during summer months. During World War II, the biggest broiler customer was the U.S. Army. After the war, emphasis was placed on the integration of production and marketing processes.

In the 1950s and 1960s, rapidly increasing broiler sales complicated coordination of vertical stages. Advances in technology at all stages led to excess production, thus, decreasing prices. Sharp industry losses in 1959 and 1961, resulting from overproduction and lack of communication among feed companies, retailers and processors led many hatcheries and some feed companies exit the industry (Martinez, 1999). Meanwhile, the remaining feed companies started to deal directly with retailers by acquiring or merging with processors. This integration allowed feed companies to become more efficient in production-related decision making, more responsive to the consumer preference, and more profitable. Thus, single companies like Ralston-Purina, Allied Mills, Central Soya, Cargill, and ConAgra began to coordinate all processes, stabilizing rapidly changing relationships between inputs, production, and marketing segments.

The 1970s and 1980s saw many feed companies leaving the broiler industry because of continuing depressed broiler prices and high input costs. At that time, processors started to take over ownership. The decision was influenced by the fact that processors had significant economies of size in the industry and the large proportion of value added in processing (Martinez, 1999). From that time on, the industry kept

implementing improved production and meat processing practices. In the mid 1980s, processors expanded their operations into breeding of the broiler stock as well. This acquisition allowed more uniform broilers which reduced costs of production. Thus, in the U.S., broilers became the inexpensive meat choice. Chicken consumption surpassed pork consumption in 1986 and beef consumption in 1993 (Rogers, 1992). Many of the structural changes that had taken place in the poultry industry extended into the hog industry.

### **2.1.2 Technological Progress and Industry Growth**

The industry has experienced a substantial increase in productivity for the past 50 years. This increased productivity is evident in the decreasing feed conversion ratios (pound of feed/pound of broilers), increasing average market weight and shortening length of time needed to grow broilers to the market weight.<sup>2</sup> For example, a commercial broiler in the 1920's took 14 to 18 weeks to grow, while today, it takes only half the time (6 to 7 weeks). Through scientifically selective genetics, the conversion of feed to meat has been cut in half to approximately two pounds of feed per one pound of meat. Table 2.1 summarizes the improvements in broiler efficiency over the

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<sup>2</sup>Along with efficiency, advances made in bird health and environment have contributed to the overall success of the broiler industry. In the 1920s and 1930s, it was not uncommon for broiler growers to lose 20% to 30% of their flocks. Presently, development of vaccines for various diseases have greatly improved overall flock health and livability. Also, experimental works on the nutritive requirements of broilers have been continually carried out. The development of feed formulation methods makes producing an efficient broiler possible. Furthermore, advances in engineering to design equipment of feeding, watering, and ventilation system have enhanced the growing environment for the bird, therefore improving efficiency of production. Modern facilities allows for a large number of broilers to be reared with minimal space requirement.

Table 2.1: Improvements in Broiler Production Over Time

Year	Average Weight (Pounds)	Market Age (Weeks)	Feed Conversion	% Mortality
1920	2.0	16	5.0	18
1930	2.5	14	4.5	14
1940	3.0	12	4.0	10
1950	3.2	11	3.0	8
1960	3.4	10	2.5	7
1970	3.8	9	2.2	6
1980	4.0	8	2.1	5
1990	4.4	7	2.0	4
2000	5.1	7	2.0	5

Source: Lacy (2000)

last 80 years.

Increasing production efficiency requires an increase in processing speed and technology. Today, modern broiler processing plants have streamlined their operations so that the entire operation is practically handled in one continuous line. Table 2.2 shows the continuing increase in volume of production over the past 40 years. The volume of production in 2000 was seven times greater than that of 1960. Compared to other meat industries, broiler production has been dramatic. In 2001, broiler production equalled 42.45 billion pounds, which is roughly the same as beef production (42.37 billion pounds), but significantly higher than the 25.94 billion pounds of pork production (National Agricultural Statistics Service, 2002).

In the past 30 years, increasing demand for chicken meat has also contributed

Table 2.2: Volume of Production and Price of Broilers

Year	Head Produced ( <i>Million</i> )	Pounds Produced ( <i>Million</i> )	Price per Pound ( <i>Cents</i> )
1960	1,794.9	6,017.2	16.9
1965	2,333.6	8,111.4	15.0
1970	2,986.7	10,818.9	13.6
1975	2,950.0	11,096.0	26.3
1980	3,963.2	15,538.5	27.7
1985	4,469.5	18,809.9	30.1
1990	5,864.1	25,630.9	32.6
1995	7,325.7	34,222.0	34.4
2000	8,262.6	41,516.3	33.6

Marketing year: December 1 to November 30.

Source: Poultry: Production and Value 2000, Annual Summary: National Agricultural Statistics Service, USDA

to the industry growth. Perry et al.(1999) report that in the 1940s, the average American ate less than 20 pounds of broiler per year (boneless weight). By 2002, the per capita consumption of broiler by Americans increased to 80 pounds. This trend is projected to continuously increase in the next decade. A growing concern about fat and cholesterol reduction in the diet has also helped to make chicken meat a popular protein source. This change in consumer tastes is one of the major contributing factors to industry growth. The increasing popularity of chicken products is also partly the result of convenience, packaging, and marketing of prepared or semi-prepared chicken meat product.

Vertical coordination by use of production contracts has also played an important role in industry growth. Contracts resulted in better production control and efficiency as they captured economies of size on feed production, processing, and marketing activities. The use of contracts reduced the cost of production since contract growers benefited from technical advice, managerial expertise, market knowledge, and access to technological advance from processors (Doye et al., 1996).

### **2.1.3 Today's Industry**

Today's broiler industry is vertically integrated into companies called *integrators* who perform every aspect of production, processing, and marketing. An integrator generally owns breeder farms, hatcheries, feed mills, and processing plants. Tyson Foods, Inc. is by far the largest integrator in the U.S., producing more than twice as

Table 2.3: Top 10 Broiler Integrators in 2002

Name of Integrator	Weekly Average Production ( <i>Million Pounds</i> )	Market Share ( <i>Percent</i> )
Tyson Foods	148.84	22.44
Goldkist	61.53	9.27
Pilgrim's Pride	57.53	8.67
ConAgra Poultry	51.53	7.77
Perdue Farms	48.15	7.26
Wayne Farms	29.15	4.39
Sanderson Farms	25.11	3.78
Mountaire Farms	19.71	2.97
Cagle's	16.18	2.43
Foster Farms	15.54	2.34

Source: WATT PoultryUSA. (2003)

many pounds of broilers as its next three competitors - Goldkist, Pilgrim's Pride, and ConAgra. Table 2.3 shows that in 2002, around 149 million pounds of ready-to-cook broilers were processed weekly by Tyson Foods compared to 61 and 57 million pounds of broilers from Goldkist and Pilgrim's Pride, respectively. The top five firms account for more than half of the total broiler production in the United States.

Broiler companies contract the production of broiler with growers who are located in the proximity to their processing plants. Since broilers do not travel well over a long distance, having farms close to processing plants reduces weight losses during transit (Lasley et al., 1988). Contract growers usually live in rural areas where employment opportunities are low and their low education levels leads to even fewer off-farm job

Table 2.4: Top 10 Broiler Producing States in 2000 and Their Volumes

State	Head Produced ( <i>Million</i> )	Pounds Produced ( <i>Million</i> )
Georgia	1,229.7	6,148.5
Arkansas	1,191.7	5,839.3
Alabama	1,038.7	5,297.4
Mississippi	739.9	3,699.5
North Carolina	698.4	4,050.7
Texas	551.0	2,589.7
Maryland	283.3	1,359.8
Virginia	264.9	1,298.0
Delaware	247.7	1,461.4
Missouri	240.0	1,080.0
Others	1,777.3	8,692.0
The U.S. Total Production in 2000	8,262.6	41,516.3

Marketing year: December 1 to November 30.

Source: Poultry: Production and Value 2001, Annual Summary: National Agricultural Statistics Service, USDA

opportunities, making broiler operations more important to households (Perry, et al., 1999).

The broiler industry is mainly concentrated in the Southeastern region of the United States. This region produces more than 85% of the U.S. broiler meat supply. As Lasley et al.(1988) indicated, the Southeastern region may have the comparative advantage due to climate because broilers are vulnerable to extremes in temperature.

Thus, broilers can be raised inexpensively in the warmer part of the country, although they require cooling during the summer months. In 2000, Georgia was the leading state in broiler production with 15% of the U.S. production, followed by Arkansas, Alabama, Mississippi and North Carolina. Table 2.4 shows the top 10 broiler producing states and their volumes of production in 2000.

## 2.2 Broiler Industry Contracts

In the U.S., approximately 99% of all broilers are produced under a contract. Contracts have been used as a tool to coordinate production between integrators and growers since the 1940s. In 1950, 95% of broiler growers were still independent. However, in 1955, after feed companies vertically integrated and moved to the South, the use of contracts dramatically increased to where 88% of all broilers were produced under a contract (Perry et al, 1999).

Martin (1994) cataloged the evolution of contracts in the broiler industry chronologically. The industry began with *open account contracts* where growers were offered credit so that they could purchase inputs (chicks and feed) and construct facilities. The extended credit was provided mainly by a feed dealer or a bank. When broilers were sold, growers repaid their debts. Even though growers made most of the production decisions, sometimes a feed dealer might interfere. Marketing decisions were made by either growers or lenders.

As the competition among dealers grew, dealers started to offer *an open account* -

*no loss contract*, which carried a clause ensuring that any deficit incurred by growers after broilers had been marketed would be cancelled. The clause allowed for shifting a negative output price risk away from growers. The next step was the use of a *guaranteed price contract*. While this type of contract was the main source of credit, thus easing grower's capital constraint, it also decreased a grower's exposure to output price and production risks by including an additional clause guaranteeing the grower a certain price when chickens were marketed. However, growers were still subject to input price risk.

The next generation of contracts began with a *flat fee contract*. Under this contract, integrators retained the ownership of birds, provided feed, medicines, and chicks and coordinated production and marketing decisions while growers were compensated for their husbandry by payment per pound, per bird, per week. The marketing decision was entirely transferred into the hands of integrators who simultaneously influenced production decisions. Within this contract, both input and output price risks were transferred to the integrator. Because of the limited risk exposure and the inability to monitor the grower's effort, ex-post opportunistic behavior by growers became inevitable. To mitigate the problem, a feed conversion bonus was added to the flat fee contracts as an incentive for growers to exert the effort and control the moral hazard problem. The bonus was calculated based on the feed conversion ratio. The lower the rate of feed conversion, the higher the bonus. These contracts became known as a *feed conversion contracts*. Later, a feed conversion contract evolved such

that the conversion bonus was based on the relative performance of growers, rather than on an absolute standard. Some other features sharing more output price risks and guaranteeing a minimum payment were also added to create a more efficient contract. This resulted in a *combination contract* which resembles the contract we observe today.

The modern broiler contracts are *take-it-or-leave-it* contracts that precisely specify growers responsibilities regarding the production procedures. Contracts, which typically cover only *one flock* of birds, generally do not guarantee any specific number of flocks per year. Broiler contracts vary depending on the company but all of them share two features: the division of responsibility for providing inputs and the method to determine the grower compensation (Tsoulouhas and Vukina, 1999).

### **2.2.1 Division of Responsibility for Inputs**

In order to obtain a contract, prospective broiler growers are responsible for constructing broiler facilities based on the specification given by integrators. A standard modern broiler house is a 500 feet long by 40 feet wide building which is well-insulated, has a controlled environment (i.e., using tunnel ventilation with a back up generator to run them should power go out) and is equipped with automatic feeders. A new house usually costs about \$150,000. Investments in broiler houses are the single largest expense faced by growers. Aho (1988) pointed out that those investments constitute about half of all the invested capital in the broiler industry. Other than fa-

cilities, growers are responsible for labor, utility costs (electricity and water), clean-up costs, and dead birds disposal.

The integrator company provides baby chicks, feed, medication, and services of field men. Items like fuel or litter can be the responsibility of either the integrator or the grower, or they can be shared. The decision about the volume of production, that is, the rotation of flocks (batches) on a given farm, as well as the size (capacity) of the broiler houses are determined solely by the integrator. The distribution of production inputs (feed and chicks) and the requests for the facilities and equipment upgrades and replacements are also under the discretion of the integrator's production managers.

### **2.2.2 The Method of Determining the Payment**

Most of the contracts are settled via *tournament-based* schemes, consisting of a base payment per pound of live meat and the bonus payment. The bonus payment is tied to the grower's performance index, relative to other growers. Generally, the relative performance is measured by the difference between a grower's individual settlement costs (grower's adjusted prime cost) and group average settlement costs (average adjusted prime cost<sup>3</sup>). The below average settlement costs will receive the

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<sup>3</sup>The individual settlement costs are determined by summing chicks, feed at average unit cost of feed, fuel at average unit cost of fuel, medications, litter, and other flock costs as charged to the grower divided by the pounds of poultry moved from the grower's farm. The average settlement costs are determined by calculating the average of individual settlement costs whose flocks were harvested approximately the same time. Usually, the calculation is on a weekly basis. For example, the settlement week covers from midnight on Saturday through the following Saturday.

bonus because it implies that the grower can produce a pound of broiler with a lower-than-average cost. The higher-than-average settlement costs will be penalized. A grower with exceptionally low (high) settlement costs is usually excluded from the average so that the other growers are not penalized (rewarded) when one grower performs really well (really poorly).

In the general case, the payment for grower  $i$  in tournament  $t$  takes the following form:

$$R_{it} = \left[ b + \beta \left( \frac{1}{n} \sum_i \frac{c_{it}}{q_{it}} - \frac{c_{it}}{q_{it}} \right) \right] q_{it}$$

where  $b$  denotes the base payment per pound of broilers,  $\beta \in [0, 1]$  is the slope of the payment scheme that determines the relative importance of the bonus payment in the total grower's compensation,  $\frac{1}{n} \sum_i \frac{c_{it}}{q_{it}}$  is the  $t$  flock average per pound settlement costs for the entire group of growers in the same settlement week,  $c_{it}$  is the integrator's costs associated with an individual grower  $i$ ,  $q_{it}$  is the number of pound of live broilers and  $\frac{c_{it}}{q_{it}}$  is the per pound settlement cost of the grower  $i$  for flock  $t$ .

Recently, some broiler contracts have included the *market price clause* such that the grower's payment is tied to the fluctuations of the market price. The market price clause is defined as the percentage difference between broiler market price and the integrator's average variable cost of producing it. This market price clause is usually truncated at zero, allowing for no down-side risk to growers if the market price is low.

In addition to performance-based payments, most broiler contracts have the minimum guaranteed payment and the catastrophic payment. The former will be applied

if the grower's revenue based on the performance payment is less than some minimum guaranteed revenue. The latter will become effective in the event of fire, windstorm, flood, or hail involving a loss of a substantial portion of the flock. However, none of these payments applies in cases of gross negligence. Both of them are designed to secure sufficient payments to prevent a grower from defaulting on the broiler houses mortgage.

### **2.2.3 Industry Organization**

Production contracts have played a decisive role in the broiler industry's remarkable growth. Knoeber (1989) used the transaction cost framework to explain the organization of the broiler industry. He argued that the importance of relationship-specific investments by both growers (broiler houses) and integrators (processing facilities) make spot markets unlikely since either party could act opportunistically and expropriate quasi-rents generated from those assets. With a certain degree of specificity, either contracts or vertical integration will be selected to organize broiler production. Knoeber claimed that as uncertainty from frequent transaction increases, contracts will be less favored compared to vertical integration since they are more incomplete. However, the industry predominantly uses the production contracts and rarely uses company-owned farms.

Why is this the case? According to Knoeber, the solution to this puzzle has two parts. First, tournament compensation reduces the cost of contracting because it

provides an effective way to adapt to technological change without contract renegotiations. The tournament-based compensation automatically adjusts to new technology affecting all growers in a specific time period in the same way. As a result, tournament compensation eliminates large *menu costs* that would otherwise accompany frequent changes in contract stipulations.

Furthermore, tournament compensation scheme is a flexible tool to handle the distribution of risks between integrators and growers while maintaining a strong incentive for good performance. Individual grower income could vary due to common production shocks such as temperature, disease, and innovations in the quality of chicks and feed. However, tournaments filter away the *common production risks* such that there is no effect on individual grower payment. Tournament type settlement also helps reduce income variability associated with the seasonal income stream, thus stabilizing the grower's cash flow. Knoeber and Thurman (1995) showed that income received by independent growers would have been six times more variable than income obtained by a contract producer. They found that price risk is the major component of overall risk measuring 84% of the payment variance, whereas the rest belong to common production risk and grower's idiosyncratic risk. They also found that 97% of overall risk is shifted from the grower to the integrator. The risk is transferred to the integrators who are typically publicly traded companies better positioned to handle risk cheaper.

Second, the requirement that growers provide capital in the form of broiler houses

creates a *performance bond* that assures good performance.<sup>4</sup> The house acts as a *hostage* that can be forfeited by a grower if shirking is detected. The fear of losing facilities acts as an additional incentive for a grower to do well in raising broilers. Lewin (2000) also supports Knoeber’s performance bond story, arguing that by having the assets tied in broiler houses, a grower will fear termination, understanding the limited use of this investment outside the current contractual relationship. Moreover, the provision of broiler houses ensures that the contractual relation is long-term. Broiler houses serves as a *credible commitment* of an intention to perform well and enter into a long-term relationship.

## 2.3 Tensions Between Contracting Parties

From the mid 1990s until now, tensions in the contractual relationship between integrators and growers have received an increasing attention nationwide. The great majority of growers’ complaints fit in the category of what is known in economic literature as the hold-up problem. The phenomenon takes on a wide variety of manifestations, all of them being consequences of the fact that a short-term contract governs a long-term investment which is relationship specific. Currently, The National Contract Poultry Grower Association (NCPGA),<sup>5</sup> state legislators, and USDA have

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<sup>4</sup>In this case, the broiler house plays the role of an “ugly princess”. An alternative would be to post a money bond. However, the money bond would be ineffective because it would give integrators an incentive to cancel the contract and seize the bond.

<sup>5</sup>NCPGA is a national cooperative association of contract poultry growers dedicated to improving the social and economic well being of growers. It has more than 25,000 members in 27 states. NCPGA also has its own publication, *Poultry Grower News*.

started to systematically seek information about the impact of integrators practices and contractual arrangements on contract growers. Based on Ilvento and Watson (1998) and the FLAG<sup>6</sup> survey (2001), we can identify eight main issues that are of concern to growers. They are as follows:

### **1. Use of tournament schemes to determine payments**

Broiler growers have expressed concerns about tournament-based payment schemes because they believe that it is unfair to compare the individual production costs with average costs for a group of growers. A grower who exerts the same effort can receive different payments from one flock to the next depending on how other growers in the settlement group performed. FLAG's survey shows that 48% of growers surveyed do not feel comfortable with tournament contracts.

### **2. Concerns about quality of inputs**

Surveys indicate that growers feel that the quality of chicks and feed are not evenly distributed among growers. A large percentage of growers believed that they were consistently given poor quality chicks that have a higher-than-expected mortality rate. Some growers feel that good-quality chicks are consistently delivered to some predetermined broiler houses, such as those of company employees who, at the same time, happen to be contract growers.

### **3. High condemnation rate with unsatisfactory explanation**

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<sup>6</sup>Farmers' Legal Action Group, Inc. (FLAG) is a nonprofit law firm based in St. Paul, MN, which provides legal assistance to farmers, farm advocates, attorneys and organizations working to help individual farmers stay on the land and to defend the family farm system of agriculture.

Grower's payments are affected by the number of birds condemned at the plants for health or quality reasons. Growers feel that sometimes the condemnation rate for their birds is higher than expected. Integrators do not always give a satisfactory explanation when growers ask about condemnation rates. Many growers believe that condemnations are the result of the mishandling of chicks during catching and loading. However, the usual contract does not assign provisions for liability between the company and growers for condemned whole birds and parts.

#### **4. Pressure to adopt facility's improvements**

Growers are frequently requested or encouraged to make improvements in their facilities. Since most contracts are for one flock, growers may be faced with no other option but to comply and make changes if they want to continue raising broilers because the integrator may request the adoption of improvements as a condition for receiving a new contract. Those changes are sometimes so specific that, once accomplished, they could not be used for other purposes. There is some anecdotal evidence presented in the surveys indicating that contracts have been revoked after growers did not comply with the integrator's recommendations.

#### **5. Accuracy of weighing chicks and feeds**

The weight of broilers raised and moved from the farm to processing plants is the crucial determinant of a grower's income. It is known that the longer the time between moving broilers from the house to the actual weighing, the more weight loss (or shrinkage) will occur. Growers frequently argue that their birds are not weighed

promptly. Some expressed their concerns about inaccurate weights due to tampering with the scales or tampering with the weight figures on tickets. Further, growers complained about the weight of feed delivered to the farm. They argued that from time to time, they would receive short loads, spilled feed, or even the wrong weight recorded on feed ticket. Those activities are considered a crime. However, hard evidence is often difficult to bring forth, and therefore, lawsuits against integrators who tamper with scales are very rare.

## **6. Timing and frequency of flocks**

An average grower will receive about six flocks of broilers annually if contracts are consistently renewed. Because most contracts are for one flock only, there is no commitment about the number of flocks a grower can expect to receive or how long the interval between flocks (for cleaning and preparing a house) will last. This creates another tension because growers who are eager to raise broilers are sometimes left with empty houses for a significant period of time.

## **7. Contract dispute resolution procedures**

The method of dispute resolution provided in a contract is rather complex and not easily understood. Survey results indicate that growers feel they have a limited ability to settle disputes. Broiler contracts usually adopt a *mandatory arbitration* as a method for resolving disputes. In arbitration, one or more arbitrators, designated by the integrator, are to make a final decision. Arbitration per se has several advantages<sup>7</sup>

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<sup>7</sup>The main advantage is that the less confrontational nature of the process can lead to an improved relationship between parties once the disputes are resolved.

but is subjected to criticism as being biased in favor of the integrators. Other forms of conflict resolution are *mediation* where a neutral mediator (an outside expert) helps both parties to resolve their disagreement and *peer review*, where a small group of people who are experienced growers and company employees decide how to resolve the dispute. Moreover, some broiler contracts have a confidentiality clause that prevents growers from consulting with an outside party if contract disputes occur. This implies that the growers, after signing a contract, effectively waived some of their rights to have disputes considered by the courts.

## **8. Retaliation for joining grower associations**

Many growers indicated that they did not feel free to join the organization representing their interests such as the NCPGA. They claim that if they were to join such organizations, their contract could be revoked without a cause, or that the integrator could retaliate using some illegal trade practices.<sup>8</sup>

Because of these issues, there needs to be regulation protecting growers from opportunistic behavior of integrators. Many broiler growers feel that the existing regulation is not enough such that more of government interventions are needed.

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<sup>8</sup>The study of FLAG (2001) points out that in Florida, an integrator had cancelled a contract with growers without a legitimate explanation. The court concluded that an integrator discriminated against growers by refusing to deal with growers due to membership in a grower association (Bladree v. Cargill, Inc., 758 F.Supp.704 (M.D.Fla.1990), aff'd without opinion by 925 F.2d 1474 (11th Cir.1991))

## 2.4 Regulation of the Broiler Industry

This section offers the overview of federal and state laws that govern the grower-integrator contractual relationship. The “Model Producer Protection Act” (henceforth, the MPPA) which has been considered in many states will also be discussed in detail. It would also be beneficial to consider the regulation in franchising contracts since the franchisor-franchisee relationship resembles to grower-integrator relationship. We will discuss in detail what regulations have been enacted in governing franchisor-franchisee relationship.

### 2.4.1 Federal Regulations Governing Broiler Contracts

The main federal legislation that directly deals with contractual arrangements in the agricultural sector is the Packers and Stockyard Act (P&S Act), which was originally enacted in 1921. Its role is to prohibit activities that might adversely affect a fair competition environment. At first, the act refers to “a live poultry dealer” as “any person engaged in the business of buying and selling live poultry in commerce.” According to the P&S Act, it is unlawful for a poultry dealer to “engage in or use any unfair, unjustly discriminatory, or deceptive practice or device, give undue/unreasonable preference/advantage to persons or localities, apportion supply among packers in restraint of commerce, conspire to apportion territory, or sales, or to manipulate or control prices” (FLAG, 2001).

Clearly, the act does not directly consider the contractual relationship between

processors and growers. The act covers only purchasing and selling of an agricultural product. As the structure of the poultry industry changed such that processors vertically integrated and owned birds, contracts became a popular way of doing business in the broiler industry. In 1987, the definition of “a live poultry dealer” in the P&S Act was changed to include the company who owns the birds and arranges for growers to raise and care for live poultry. This change brought broiler contracts under the P&S Act for the first time. From that time on, the USDA has passed regulations providing more detailed requirements covering contractual relationships in the statutory provisions. These regulations can be found in the Code of Federal Regulations, part 201 of Title 9 (9 C.F.R. pt. 201) (FLAG, 2001). Within the USDA, The Grain Inspection, Packers and Stockyards Administration (GIPSA) is the agency that implements these regulations and enforces the P&S Act.

Another federal legislation is the Agricultural Fair Practice Act (AFPA) of 1967. The AFPA prohibits processors from discrimination against or intimidation of farmers due to membership in any organization (FLAG, 2001). The AFPA evolved from the Capper-Volstead Act of 1922 which itself resulted from the push to achieve a countervailing force against monopoly power in a vertical supply chain by labor unions a century ago. Section 1 of the Capper-Volstead Act provides that “persons engaged in the production of agricultural products as farmers, planters, ranchmen, dairymen, nut or fruit growers, may act together in associations, corporate or otherwise, with or without capital stock, in collectively processing, preparing for market, handling, and

marketing in interstate and foreign commerce, such products of persons so engaged.” The Act goes on to allow “Association [to] have marketing agencies in common; and such associations and their member make the necessary contracts and agreements of effect such purposes.” Currently the Capper-Volstead Act is administered by the USDA. Besides the Capper-Volstead Act, the Sherman Act and the Clayton Act prohibit certain activities that may restrict market access or suppress competition (Heykoop, 2002).

However, there are many existing loopholes in the current regulations. FLAG (2001) offers several examples that the current federal laws have some gaps. For example, under the P&S Act, the integrator is required to supply contract growers a ranking sheet giving information about factors used in determining grower’s payments for each flock. However, the name of other growers are not required. Thus, the integrator’s practice to include its own employees in the average settlement costs calculation does not violate the P&S Act (FLAG, p. 49). As a result, it is possible that company personnel compete against non-employee growers.

FLAG’s study also argues that the P&S Act does not explicitly address the issue of chick and feed quality. The P&S Act broadly implies that an integrator shall distribute inputs of varying quality randomly to growers (FLAG, p. 51). Also, the P&S Act has no regulation concerning timing and frequency of flocks one should receive. Since the contract makes it clear that there is no commitment from the integrator to deliver more than one flock, it is difficult for regulators to police the possible

unfair practice on flock distribution. Integrators might argue that growers should have acknowledged the risk for not receiving flocks before putting their names on the contract. Hence, the P&S act does not completely shield growers from the possible discrimination practice. Moreover, there is no law stating that the termination of a grower without economic justification is in violation of the AFPA or the P&S act (FLAG, p. 59). This implies that it is not illegal to have the facility improvement as a condition for contract renewal.

Recently, there were several attempts to pass legislation regulating the use of broiler contracts. In 1999, Representative Marcy Kumpur of Ohio introduced two bills to the House Agriculture Committee: “The Poultry Farmers Protection Act” of 1999 and “The Family Farm Cooperative Marketing Amendments Act” (Poultry Growers News, 2000). The former would amend the P&S Act and will give GIPSA enforcement authority to take actions when unfair and deceptive practices are discovered within the poultry industry. The latter would amend the AFPA to correct the most significant weaknesses of the current AFPA, which includes a disclaimer provision permitting integrators to refuse to do business with a grower for any reason. The latter would eliminate this disclaimer. However, as in 2000, all of those attempts were stalled.

In the subsequent year, Senator Tom Harkin (Iowa) introduced “The Agricultural Producer Protection Act” (S.3243) to the Congress in 2000. The bill would set minimum standards for agricultural contracts, requiring good-faith negotiation between integrators and grower associations. Again, the bill was not approved (Poultry Grow-

ers News, 2000). In 2001, Tom Daschle (South Dakota) proposed the same kind of legislation called “Securing A Future for Independent Agriculture Act of 2001,” but this bill was overshadowed by the events of September 11<sup>th</sup> (RAFI, 2001).

### 2.4.2 States Regulations

Many states have proposed broiler industry regulation to their own legislatures. In the 1990s, Minnesota led the way in protecting contract growers by setting several guidelines on contract cancellation and requiring a mediation clause in contracts between growers and processors (Lewin, 2000). For example, if a contract requires a grower to make a capital investment in buildings or equipment having a useful life of five years or more, costing \$100,000 or more, the integrator may not cancel or terminate the contract until: (1) the grower has been given written notice of at least 180 days and (2) the grower has been reimbursed for damages incurred by an investment in buildings or equipment that was made for the purpose of meeting the requirements of the contract.

The same type of legislation was considered in Wisconsin where it allowed growers a 72-hour grace period before cancellation of a contract and required an integrator to provide a written document stating all conditions that might cause deductions in payments to growers. Kansas also passed a law requiring all contracts to have *an implied promise of good faith* where an integrator must present the contract with honest and accurate information to growers (both written and oral communication).

Several states that considered similar legislation are Louisiana, Alabama, Mississippi, and Oklahoma. While some states successfully passed legislation to protect growers, some did not (Louisiana and Alabama)(Hamilton, 1995).

Recently, Iowa Attorney General Tom Miller and his counterparts from 16 states<sup>9</sup> have proposed a new legislation aimed to protect contract growers. They have banded together for the Model Producer Protection Act (henceforth, MPPA). The model claimed that the legislation would “help preserve competition in agriculture for the benefit of farmers and consumers” (Iowa Department of Justice, 2000). Tom Miller claimed that

*In production contracting, we worry about the great disparity in bargaining power and marketing information between contractor companies (integrators) and individual producers. Large companies often offer contracts to growers on a take-it-or-leave-it basis. Risk to producers are buried in page of legalese, and producers easily can be stuck with unfair contract terms. On top of that, they may be barred from disclosing any terms to others.*

However, the proposed MPPA has had a difficult time in many states. Overall, at the state level, only a handful of states have legislation in place. In Georgia and Illinois, the MPPA was successfully passed in the state house. However, in many states such as Kentucky, South Dakota, and South Carolina, the bills were not successfully introduced (RAFI, 2001). Currently, several states are still attempting to include the MPPA in their own legislations.

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<sup>9</sup>The model legislation was endorsed by the Attorney General of Colorado, Indiana, Iowa, Kentucky, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, North Dakota, Oklahoma, Vermont, West Virginia, Wisconsin, and Wyoming.

### 2.4.3 The Model Producer Protection Act

The MPPA,<sup>10</sup> proposed by several states, contains six major components aimed at alleviating tensions in the industry. These tensions have been identified but have not been covered, partially or wholly, by any federal regulations.

#### 1. Plain language

The *plain language* provision can be found in industries outside the agricultural sector as well. It is likely that plain and simple language should convey more useful information, providing no meaning is lost and contracts remain transparent. To accomplish this objective, the MPPA sets out two requirements. First, broiler contracts must be accompanied by a cover sheet (Section 4b(2)) including a written statement of the material risks faced by the producer, a statement advising growers to read the contract, and an index of the major provisions of the contract and the pages on which they are found. The second component includes plain language requirements themselves (Section 4b(3)). A broiler contract “must be in legible type, appropriately divided and captioned by its various sections and written in clear and coherent language using words and grammar that are understandable by a person of average intelligence, education and experience within the industry.”

#### 2. A three-day cancellation period

This *cooling off* provision has been embedded in consumer law for decades. It is not uncommon to give consumers a second chance to back out of transactions. The

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<sup>10</sup>A copy of the MPPA can be found at <http://www.newrules.org/agri/ppa.html>

same should apply to the contractual arrangement. Boehlje et al. (2001) argued that such a provision would force integrators to reveal some strategically important information to the public. Harl et al. (2001) responded by arguing that these unintended consequences are exaggerated and that there is no evidence showing that the three-day right to review has any adverse economic result on contracting parties.

### **3. A first-priority lien for payments due under a contract**

This provision (Section 7b) offers a way to protect the grower's right to receive payments if integrators encounter financial difficulty or become insolvent. In fact, the same type of provision has existed in the P&S Act since 1976 (Harl et al., 2001). Without this provision, the integrator's lender would typically have the first lien on the integrator's property. That is, the integrator's lender would be paid before growers.

The proposed lien could likely increase financial risk in the industry. The lenders may limit the integrator's access to capital since the risk of default is higher. However, there has been no compelling evidence of adverse impact from the same provision in the P&S Act amended in 1976 (Harl et al., 2001).

### **4. Protection from capricious termination**

This provision directly addresses the grower's complaints about the pressure to adopt facility's improvements and the fear of retaliation by integrators. This problem emerges from the fact that a long-term investment (in broiler houses) is governed by a short-term contract. In order to nullify this classic hold-up problem, this provision

attempts to eliminate the possibility of an unexpected contract termination. Section 8 of the MPPA makes it more difficult to terminate, cancel, or not renew a contract if the grower has made an investment of \$100,000 or more in facilities. Furthermore, Section 8 points out that it is a breach of contract if integrators terminate the contract unjustly. Such a termination allows growers to collect damages associated with any capital investment. Damages can be calculated on the basis of the value of the remaining useful life of the facilities (Section 8b(2)).

This provision of legislation may create a perverse effect. Preventing termination might induce growers to invest more in the facilities since the risk of losing the investment is shifted to integrators. With this legislation, housing facilities cease to play the role of a *performance bond*. The legislation acts like a warranty such that growers' losses are completely shielded, regardless of opportunism. Such a provision could make the construction of company-owned farms more attractive.

## **5. Confidentiality clauses are prohibited**

With this provision, broiler growers can discuss their contracts with their attorneys, financial advisors or government authorities. This should lead to more efficient bargaining since all relevant information is transparent to contract growers. The elimination of confidentiality clauses may have some negative effect as well. This may include the discovery of a valuable production technique by competing firms in the industry. The easier the dissemination of valuable information, the less investment in R&D the industry would have to undertake due to free-riding.

## **6. Tournaments and other “unfair practices” are prohibited**

First, practices related to coercion, retaliation, or discrimination against growers because of their involvement in producer organizations or because they became whistle blowers are considered unfair. Second, it is considered unlawful to refuse to provide information used in determining grower compensation or not to permit a grower to observe weighing of birds and feed (Section 9b(4)). Third, contracts must contain language providing for the resolution of disputes through mediation, and mediation must be exercised before going to court (Section 9b(9) and 12). This provision would eliminate the mandatory arbitration clause that tends to favor integrators. Growers would benefit from the fact that neutral outsiders, rather than arbitrators, would resolve disputes justly. Fourth, tournament-based compensation is considered unfair. Section 9b(5) stated that “[it is unfair] to use the performance of any other contract producer to determine the compensation of a contract producer under a production contract or as the basis for termination, cancellation, or renewal of a production contract.” Compounding this problem is the fact that tournament-based compensation is very sensitive to the integrator supplied quality of inputs.

Banning tournaments, however, could add significant risks to broiler growers. As argued by Knoeber and Thurman (1995), the benefit of tournaments is the process of risk shifting from growers to integrators. They showed that growers are responsible for only 3% of total risk. The input-output price risks are transferred to the integrator who can handle the risk more efficiently. Banning tournaments would also

increase transaction costs associated with contract renegotiation every time there is a significant technological progress in production technology (Knoeber, 1989).

#### 2.4.4 Franchising Contracts

In a typical franchising relationship, a franchisor contracts with a franchisee to sell a product. In order to receive a right to use franchisor's brand name, the franchisee must construct a facility according to the franchisor's specification. The contract consists of a two-part payment by the franchisee to the franchisor. The franchisee pays an initial non-refundable fee and a continuing royalty payment, usually a percentage of sales. The franchisor provides on-going support to the franchisee. The franchisor maintains the right to terminate the contract if the franchisee does not deliver products consistent with the quality guaranteed by the brand name. Franchising contracts are parallel with broiler contracts and are also subject to the problem similar to the grower-integrator relationship.

The federal regulation<sup>11</sup> protecting franchisees from the opportunistic franchisor was established in 1979 (Beales and Muris, 1995). The Federal Trade Commission (FTC) announced rules called *The Trade Regulation Rule on Disclosure Requirements and Prohibitions Concerning Franchising and Business Opportunity Ventures* (also

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<sup>11</sup>In addition to federal regulations, several states have enacted laws that restrict unjust franchise terminations and non-renewals, requiring good cause and advance termination notice, as well as the opportunity for the franchisee to correct the failure. (Brickley, Dark, and Weisbach, 1991). For example, the Wisconsin Legislature passed the *Fair Dealership Law* in 1974. The purpose was to promote fair business relations between franchisors and franchisees and to protect franchisees against unfair treatment by franchisors who are in an inherently superior economic position with a superior bargaining power.

known as the Franchise Rule) that were meant to balance the bargaining positions and thereby prevent opportunistic behavior. Pursuant to that rule, franchisors must prepare a disclosure document<sup>12</sup> and provide a copy to all prospective franchisees consistently. The FTC believes that its Franchise Rule will protect small business people from deceptive marketing of franchisors, therefore, preventing some elements of the hold-up problem. Moreover, the Franchise Rule applies in all states. If the protection afforded under state law is greater in states that have adopted similar specific franchise regulations, the FTC may accept the state's disclosure in lieu of its own.

Another set of federal statutes directly affects the termination power of franchisees. For example, Beales and Muris (1995) mentioned that the *Petroleum Marketing Practices Act* of 1978. It addresses mostly issues of termination (i.e., non-renewal of contracts between petroleum companies and gasoline retailers). Petroleum companies must present a good cause for the termination of gasoline retailers. Another federal statute covers automobile dealers - *the Automobile Dealer Day-in-Court Law*. Car manufacturers often attempt to force dealers to sell more cars than they wish to sell by setting longer retail hours and forcing them into excessive competition with dealers in the same area, eventually cutting their profits. The law dictates what car manufacturers can write into the contract with car dealers. It restricts the car manufacturer's ability to set retail hours and requires a good-cause termination. Recently,

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<sup>12</sup>For example, required fee, basic investment, termination condition, litigation history, etc. A document should satisfy the requirements of the Uniform Franchise Offering Circular (UFOC).

the Chicago-based American Franchisee Association asked Congress to pass more legislation for governing the relationship between franchisors and franchisees. *The Model Responsible Franchise Practice Act* was introduced to both federal and state government, demonstrating how to write franchisee rights into law. The proposed outcome of these regulations will make opportunistic behaviors by franchisors more costly.

## 2.5 Theories of Regulation

To explain the pattern of regulations in the broiler industry, two theories have been proposed. The *public interest theory* emphasizes the regulation's role in correcting market imperfections. In this case, regulatory agencies are viewed as benevolent maximizers of social welfare. The *interest group theory* emphasizes the role of interest groups in the formation of regulations. Regulations are viewed as products of competition among groups exercising their political influence.

### 2.5.1 The Public Interest Theory

According to the First Welfare Theorem, a perfectly competitive equilibrium is Pareto optimal. The price of any commodity will reflect its social cost of production as well as each consumer's individual valuation. Any government intervention that interferes with the proper functioning of the perfectly competitive setting will

lead to a decrease in social welfare because agents are constrained and cannot fully exercise their available trading options. Unfortunately, the assumption behind the model of competitive market economy is frequently violated. Market failures emerging from economic agent's behavior or the nature of goods are common. In this case, government intervention may be needed to restore efficiency.

The major sources of market failures are 1) market power 2) imperfect information 3) externality and 4) public goods. According to the public interest theory, government intervention is the response of the government to public demands to remedy inefficiency and inequities from those sources of market failures. It is virtually costless and has an effective instrument to correct market failures (Posner, 1974).

Government can correct market failures in two ways: enacting laws prevent economic agents from certain behaviors or granting tax or subsidy. As a result, several public utility companies are regulated by government agencies. By using tax and subsidy, all government attempts to correct market failures are based on the taxation scheme called *Pigouvian*. The Pigouvian tax is an excise tax levied on producers of market imperfections (i.e., producer of externality). It forces those producers to take into account the extra costs of their production imposing on society such that they will not over-produce externalities or under-produce public goods.

Broiler contracts likely suffer from the two sources of market failures: integrator market power and imperfect information. It is true that growers may have many choices of integrators with which to contract. However, once the contract is signed,

integrators will have a market power in a contractual relationship due to the fact that growers have sunk their investments.<sup>13</sup> Integrators can force growers to accept the inefficient contract terms since they realize that it is costly for growers to find a new contract. Growers also likely possess imperfect information about contractual relationship. One example is that they have no way to estimate in advance how much to expect in payment since factors related to the calculation of payments (especially, other growers' performance and quality of chicks and feed) are beyond their control. Many of them do not know how their feed or birds are weighed and are not aware of the length of the time between flock placement. Some growers reported that they do not even understand their contracts or what is important in their income calculation (Ilvento and Watson, 1998). Nevertheless, no concrete regulations actions have happened thus far (Vukina, 2001).

Lewin (2000) supports more regulations in broiler contracts since market power allows integrators to compensate growers insufficiently.<sup>14</sup> By using a parallel of efficient wage theory, she argued that involuntary unemployment is needed to create worker incentive for high effort without requiring a high compensation premium. In the broiler industry, if a contract involves a specific asset, then the integrator does not need to create a shortage of contract. The fear of contract termination induces a high effort without efficient compensation. This effect would be magnified if integrators

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<sup>13</sup>The same situation can occur in franchising contracts. Franchisors have a market power in a contractual relationship once the franchisee's investment is sunk as well.

<sup>14</sup>In her paper, market power enables the franchisor to terminate the contract at will which works as a threat such that franchisees do not need to compensate efficiently.

have market power because less demand for franchisees will be internalized such that their compensation can be greatly reduced without inducing low effort.

In order to correct imperfect information in contracting, some proponents of regulation suggested that tournament contracts be replaced by fixed performance standards. The fixed performance standards eliminate a comparison among growers (whose group composition is unknown). However, Tsoulouhas and Vukina (1999) argued that replacing tournament contracts with fixed performance standards, absent of any other rules, is not welfare enhancing. Their analysis shows that the replacement will decrease grower income insurance without raising grower welfare because the replacement eliminates the group composition risks (i.e., risk related to uncertainty about the average outcome of growers. The origin of the risk comes from the imperfect knowledge of each grower's ability) but adds the common production risks which are larger. Without regulating piece rate in fixed performance standards, social welfare is strictly reduced.

Brickley et al. (1991) and Beales and Muris (1995) explicitly address why government intervention would ever be necessary to alleviate franchisor market power. Brickley et al. view that economic agents will always choose the organization that maximizes efficiency and minimizes opportunism. They predict that if market failures occur, protective legislations will reduce the number of franchising in all franchises due to decreased gains from opportunism. However, they found no evidence for market failures. Beales and Muris also support no regulations in franchise contract termi-

nation. If market failures exist, then the likelihood of contract termination should increase with the size of appropriable rents owned by franchisees. These authors found little evidence of a weak correlation between the size of franchisee investments (proxied by size of median of investments required by franchisors and average size of franchise establishments) and the termination rate.

Based on the presented literature, we conclude that the evidence of market failures are minimal. What Brickley et al. and Beales and Muris found is that protective legislations might be inefficient and may create frictions in the market of franchising. In broiler contracts, it is Pareto inefficiency to replace tournament contracts. Even though growers are exposed to market failures (imperfect information about group composition), the current tournament-based scheme offers more insurance to growers.

### **2.5.2 Interest Group Theory**

From the previous analysis of federal and state attempts to regulate broiler industry contracts, we can derive two interesting observations. First, many federal and state legislations that would diminish an integrator's bargaining power were not successful. Second, the push for regulation always comes from growers, grower organizations, or their advocates. Integrators have never asked for regulation. In this section, we elaborate on the hypothesis that the absence of regulation can be explained by the interest group theory of regulation.

The economic theory of regulation originated with Stigler (1971). He offered

a theory explaining why “regulation is acquired by the industry and is designed and operated primarily for its benefit” (p. 3). In this theory, regulation is a tool used by interest groups to shift the power of *coercion* by government or regulatory agencies to favor group profits. All interest groups seek to maximize profits which can be increased if competition is reduced by obtaining favored legislations.<sup>15</sup> Interest groups will compete for favorable legislations by offering political support to their representatives or political parties who maximize their votes (to remain in the office) and wealth. Once their representatives are in office, regulatory officials will be selected and instructed so that they serve the interest of the group who supported them. According to Stigler (1971), financing a favored legislature raises a free-rider problem. He stressed that a successful interest group tends to be concentrated so the free-rider problem is controlled.

Peltzman (1976) extended Stigler’s model and developed a model of wealth redistribution by regulators seeking to maximize votes. In the simplest version of the model, the probability of a politician receiving support from a group is taken to be a function of the average net gain to the members of the group. A large number of members provide a broader base for support but dilute the net gain per member, causing members to be less likely to grant votes and money. Peltzman found that regulation is likely to benefit small interest groups where each member stands to gain from regulation. Each member realizes the higher per-capita gain, thus has an in-

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<sup>15</sup>The favored legislations can be in the form of direct subsidies, restriction of entry, or licensing.

centive to contribute more resources in order to achieve a favored legislature. The conclusion is that small interest groups will dominate in the regulatory process.

Focusing on competition between interest groups, Becker (1983) presented a model of political influence of interest groups where each group maximizes its welfare by choosing an expenditure level to produce political pressure. A property of Becker's model is that aggregate influence is zero, and the influence of one group relative to another determines the amount of regulatory activity (measured by the wealth transfer). In his research, he derived four propositions about the political influence of interest groups. They are as follows:

1. The political effectiveness of a group is mainly determined not by its absolute efficiency - e.g., its absolute skill at controlling free riding - but by its efficiency relative to the efficiency of other groups.
2. Political policies that raise efficiency are more likely to be adopted than policies that lower efficiency.
3. Politically successful groups tend to be small relative to the size of the groups taxed to pay their subsidies.
4. Competition among pressure groups favors efficient methods of taxation.

Applying this theory to analyze the broiler industry, it can be seen that the industry is composed of only a handful of integrators (see table 2.3) and a large number of contract growers nationwide. According to Becker's proposition (1 and 3), a small

number of integrators leads to a less severe free-rider problem which effectively enables them to pressure regulatory agencies into opposing legislations proposed by broiler growers. Since per capita gain from opposing protective legislations is high, each integrator will find it beneficial not to lessen political support (votes and money) in creating political pressure. Politicians or regulators will also find that those companies are consistent sources of campaign contributions; thus, they have incentives to opposing the passage of legislations.

Several pieces of anecdotal evidence have been recorded by RAFI (2001) on pressures by integrators in the legislation process. For example, in Oklahoma, a “Contract Growers Protection Act,” Senate Bill 162 was not approved in the spring of 2001. State Senator Paul Muegge claimed that the integrators used “strong arm tactics” and said that “it’s a shame that legislators can be bought and paid by relentless companies who apparently have no regard for the lives its operation turns upside down” (RAFI, 2001). In South Dakota, a “Contract Farmer Protection Act” was not approved. The bill was believed to be opposed by integrators as well.

On the other hand, broiler growers are plagued with the usual free-rider problem as the marginal impact of one grower’s contribution to favored legislations is smaller. The fact that growers cannot freely join associations because of fear of retaliation also aggravates the free-rider problem. Moreover, growers will be less likely to organize a group efficiently because a large number of growers will have a much different perspective about the industry. For example, growers who complain about tournaments

will likely be low-ability growers. High-ability growers will perceive tournaments as efficient tools to compensate growers due to their rewards. This heterogeneity of growers will not permit incentives for organizing pressure groups to oppose tournament compensation. These factors weaken the collective actions of growers.

According to Becker's (1983) proposition 2 and 4, unsuccessful regulations pushed by growers will likely be of low efficiency. One apparent example is that broiler tournament contracts are still not regulated while many growers perceive that they are unfair. It is unfair for growers in the sense that tournament contracts compare individual performance to the unknown groups of growers so performance standards are changed in every period. Thus, growers cannot anticipate the amount of compensation even though they maintain their best effort. Levy and Vukina (2004) confirm that broiler tournaments are more efficient over fixed performance standards (piece rate contract) if growers are heterogeneous in abilities and randomly mixed from tournament to tournament. Although tournaments expose growers to group composition risks, they also shield growers from more significant common production risks (for example, disease, or excessively high temperature). Thus, tournaments welfare dominates fixed performance standard contracts.

From the interest group theory of regulation we conclude that integrators are likely to be successful in opposing growers' push for regulations since they can organize pressure groups more effectively. While the integrators make up few companies operating on a national level, most broiler growers are localized, making it harder

to organize nationally to compete for political pressure with integrators. Competitions between integrators and grower pressure groups result in existing contractual arrangements operating efficiently without further regulations.

## 2.6 Conclusion

We can identify two possible sources of market failures that may require regulations in broiler contracts. In the bilateral contractual relationship, integrators will possess more bargaining power since the long-term investment is governed by a short-term contract. Integrators can force growers to accept inefficient contract terms since it is costly for growers to find a new contract. Growers also have imperfect information in a contractual relationship. Growers could not anticipate the income from tournament compensation since many factors affecting outcomes are determined by integrators.

However, there is very little regulation in broiler contracts. Although growers have expressed concern about problems stemming from market failures (such as quality of chicks and feed, pressure to adopt a facility's improvements, tournaments, and etc.), no concrete regulatory actions have been taken in the federal level working thus far. Many regulations are opposed by integrators. Only a few states have regulations on broiler contracts.

We offer two explanations as to why there is no regulation in broiler contracts. First, it seems like the evidence of market failures is not strong enough. Studies

from franchising contracts suggest the evidence of market power in a contractual relationship is rare since economic agents have already chosen efficient contract terms. The existing contractual arrangements also exhibit welfare domination over other arrangements. For example, replacing tournaments with fixed performance standards will likely expose growers to more significant common production risks, which tournaments would eliminate. Second, integrators are relatively more efficient in exerting political influence than contract growers. Since integrators are small in number, each integrator has a bigger per capita gain from opposing growers' legislation. On the other hand, growers are abundant and have more diversity in their opinions about contractual relationships in the industry. The result of competition between different pressure groups will be that efficient contractual arrangements will likely prevail. Therefore, broiler contracts need no further regulation because they have already adopted the efficient contractual arrangements.

## Chapter 3

# Dynamic Incentive and Agent Discrimination in Broiler Tournaments

### 3.1 Introduction and Literature Review

In many business environments, including agriculture, economic agents often contract with each other repeatedly. Ideally, such relationships are governed by extensive long-term contracts. If two parties can sign a complete long-term contract, they can always contractually duplicate how they would behave in the absence of such contracts and in general, function more efficiently (Laffont and Tirole, 1993). In practice, however, business is often conducted by a series of short-term contracts due to the unwillingness or inability of parties to commit to a long-term relationship. Commitment refers to the ability of economic agents to restrict their future actions in advance by pledging to stick to the contract until some predetermined date (Salanie, 1997). There are various reasons for the lack of commitment depending on the institutions considered. For example, regulators may not be able to commit because

the current administration cannot bind future ones.<sup>1</sup> Non-commitment situations are also common in relationships between private parties. Contracts are costly to write and contingencies are often difficult to foresee. In most cases, the lack of information necessary to contractually describe future technologies and environments may render current long-term contract meaningless in the future.

In dynamic contracts, the lack of commitment is the source of implicit incentives, which can be positive or negative. In general, implicit incentives arise when a principal has some ex post capacity to respond to an agent's performance and when the agent's current performance is informative about his future performance (Meyer, 1995). Positive implicit incentives are known in the literature as *career concerns*. They occur whenever the principal (or the labor market) uses an agent's current output to update his belief about the agents' ability and then adjusts future compensation in the direction of these updated beliefs. Managers in firms, for example, may be motivated not only by the explicit contractual links between pay and performance but also because good performance today will enhance the labor market's perception of one's ability and henceforth improve future earnings.

Career concerns were first discussed by Fama (1980), who argued that incentive contracts are not needed because managers are disciplined by the labor market such that good performances will generate high salary offers and poor performances low offers. Holmstrom (1999) showed that the labor market discipline is not a perfect

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<sup>1</sup>Laffont and Tirole (1988) call this situation the "changing principal framework."

substitute for incentive contracts. In the absence of contracts, managers would typically work too hard in early years (when the market is still assessing their abilities) and not hard enough in later years.

Closely related to career concerns are perverse implicit incentives known as the *ratchet effect*, which arises in dynamic models of regulated firms such as Freixas, Guesnerie, and Tirole (1985), Baron and Besanko (1987), and Laffont and Tirole (1988). Here, the incentive problem is manifested in a regulated firm not being willing to produce efficiently today fearing the regulator might infer that low cost production is easy to achieve and impose even tighter constraints in the future. The same problem is also present in the design of optimal dynamic schemes for motivating workers where the employer cannot commit not to revise an employee's compensation, holding him to a higher standard tomorrow as a result of his good performance today. For example, in Lazear (1986) and Gibbons (1987), a worker's private information that he is reluctant to reveal concerns a firm-specific attribute such as job difficulty, whereas in Aron (1987) and Kanemoto and MacLeod (1992), a worker's private information concerns a worker-specific attribute such as ability. The behavior of an agent under career concerns and ratchet effect type of incentives is quite different. Under career concerns, the agent will try to prove he is efficient, whereas under the ratchet effect, he may try to prove he is inefficient (Laffont and Tirole, 1988).

Despite the substantial theoretical attention that has been given to dynamic incentive contracts with either career concerns or ratchet effect type of implicit incentives,

these models have been rarely empirically tested against the contract data. A notable exception is Gibbons and Murphy (1992) who show that the optimal compensation contract optimizes the combination of implicit incentives from career concerns and the explicit incentives from the compensation contract. They predicted that explicit incentives should be the strongest for workers close to retirement (whose career concerns should be the weakest) and found empirical support for this prediction based on the relationship between chief executive compensation and stock market performance. Another example are Allen and Lueck (1999) who studied the crop share and cash-rent land contracts and found no evidence of the ratchet effect.

An interesting characteristic of many agricultural contracts is that they are always explicitly uniform and short-term. This means that all agents contracting with the same principal are operating under formally identical contract provisions, and contracts cover only one flock or one batch at a time (Levy and Vukina, 2002). In dynamic incentive problems (such as repeated production contracts), unless the principal can fully commit not to change the contract provisions for the entire duration of the relationship, in which case a dynamic incentive problem becomes essentially static, implicit incentives become potentially important even when explicit incentives can be provided. This is due to the fact that the current performance affects not only the current reward, but also may affect the terms of the future explicit or implicit incentive contract.

Because complete contracts are very difficult to write, explicit uniform contracts do

not necessarily guarantee that all agents will be treated equally. When the principal and agents contract repeatedly, an explicitly uniform but incomplete contract leaves the possibility to the principal to treat agents differently after learning about their abilities over time. For example, the principal may assign more difficult tasks to higher-ability agents or may strategically distribute variable quality inputs such that they end up in the hands of agents who can make the best use of them. Depending on the production technology, such discrimination of agents can cause hidden incentives of either a positive (career concerns) or negative (ratchet effect) type.

In fact, the complaints of contract broiler growers that they have been treated unfairly at the hands of processors have been well documented by Lewin (2000) and Tsoulouhas and Vukina (2001). One of the arguments frequently raised was that the settlements of these contracts were biased because the initial quality and distribution of production inputs were not stipulated by the contract but were exclusively under control of the processor.

The objective of this chapter is to test whether integrators, after observing their contract growers' abilities in the sequences of repeated short-term contracts, improve their profitability by systematically discriminate among growers by strategically distributing production inputs of varying quality. The discrimination may take one of two forms: 1) a strategy that provides high-ability agents with high-quality inputs and low-ability agents with low-quality inputs, or 2) a reciprocal strategy that provides low-ability agents with high-quality inputs and high-ability agents with low-

quality inputs. The first integrator's strategy would stimulate a career concerns type of response on the part of the growers, whereas the second strategy would generate a ratchet effect type of response. Which strategy the integrator pursues will entirely depend upon the nature of the production technology.

Unlike other researches on dynamic incentives which are chiefly concerned with the properties of optimal dynamic contracts, the theoretical model of this research emphasizes the optimal response of an agent faced with a given (observed) short-term contract and future actions of a non-committal principal. Our two-period model is based on the backward-looking (passive) target setting revision rule similar to Weitzman (1980). We showed that in a career concerns type of environment, the agents' optimal dynamic responses lead to a separating equilibrium where the correct ranking with respect to agent abilities is obtained, enabling the principal to engage in a strategic distribution of inputs. In a ratchet effect type of environment, higher values of the discount factor and the ratchet coefficient increase the likelihood of a pooling equilibrium where all agents exert zero effort in the first period. Separating equilibrium is possible for lower values of said parameters, but the aggregate effort exerted by agents is smaller than in the full commitment case, so the discrimination of agents would not pay even if the principal could discern their abilities.

Empirical testing is carried out using the contract production data for broiler chickens.<sup>2</sup> Our econometric model specifies the quality of production inputs received

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<sup>2</sup>The USDA, Grain Inspection, Packer and Stockyards Administration provide the data set used in this chapter through the cooperative agreement No.99-ESS-02.

by a grower as a function of his abilities. We measure abilities as the growers' fixed effects in the production function or in the settlement cost panel data regression model. The quality of production inputs is approximated by the quality of chicks delivered to a farm. The results show that there is no significant input discrimination among growers based on their abilities that would lead to either career concerns or ratchet effect type of dynamic incentives.

## 3.2 Contract in the Broiler Industry

The broiler industry is often considered a role model for the industrialization of agriculture. The industry is entirely vertically integrated from breeding flocks and hatcheries to feed mills, transportation divisions, and processing plants. A large proportion of the industry's value comes from the processing sector, which explains why processors became the coordinators of the industry. The finishing stage of the production process is organized almost entirely through contracts between processors and independent growers.<sup>3</sup> Large national companies, such as Tyson and Perdue, dominate broiler contract production. These companies run their operations through smaller profit centers spread throughout the country.

Modern broiler production contracts are agreements between an integrator and growers. These contracts bind growers to tend for a company's chickens until they

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<sup>3</sup>Finishing is the final stage of the production process where one-day old chicks are brought to the farm and grown to market weight.

reach market weight by strictly following specific production practices in exchange for monetary compensation. Each profit center offers a uniform contract to all prospective growers on a take-it-or-leave-it basis. Contracts have two main components: 1) the division of responsibility for providing inputs, and 2) the use of tournaments to determine grower compensation. Broiler production contracts require growers to construct and equip chicken houses and supply labor and management. They are also responsible for utilities, repair and maintenance, and waste disposal. The integrator's responsibility is to provide baby chicks, feed, medication, and the services of field personnel (Vukina, 2001).

Most of the modern broiler contracts are settled using a two-part piece-rate tournament consisting of a fixed base payment per pound of live meat produced and a variable bonus payment based on the grower's relative performance. The bonus payment, usually called "the adjusted prime cost rating", is calculated as a percentage of the difference between group average settlement costs and grower's individual settlement costs. Settlement costs for each grower are calculated by adding chicks, feed, fuel, medication, and other flock costs divided by total pounds of live broilers produced. The calculation of the group average settlement costs includes growers whose flocks were harvested within the same week. For the below average settlement costs, the grower receives a bonus; for the above average settlement costs, he receives a penalty. The number of growers in the settlement group ranges between 10-35 depending on the size of the integrator as well as other logistical and market conditions.

Specifically, the payment to grower  $k$  for flock  $t$  is calculated as:

$$R_{kt} = [I + \Delta_t + r(\frac{1}{n} \sum_j \frac{c_{jt}}{Y_{jt}} - \frac{c_{kt}}{Y_{kt}})]Y_{kt}$$

where  $I$  is the base payment;  $r \in [0, 1]$  is the slope of the payment scheme that determines the relative importance of the bonus payment in the total grower's compensation;  $Y_{kt}$  is the number of live pounds of broilers produced;  $c_{kt}$  is the cost of inputs supplied by the integrator to grower  $k$  (chicks, feed, medication, etc.);  $\frac{1}{n} \sum_j \frac{c_{jt}}{Y_{jt}}$  is the flock average per pound settlement cost; and  $\Delta_t$  is the market price adjustment specified as the percentage difference between the market price for broilers and the integrator's average variable production costs.<sup>4</sup>

An interesting feature of broiler contracts is that most of them are *short-term* (i.e., most contracts cover one flock at a time). Contracts generally do not guarantee to the growers a fixed number of flocks per year, hence the decision about the volume of production (rotation of flocks on a farm) is determined solely by the integrator. This flexibility is important to the integrators because by delaying the delivery of new flocks to growers, they can manipulate their supplies in response to the market signals. In most instances, after one flock is harvested, the contract gets tacitly renewed and the grower receives a new flock. The cases of grower terminations are quite rare and are typically caused by a major violation of the contract stipulations (e.g., gross negligence or theft of feed or birds) or by the closure of a profit center or the bankruptcy of the company. It is not unusual for the contract growers to

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<sup>4</sup>The market price clause " $\Delta_t$ " is a relatively new modification to a standard broiler tournament contract and does not exist in all contracts.

spend their entire career growing chickens for one integrator. Therefore, over time, the integrator can develop a precise knowledge of growers' abilities. However, the explicit contracts almost never change despite the fact that the integrators may be able to benefit from offering different contracts to different types of growers.

### **3.2.1 Distribution of Inputs**

Aside from the standard moral hazard type of problems associated with growers' efforts being unobservable by the integrator, from the perspective of this study, the asymmetry of information regarding the provision of the integrator's inputs is particularly important. For example, growers usually observe only the quantity of inputs they receive at the time of delivery, but not necessarily the quality of inputs. The quality will be fully revealed to them during the production phase and especially after the performance results are compared against historical averages of previous flocks. The growers' complaints about the provision of inputs have been documented in trade magazines and academic literature (see Ilvento and Watson (1998) and FLAG (2001)). An industry survey conducted by Ilvento and Watson reveals that approximately 40% of growers felt that the quality of chicks was not evenly distributed among growers, and 50% were doubtful about the fairness of the process. About 40% of growers questioned the matching of feed weight tickets and actual feed deliveries to farms, whereas several growers felt that good-quality chicks were consistently delivered to newer broiler houses.

These and similar complaints may be well founded. Because the written contracts specify no commitment from the integrator regarding the fair distribution of inputs, having the information about growers' abilities may allow the integrator to discriminate among them by strategically distributing uneven quality inputs to minimize the cost of production. The variation in the quality of inputs can be significant, especially when it comes to baby chicks and feed. The direction of discrimination, if it in fact exists, will depend on the characteristics of the broiler production technology.

For the purposes of this research, it is useful to think about two technological scenarios, which can be defined by the relationships among marginal products. Introducing  $y_i$  to symbolize the production of high ability agent,  $y_j$  the production of low ability agent,  $x_H$  the high quality input, and  $x_L$  the low quality input, *technology A* can be defined by:  $\frac{\partial y_i}{\partial x_H} \geq \frac{\partial y_j}{\partial x_H}$ ,  $\frac{\partial y_i}{\partial x_L} = \frac{\partial y_j}{\partial x_L}$  and  $\frac{\partial y_i}{\partial x_H} > \frac{\partial y_i}{\partial x_L}$ ,  $\frac{\partial y_j}{\partial x_H} > \frac{\partial y_j}{\partial x_L}$ ; and *technology B* by:  $\frac{\partial y_i}{\partial x_H} = \frac{\partial y_j}{\partial x_H}$ ,  $\frac{\partial y_i}{\partial x_L} \geq \frac{\partial y_j}{\partial x_L}$  and  $\frac{\partial y_i}{\partial x_H} > \frac{\partial y_i}{\partial x_L}$ ,  $\frac{\partial y_j}{\partial x_H} > \frac{\partial y_j}{\partial x_L}$ . The first two conditions for technology A indicate that the marginal product of high-quality input when used by a high-ability grower is larger (or equal) than when used by the low-ability grower, whereas the marginal product of the low-quality input is the same for both types. The interpretation of the first two conditions for technology B is exactly the opposite. The last two conditions are the same for both technologies and indicate that both high and low-ability growers will do better with high-quality input than with low-quality input.

Assuming integrator's profit maximizing/cost minimizing behavior and a given

distribution of input quality, technology A would imply an obvious strategy of giving high-quality inputs to high-ability growers and low-quality inputs to low-ability growers (strategy A). In contrast, if technology B were the correct representation of the production process, an efficient strategy would require giving high-quality inputs to low-ability growers and low-quality inputs to high-ability growers (strategy B). The integrators will implement strategy A if they know that the high-ability growers can utilize the high-quality inputs more effectively than the low-ability growers, whereas their performances are indistinguishable when both use the low-quality input. The integrators will implement strategy B if they believe that high-ability growers may somehow salvage low-quality chicks from performing very poorly, whereas the high-quality chicks will perform well no matter who tends them. The detailed technological characteristics of the broiler production process are not observable by outsiders, hence we as researchers are unsure which technology more closely describes the broiler production and consequently which strategy is more likely to be pursued by integrators.

In summary, the integrators who are tournament organizers would update their beliefs about grower's abilities based on settlement costs in repeated tournaments, and absent significant transaction costs may have correct incentives to strategically distribute inputs to growers according to their types. If the production of broilers is characterized by technology A, the resulting integrator's strategic allocation of varying quality inputs should create a career concerns type of dynamic incentive for the growers because doing well in the current tournament has double benefits. When

a grower manages to produce broilers at below average settlement cost, he will not only earn the current period bonus but will also improve his chances of receiving high-quality inputs in the next period tournament. Contrary to this, the integrator's strategic distribution of inputs aligned with technology B should generate a ratchet effect type of dynamic incentive. This is because the benefits of doing well in the current tournament (thereby signaling one's high ability) are, to a certain degree, offset by an increasing chance of being stuck with low-quality input in the next period tournament.

### 3.3 Model

The production of broiler chickens is organized via short-term (one flock at a time) contracts, and payment is based on a piece-rate (cardinal) tournament. Prior to the beginning of production, the integrator offers an identical contract to all growers. For simplicity, we assume that in each tournament the competition takes place only between two growers,  $k = i$  and  $j$ , randomly drawn from the population of  $z$  growers that grow chickens for that integrator. We also assume that the contract will be automatically renewed for one more flock, such that the total number of time periods (flocks) in our model is two,  $t = 1$  and 2. The payment scheme is in the following form

$$R_{kt} = I + r(y_{kt} - y_{-kt}) \quad (3.1)$$

where  $R_{kt}$  is the payment to grower  $k$  in period  $t$ ,  $I$  is the base payment,  $r$  is the slope of the bonus payment, and  $y_{kt}$  is the level of output. The bonus payment is determined as a percentage of the difference between growers' output levels.<sup>5</sup> It is obvious that the aggregate bonus payment is a wash, that is, the winner's bonus will exactly cancel the loser's penalty and the total integrator's compensation expenditure in a given tournament is only  $2 \times I$ .

The production of broilers is assumed to be a function of the fixed quantity of inputs provided by the integrator to each grower,  $X = x_H + x_L$ , and the grower's effort where  $e_{kt} \in [0, \infty]$ . For simplicity, we also assume that in each period, the integrator owns  $2X$  units of input, half of which is high quality, and half is low quality. The previously discussed technology A is represented by the following production function:

$$y_{kt} = \theta_k e_{kt} x_H + \frac{1}{m} x_L + u_t + \zeta_{kt} \quad (3.2)$$

and technology B by:

$$y_{kt} = \theta_k e_{kt} x_L + \frac{1}{n} x_H + u_t + \zeta_{kt} \quad (3.3)$$

where  $\theta_i > 1$  and  $\theta_j = 1$  is the ability of grower  $k$  defined such that grower  $i$  has higher ability than grower  $j$ , and the difference in abilities between the two growers is reasonable small. The marginal products of "effortless" inputs ( $x_L$  in technology

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<sup>5</sup>Notice that the payment mechanism that we use is a somewhat simplified version of the actual scheme described in Section 3.2. The main difference comes from our assumption that the total quantity of inputs delivered is fixed, and the competition among growers is about producing more output (heavier birds). Other studies dealing with broiler tournaments (e.g., Knoeber and Thurman, 1994 and Tsoulouhas and Vukina, 1999) have assumed that the output is fixed and that the growers compete for better feed efficiency. The latter approach implicitly assumes constant percentage mortality across all growers, whereas this study assumes constant feed utilization across all growers, both of which are, to a certain extent, simplifications of reality.

A and  $x_H$  in technology B),  $\frac{1}{m}$  and  $\frac{1}{n}$  respectively, are such that  $m > n > 0$ . The common production shocks  $u_t$  and grower idiosyncratic shocks  $\zeta_{kt}$  are both *iid* with mean zero and finite variance.

The *priori* technology restrictions discussed earlier can be summarized as follows. In the case of technology A,  $\frac{\partial y_i}{\partial x_H} \geq \frac{\partial y_j}{\partial x_H}$  will be satisfied if  $e_{it} \geq e_{jt}$ . Meanwhile,  $\frac{\partial y_i}{\partial x_L} = \frac{\partial y_j}{\partial x_L} = \frac{1}{m}$  is automatically satisfied, and  $\frac{\partial y_k}{\partial x_H} > \frac{\partial y_k}{\partial x_L}$  requires  $\theta_k e_{kt} > \frac{1}{m}$ . Similarly in case of technology B, in order for  $\frac{\partial y_i}{\partial x_L} \geq \frac{\partial y_j}{\partial x_L}$  to hold, we need  $e_{it} \geq e_{jt}$ . Also,  $\frac{\partial y_i}{\partial x_H} = \frac{\partial y_j}{\partial x_H} = \frac{1}{n}$  is automatically satisfied, and  $\frac{\partial y_k}{\partial x_H} > \frac{\partial y_k}{\partial x_L}$  requires  $\frac{1}{n} > \theta_k e_{kt}$ .

Growers are assumed to be risk neutral with identical utility functions  $U(R_{kt} - C(e_{kt}))$ , where  $C(e_{kt}) = X(\frac{e_{kt}^2}{2})$  represents the total cost (disutility) of effort. The exertion of effort is essential for the cost to exist,  $C(e_{kt} = 0) = 0$ , cost is increasing in effort,  $\frac{\partial C}{\partial e_{kt}} > 0$ , and convex,  $\frac{\partial^2 C}{\partial e_{kt}^2} > 0$ .

Since we do not address the problem of optimal contract design, the formal treatment of the integrator's optimization problem is conveniently ignored. It will suffice to say that the integrator is interested in maximizing two-period profits by deciding how to allocate the varying quality inputs among growers of different abilities. The institutional structure (repeated one-flock contracts) enables the integrator to learn about growers' abilities over time and then decide whether to stay with the original contract stipulations or to use this information to change the contract to his advantage. In the first case we will say that the integrator can fully and credibly commit to follow the original contract. In this case a dynamic incentives problem becomes

essentially *static*. In the second case we will say that the integrator cannot commit to the original contract but can, in a sense, commit to some passive target setting rule that the agents will discover in equilibrium.

### 3.3.1 Full Commitment

The explicit (written) contracts observed in the broiler industry do not specify any particular scheme of input distribution among growers. For simplicity, let's assume that the integrator can credibly commit to an even distribution of inputs. In the framework of this model, this amounts to supplying each grower with half of high-quality input and half of low-quality input in both time periods, that is  $x_H = x_L = \frac{X}{2}$ . This scheme serves the purpose of extracting information about grower abilities because it does not bias the outcome of the tournament in favor of either contestant. This scheme is also attractive because it sounds inherently fair.

Each grower maximizes his utility by solving the following two-period problem

$$\max_{e_{k1}, e_{k2}} ([I + r(y_{k1} - y_{-k1}) - C(e_{k1})] + \delta [I + r(y_{k2} - y_{-k2}) - C(e_{k2})]) \quad (3.4)$$

where  $k = i, j$ ,  $\delta \in [0, 1]$  is a discount factor. Given full commitment on the part of the integrator about not altering the distribution of inputs in the second time period, and given the assumptions about *iid* shocks, the two-period problem becomes essentially static. This means that the maximization problem that each grower is facing in period  $t = 1$  is independent from the problem in  $t = 2$ . For both technologies specified by the production functions (3.2) and (3.3) and grower cost function, the first-order

conditions are:

$$\frac{r\theta_k}{2} - e_{k1} = 0; k = i, j \quad (3.5)$$

$$\frac{r\theta_k}{2} - e_{k2} = 0; k = i, j \quad (3.6)$$

Due to the fact that the program is concave, the first-order conditions are sufficient.

Based on (3.5) and (3.6), we can state the following proposition:

**Proposition 1:** Given a uniform tournament payment mechanism and a full commitment not to change the provision of variable quality inputs in the second time period, the optimal effort level  $e_{kt}^*$  is increasing with grower's ability but is constant across time periods.

**Proof:** From the first order conditions (3.5) and (3.6), the closed form solutions for optimal effort levels are  $e_{k1}^* = e_{k2}^* = \frac{r\theta_k}{2}; k = i, j$  for both technologies. Because the marginal reward for winning the tournament is the same for both growers regardless of their type and unchanged in both periods, the decision to exert effort depends solely on ability. Since  $\theta_j = 1$  and  $\theta_i > 1$ , it follows that  $e_{it}^* > e_{jt}^*$  for all  $t$ .

**Q.E.D.**

It is easy to see that in the full commitment case there are no implicit dynamic incentives of any kind. When exerting effort in the first period, growers are only concerned with winning the tournament in period  $t = 1$ , ignoring possible implications that this outcome may have for the allocation of inputs in future tournaments. This is because they trust the integrator's commitment not to alter the allocation of inputs

based on the information about growers' abilities that may have been acquired in the first period.

### 3.3.2 Career Concerns

In this section we assume that the technology of broiler production is adequately represented by production function (3.2). As mentioned earlier, technology A would create incentives for the integrator to engage in the strategic distribution of inputs such that the high-ability agent ends up with high-quality input and low-ability agent with low-quality input. In particular, we assume that the integrator cannot commit to the even distribution of varying quality input, but instead operates under a passive target setting rule similar to that of Weitzman (1980).

$$x_{H,2} = \frac{X}{2} + \beta(y_{k1} - y_{-k1}) \quad (3.7)$$

$$x_{L,2} = \frac{X}{2} - \beta(y_{k1} - y_{-k1}) \quad (3.8)$$

The adjustment coefficient  $\beta > 0$  is treated as a behavioral parameter of the integrator that converts the difference in the volume of output between two growers that resulted from the fair distribution of inputs ( $\frac{X}{2}$ ) in the first period into a deviation from the fair distribution in the second period. The magnitude of  $\beta$  measures the strength of the positive implicit incentive effect (i.e., career concerns). The growers do not know the rule exactly. They only know that winning the tournament in the first period means that their percentage of high-quality input in a flock given in the second period will improve from 50%.

In this environment, each risk neutral grower solves the problem identical to the one in (3.4). Let  $E_k(\beta) = \tilde{\beta}_k$  denote individual grower's expectation about the distribution rule. In equilibrium, the expectations about  $\beta$  are aligned such that  $\tilde{\beta}_i = \tilde{\beta}_j = \beta$ . The production technology A in (3.2) implies that  $E_k(y_{k1} - y_{-k1}) = \frac{X}{2}(\theta_k e_{k1} - \theta_{-k} e_{-k1})$ . From the rule in (3.7) and (3.8), the result of competition in  $t = 1$  will determine the composition of inputs obtained in  $t = 2$  which affects output in  $t = 2$ . This can be seen from:

$$\begin{aligned} E_k(y_{k2} - y_{-k2}) &= \frac{X}{2}(\theta_k e_{k2} - \theta_{-k} e_{-k2}) \\ &\quad + \frac{\beta X}{2}(\theta_k e_{k1} - \theta_{-k} e_{-k1})(\theta_k e_{k2} + \theta_{-k} e_{-k2}) \\ &\quad - \frac{\beta X}{m}(\theta_k e_{k1} - \theta_{-k} e_{-k1}) \end{aligned} \quad (3.9)$$

Using both expressions from (3.9), the first-order conditions are:

$$\frac{r\theta_k}{2} \left[ 1 + \delta\beta(\theta_k e_{k2} + \theta_{-k} e_{-k2} - \frac{2}{m}) \right] - e_{k1} = 0 \quad (3.10)$$

$$\frac{r\theta_k}{2} [1 + \beta(\theta_k e_{k1} - \theta_{-k} e_{-k1})] - e_{k2} = 0 \quad (3.11)$$

where  $k = i, j$ . The comparison of the first-order conditions in the full commitment case (3.5) and (3.6) with (3.10) and (3.11) reveals the magnitude of the implicit dynamic incentive effect of the career concerns type via the expressions in the square brackets. The effect is caused by the effort exerted in  $t = 1$  now affecting the allocation of inputs in  $t = 2$ . We solve for the equilibrium in the Cournot-Nash sense<sup>6</sup> where

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<sup>6</sup>Another stronger equilibrium concept is the Subgame Perfect Equilibrium (SPE). One can think that our solution falls into the SPE in the following: Given that grower  $i$  wins the first tournament,

each grower takes the other grower's effort as given. Then, each grower's own effort is the best response to the effort he expects his opponent would exert. The closed-form solutions for the optimal effort levels are

$$e_{i1}^{**} = -\frac{r\theta_i[2(m - 2\beta\delta) + mr\beta\delta(\theta_i^2 + \theta_j^2)]}{m[-4 + r^2\beta^2\delta(\theta_i^2 - \theta_j^2)^2]} \quad (3.12)$$

$$e_{i2}^{**} = \frac{r\theta_i[-2m - r\beta(\theta_i^2 - \theta_j^2)(m - 2\beta\delta + mr\beta\delta\theta_j^2)]}{m[-4 + r^2\beta^2\delta(\theta_i^2 - \theta_j^2)^2]} \quad (3.13)$$

$$e_{j1}^{**} = -\frac{r\theta_j[2(m - 2\beta\delta) + mr\beta\delta(\theta_i^2 + \theta_j^2)]}{m[-4 + r^2\beta^2\delta(\theta_i^2 - \theta_j^2)^2]} \quad (3.14)$$

$$e_{j2}^{**} = \frac{r\theta_j[-2m + r\beta(\theta_i^2 - \theta_j^2)(m - 2\beta\delta + mr\beta\delta\theta_i^2)]}{m[-4 + r^2\beta^2\delta(\theta_i^2 - \theta_j^2)^2]} \quad (3.15)$$

where the superscript \*\* on  $e$  is interpreted as an optimal level in the non-commitment case. Since technology A is characterized by  $\frac{\partial y_k}{\partial x_H} > \frac{\partial y_k}{\partial x_L}$  which requires  $\theta_k e_{kt} > \frac{1}{m}$ , it immediately follows that  $e_{kt}^{**}$  must be strictly more than 0, for all  $k = i, j$ ;  $t = 1, 2$ . In order for all equilibrium efforts to be positive, the integrator has to choose the adjustment coefficient such that it lies in the range  $\beta \in (0, \bar{\beta}]$ .<sup>7</sup> Based on (3.12)-(3.15), we can derive two propositions. They are as follows:

**Proposition 2:** Under a career concerns type of dynamic incentives ( $\beta > 0$ ), the equilibrium effort levels are such that in both periods, the high-ability agent exerts

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grower  $j$  best strategy in the 2<sup>nd</sup> period is to exert the optimal effort level realizing that he has more of low-quality inputs to work with. Grower  $i$ , knowing that he has more of high-quality inputs, will exert the optimal effort as well. There is no "bidding" on effort level in the second period because the game ends here. In the first period, growers do not know who they will compete with before entering the contractual relationship, their best strategy is to exert their optimal effort, assuming others do the same. In this case, the scenario of not exerting effort (or under exerting effort) by both growers will not occur because they would not pursue their best strategies by equating marginal benefit of exerting effort with marginal cost in the first period.

<sup>7</sup>Because  $e_{j2}^{**}$  is decreasing, the marginal condition  $\theta_j e_{j2}^{**} > \frac{1}{m}$  might be violated. The upper bound on  $\beta$  is obtained by using expression (3.15) to solve for  $\bar{\beta}$  from the above marginal condition.

higher effort than the low-ability agent.

**Proof:** From the closed form solution in (3.12) and (3.14), we obtain the expression that  $\frac{e_{i1}^{**}}{e_{j1}^{**}} = \frac{\theta_i}{\theta_j}$  where  $\theta_i > 1$ , and thus,  $e_{i1}^{**} > e_{j1}^{**}$ . From the first-order condition in (3.11) and  $e_{i1}^{**} > e_{j1}^{**}$ , it is obvious that the second period effort of grower  $i$  is higher than that of grower  $j$  (i.e.,  $e_{i2}^{**} > e_{j2}^{**}$ ).

***Q.E.D.***

Proposition 2 indicates that even when the agents anticipate the distortion of input allocation in the future, they still exert effort such that the correct ordering of abilities is preserved. By observing the outcome of the tournament in the first period the integrator can decipher growers' types and distribute inputs according to their preferred strategy. Given the fact that the high-ability agent exerts higher effort than the low-ability agent, it follows that the high-ability agent wins the tournament, thereby revealing his type as high-ability type.<sup>8</sup> The integrator will use this information to change the allocation of inputs from 50:50 in favor of giving the high-ability type more of the high-quality input in the second period at the expense of giving the low-ability type more of the low-quality input.

**Proposition 3:** Under the career concern type of dynamic incentives, effort levels are such that in the first period, both agents exert higher effort than in the

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<sup>8</sup>In the two-period model such as ours, this statement is not exactly true. Due to the presence of idiosyncratic shocks, it is possible that the high-ability agent even by exerting higher effort than low-ability agent may still lose because of bad luck. This could send a wrong signal to the integrator and his input allocation strategy will end up being erroneous. As the number of tournaments played increases, the idiosyncratic shock will eventually fade, as its mean equals zero, and the ordering of outputs in the tournament would accurately reflect the ordering of abilities.

full commitment case. In the second period, the high-ability agent still exerts more effort but the low-ability agent exerts less effort than in the full commitment case. Aggregate two-period output in the non-commitment case is however larger than in the full commitment case.

**Proof:** The proof of  $e_{i1}^{**} > e_{i1}^*$  and  $e_{j1}^{**} > e_{j1}^*$  follows from equation (3.10). The value of the marginal benefit from exerting effort in  $t = 1$  for grower  $k = i, j$  increases compared to that of the full commitment scenario by  $\frac{r\beta\delta\theta_k}{2}(\theta_k e_{k2}^{**} + \theta_{-k} e_{-k2}^{**} - \frac{2}{m})$ . This is because of the prior restriction that  $\theta_k e_{kt} > \frac{1}{m}$  and consequently  $(\theta_k e_{k2}^{**} + \theta_{-k} e_{-k2}^{**} - \frac{2}{m}) > 0$ .

To prove  $e_{i2}^{**} > e_{i2}^*$  and  $e_{j2}^{**} < e_{j2}^*$ , we use equation (3.11). The low-ability grower loses the tournament in the first period and therefore, his second period effort will be reduced from the full commitment level by  $\frac{r\beta\theta_j}{2}(\theta_i e_{i1}^{**} - \theta_j e_{j1}^{**})$ . The high-ability grower wins the tournament in the first period and therefore, his second period effort will be increased by  $\frac{r\beta\theta_i}{2}(\theta_i e_{i1}^{**} - \theta_j e_{j1}^{**})$  from the full commitment level.

The strategy of creating positive dynamic incentives will clearly increase the aggregate output in the first period because both efforts are higher relative to the full commitment case. The strategy will also increase the output of the high-ability agent in the second period (because of both higher proportion of  $x_H$  and higher effort) at the expense of decreasing the output of the low-ability agent in the second period. To prove that the aggregate two-period output in the career concerns case is larger than in the full commitment case, it is sufficient to show that the second period ag-

gregate output is larger than in the full commitment case. From the target setting rule in (3.7) and (3.8) and the first order condition in (3.11), we obtain the expression for the expected aggregate production in the second period under a career concerns type of dynamic incentive that  $y_{i2} + y_{j2} = \frac{rX}{4}(\theta_i^2 + \theta_j^2) + \frac{rX\beta}{2}(\theta_i e_{i1}^{**} - \theta_j e_{j1}^{**})(\theta_i^2 - \theta_j^2) + \frac{rX\beta^2}{4}(\theta_i e_{i1}^{**} - \theta_j e_{j1}^{**})(\theta_i^2 + \theta_j^2) + \frac{X}{m}$ . If  $\beta = 0$ , the above expression would reduce to the full commitment case level of second period output where only the first and the last elements of the sum on the right hand side survive, the rest of them equal zero. Clearly, the aggregate second-period output in the non-commitment case is larger than in the full commitment case because all other terms in the above sum are positive.

***Q.E.D.***

Proposition 3 indicates that the strategy of discriminating among growers based on their abilities by delivering high-quality input to high-ability agents and low-quality input to low-ability agents is profitable to the integrator, hence the incentives to discriminate are correctly aligned.<sup>9</sup>

### 3.3.3 Ratchet Effect

In this section we assume that the technology of broiler production is adequately represented by production function (3.3). Technology B may create incentives for the integrator to engage in the strategic distribution of inputs such that high-ability agent

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<sup>9</sup>Notice that within the structure of this model, comparing profits of the integrator between the two scenarios is the same as comparing outputs (efforts) because the total inputs utilized are fixed at  $2X$  and so are the total payments to the growers ( $2I$ ).

ends up with low-quality input and low-ability agent with high-quality input. Similar to the career concerns type of environment, here we assume that the integrator cannot commit to the even distribution of varying quality input but instead operates under the target setting rule similar to (3.7) and (3.8):

$$x_{H,2} = \frac{X}{2} - \gamma(y_{k1} - y_{-k1}) \quad (3.16)$$

$$x_{L,2} = \frac{X}{2} + \gamma(y_{k1} - y_{-k1}) \quad (3.17)$$

In this case,  $\gamma > 0$  measures the strength of the negative implicit incentive effect (i.e., the ratchet effect).

The first-order conditions for the grower maximization problem are:

$$\frac{r\theta_k}{2} \left[ 1 + \delta\gamma(\theta_k e_{k2} + \theta_{-k} e_{-k2} - \frac{2}{n}) \right] - e_{k1} = 0 \quad (3.18)$$

$$\frac{r\theta_k}{2} [1 + \gamma(\theta_k e_{k1} - \theta_{-k} e_{-k1})] - e_{k2} = 0 \quad (3.19)$$

where  $k = i, j$ . The closed form solutions for optimal effort levels are the same as in (3.12)-(3.15). Because of the marginal condition that  $\frac{1}{n} > \theta_k e_{kt}$  characterizes technology B, it is actually possible for the equilibrium efforts to be zero. The critical relationship determining the type of equilibrium that will emerge is easily derivable from (3.18):

$$\frac{1}{\delta\gamma} < \left( \frac{2}{n} - \theta_i e_{i2}^{**} - \theta_j e_{j2}^{**} \right) \quad (3.20)$$

Condition (3.20) can be used to formulate three propositions. They are as follows:

**Proposition 4a:** Under ratchet effect type of dynamic incentives ( $\gamma > 0$ ), condition (3.20) guarantees that the equilibrium effort levels in the first period are both zero. In the second period, equilibrium efforts are at the full commitment levels.

**Proof:** If (3.20) holds,  $e_{i1}^{**} = e_{j1}^{**} = 0$ ,  $e_{i2}^{**} = \frac{r\theta_i}{2}$ , and  $e_{j2}^{**} = \frac{r\theta_j}{2}$ .

**Q.E.D.**

It is easy to see that the likelihood of pooling equilibrium at zero effort depends on the magnitude of the discount factor and the ratchet effect coefficient. The values of  $\delta$  closer to unity means that future events are less discounted, hence the punishment associated with revealing one's high type and receiving the low-quality input in the second period is more important. Similarly, higher values of  $\gamma$  generate dynamic incentives that make the pooling equilibrium more likely as well.<sup>10</sup> This is because larger  $\gamma$  means stronger departure from the equitable distribution of inputs in the second period based on the tournament outcome in the first period. Again, the incentives not to win the tournament and reveal the high type are strong compared to the benefits associated with winning the tournament in the first period but losing in terms of receiving a large proportion of low-quality input in the second period. Very similar results are obtained by Freixas, Guesnerie, and Tirole (1985) in a substantially more complicated model.

**Proposition 4b:** When condition (3.20) does not hold, the ratchet effect type of

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<sup>10</sup>Notice that, unlike in the career concerns case, there is no upper bound on the value of  $\gamma$  in the ratchet effect type of environment since (3.20) automatically forces both growers to exert zero effort, and all marginal conditions are satisfied.

dynamic incentives generates a separating equilibrium where, in both time periods, the high-ability agent exerts higher effort than the low-ability agent.

**Proof:** From (3.18), it follows that  $[1 + \delta\gamma (\theta_k e_{k2} + \theta_{-k} e_{-k2} - \frac{2}{n})] > 0$  and  $\frac{e_{i1}^{**}}{e_{j1}^{**}} = \frac{\theta_i}{\theta_j}$  where  $\theta_i > 1$  and thus  $e_{i1}^{**} > e_{j1}^{**}$ . From (3.11) and  $\theta_i > 1$  and thus  $e_{i1}^{**} > e_{i2}^{**}$ , it follows that  $e_{i2}^{**} > e_{j2}^{**}$ .

**Q.E.D.**

**Proposition 5:** Under the ratchet effect type of dynamic incentives, effort levels in both pooling and separating equilibria are such that, in the first period, both agents exert lower effort than in the full commitment case. In the second period, in the pooling equilibrium, both agents exert the full commitment level of effort, and in the separating equilibrium, the high-ability agent exerts higher effort and the low-ability agent exerts lower effort than in the full commitment level. Aggregate two-period output in the non-commitment case is smaller than in the full commitment case.

**Proof:** See Proposition 4a for the case of a pooling equilibrium. For the case of a separating equilibrium,  $e_{i1}^{**}$  and  $e_{j1}^{**}$  always decrease from the full commitment level because using (3.18) and (3.20), we obtain  $e_{i1}^* - e_{i1}^{**} = \frac{r\delta\gamma\theta_i}{2} (\frac{2}{n} - \theta_i e_{i2} - \theta_j e_{j2}) > 0$  and  $e_{j1}^* - e_{j1}^{**} = \frac{r\delta\gamma\theta_j}{2} (\frac{2}{n} - \theta_i e_{i2} - \theta_j e_{j2}) > 0$  whereas  $(\theta_k e_{k2} + \theta_{-k} e_{-k2} - \frac{2}{n}) < 0$  because of the prior marginal restriction of technology B. To prove that  $e_{j2}^{**} < e_{j2}^*$  and  $e_{i2}^{**} > e_{i2}^*$ , from (3.19), we see that grower  $j$  reduces his effort from the full commitment level by  $\frac{r\gamma\theta_j}{2} (\theta_i e_{i1}^{**} - \theta_j e_{j1}^{**})$ , whereas grower  $i$  increases his effort by  $\frac{r\gamma\theta_i}{2} (\theta_i e_{i1}^{**} - \theta_j e_{j1}^{**})$ .

In the case of a pooling equilibrium, the aggregate outputs in the first and second period are  $y_{i1} + y_{j1} = \frac{X}{n}$  and  $y_{i2} + y_{j2} = \frac{rX}{4}(\theta_i^2 + \theta_j^2) + \frac{X}{n}$  which is clearly less than the full commitment aggregate level of output  $\frac{rX}{2}(\theta_i^2 + \theta_j^2) + \frac{2X}{n}$ . In the separating equilibrium, the aggregate outputs are  $y_{i1} + y_{j1} = \frac{rX}{4}(\theta_i^2 + \theta_j^2) - \frac{r\delta\gamma X}{4}(\theta_i^2 + \theta_j^2) \left[ \frac{2}{n} - \theta_i e_{i2}^{**} - \theta_j e_{j2}^{**} \right] + \frac{X}{n}$  and

$y_{i2} + y_{j2} = \frac{rX}{4}(\theta_i^2 + \theta_j^2) + \frac{r\gamma X(\theta_i^2 - \theta_j^2)}{2} \left[ \frac{r(\theta_i^2 - \theta_j^2)}{2} (\delta\gamma \left( \frac{2}{n} - \theta_i e_{i2}^{**} - \theta_j e_{j2}^{**} \right)) \right] + \frac{rX\gamma^2(\theta_i^2 + \theta_j^2)}{4} \left[ \frac{r(\theta_i^2 - \theta_j^2)}{2} (\delta\gamma \left( \frac{2}{n} - \theta_i e_{i2}^{**} - \theta_j e_{j2}^{**} \right)) \right] + \frac{X}{n}$ . It can easily be verified that the second term in the expression for  $y_{i1} + y_{j1}$  will always outweigh the second and third term in the expression for  $y_{i2} + y_{j2}$ .

***Q.E.D.***

The results obtained in this section indicate that if broiler production is adequately described by technology B, then the integrator's incentives to engage in a discriminatory allocation of inputs are rather limited under non-commitment case. One situation is described by a pooling equilibrium where the ratchet effect type of dynamic incentives would motivate agents to totally shirk in the first period in order not to reveal their types. In this case, the discrimination is impossible because the integrator cannot distinguish between high-ability and low-ability types. Another situation is characterized by a separating equilibrium where the correct ordering of types according to abilities is secured. However, in pursuing the discrimination by delivering low-quality input to the high-ability agent, and high-quality input to the low-ability agent, the integrator's profits do not exceed the profits under the full com-

mitment equitable scenario; therefore, the integrator has no incentives with which to discriminate.

### 3.4 Empirical Evidence

The theoretical model in the previous section enables us to formulate testable hypotheses about the strategic behavior of the integrator when it comes to supplying inputs of varying quality to growers of different abilities. Accepting technology A as an accurate description of efficient broiler production, we hypothesize that the integrator would behave strategically by supplying high-ability growers with high-quality inputs and low-ability growers with low-quality inputs. Accepting technology B as valid, we hypothesize that the incentives for discrimination are absent.

The basic econometric model to test whether there is a discrimination from the data on individual broiler contract settlements is of the following form:

$$M_{it} = a_0 + a_1 A_i + \epsilon_t \quad (3.21)$$

where  $M_{it}$  represents the quality of inputs supplied by the integrator to grower  $i$  in flock  $t$ ;  $A_i$  is the inherent ability of individual grower which is assumed constant across time and  $\epsilon_t$  is the error term. The expected sign of  $\hat{a}_1$  is positive indicating the career concerns type of implicit incentives.

### 3.4.1 Data and the Definition of Variables

The data set used to test the hypothesis includes production information gathered from five different production contracts. The basic structure of all five contracts is the same and corresponds to the description provided in Section 3.2. However, there are smaller modifications in each one of the contracts, mainly determined by the grow-out technology used and the size of the birds grown under a particular contract.<sup>11</sup> Namely, two of our contracts (RFF1 and RFF2) are for the production of roasters with female fillers, one for roasters with straight run (RSR), one for large broilers (LB), and one for regular size broilers (RB).

The tournaments are separated by the settlement date, which happened to be every Saturday. For three contracts, the settlement dates range from July 1995 to July 1997 totalling 104 tournaments each. The time span of the remaining two contracts is somewhat shorter. The number of tournaments that each grower participated in is not equal for all growers. During the time period covered by the data, some growers may have produced as little as one flock while others may have produced as many as 11 flocks. The number of growers in each of the profit center varies from 195 in RFF2 to 354 in LB. The average number of growers per tournament varies from 9 (RSR) to 31 (LB). The total number of observations is 7,565 flocks. After deleting the unusable

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<sup>11</sup>According to their live weight at harvest, the industry distinguishes broilers (4-5 pound birds) from roasters (5-6.5 pound birds). The technology for growing roasters (single sex, male birds) can differ depending on whether female fillers or straight-run fillers are used. In both cases, the chicken house space gets divided into two compartments, one stocked with male birds who will be harvested as roasters and the other with either be single sex female birds (female fillers) or both sexes (straight run). After about seven weeks when fillers are harvested, the barrier is removed so that the roasters can use the entire space for another couple of weeks to grow to their marketable weight.

Table 3.1: Data Summary Statistics of 5 contracts

<i>Contract Number</i>	<i>No. of Tournaments</i>	<i>No. of Usable Observations</i>	<i>Avg No. of Growers per Tournament</i>
<b>LB</b>	104	3194	31
<b>RFF1</b>	104	1202	12
<b>RFF2</b>	68	810	13
<b>RB</b>	46	831	18
<b>RSR</b>	104	937	9

observations, we are left with 6,974 flocks. Table 3.1 provides summary statistics of the data set. Each observation in the data set includes the production information of one grower for one flock of birds. The data contains the information on costs for various inputs supplied by the integrator (chicks, feed, medication, vaccination etc.), the number of birds placed and harvested, the quantity of broiler meat (live weight) produced, the dates when production started and terminated, and mortality rates, etc.

In order to carry out the econometric estimation, we need to decide how to measure the model variables. The right hand side variable in (3.21) is grower ability. We define abilities as inherent or acquired skills resulting from experience, education, age, etc., as well as other grower-specific factors such as location, quality, and vintage of the production facilities and equipment. We measure abilities as the growers' fixed effects in the production function or in the settlement cost panel data regression model. In the production function approach, we stay with our model assumption that the total

quantity of inputs in production is fixed and that the competition among growers is about producing more output. In this case, the variation in grower performance, after correction for the scale of operation, is adequately captured by the variation in the quantity of live weight produced. Alternatively, as in Knoeber and Thurman (1994), Tsoulouhas and Vukina (1999), and Levy and Vukina (2004), one can assume that the output level is fixed and that growers compete to produce the targeted level of output at the smallest possible costs. In this case, the differences in grower performance are fully captured by the difference in the per pound settlement costs,  $\frac{c_{kt}}{Y_{kt}}$ . We expect both approaches to yield similar results.

The dependent variable in (3.21) is the quality of inputs supplied by the profit centers to their growers. Among all inputs that integrators provide, the quality of feed, and the quality of baby chicks are the most important ones. Given the fact that the quality of feed is impossible to measure without the laboratory analysis, this type of data is difficult to obtain. Instead, we focus on the quality of chicks.

The quality of baby chicks depend on several factors such as breed, age of the laying hens, the age of flock when arriving on the farm, the composition of various breeds in a given flock, the travel distance from one hatchery to the farm, etc. Given the information available in the data set, we believe that the quality of chicks can be approximated by the percentage of chicks that died within the first week of arriving at the farm.<sup>12</sup> In particular, the quality will be measured as a percent deviation from the

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<sup>12</sup>The implicit assumption governing this approach is that there is limited number of things that the grower can do in order to prevent chick mortality when they are only one week old. The

grower specific average first week mortality. The assumption employed here is that, given grower ability, a certain percentage of birds will die on the farm in every flock. The departure from this average mortality should measure the departure from the average quality of chicks typically received by farmers. Hence, higher than average first week mortality (positive number) means that the flock is composed of a high percentage of low-quality input and lower than average first week mortality (negative number) means the flock is composed of a high percentage of high-quality input.

### 3.4.2 Econometric Model

The econometric approach to estimate model (3.21) involves two steps. In the first step, we estimate grower abilities in each contract as the grower fixed effects in a two-way-fixed-effects, panel data regression model. In the second step we regress the input qualities received by an individual grower on the estimated grower abilities from the first step.

In the first step, we use two approaches. The first approach involves the estimation of the production function of the following form:

$$Q_{it} = \alpha_0 + \alpha_1 M_{it} + \sum_{k=2}^n \mu_k d_{it}^k + \sum_{k=2}^T u_k g_{it}^k + \alpha_2 H_{it} + \omega_{it} \quad (3.22)$$

where  $Q_{it}$  is the number of pounds of live broilers produced by grower  $i$  in tournament  $t$ ,  $M_{it}$  is the percent deviation from the individual grower average first week percentage of them that will die is to large extent determined by their quality, which is exclusively under control of the integrator. On the other hand, the subsequent mortality that will occur during the production cycle is largely determined by what the grower does (his abilities and effort) and not so much by the initial quality of chicks received.

mortality,  $H_{it}$  is the number of chicks placed (i.e., head started) on the farm,  $n$  is the number of growers in each contract,  $\mu_k$  is the ability of grower  $k$ ,  $d_{it}^k$  is the dummy variable for grower  $k$  defined such that  $d_{it}^k = 1$  whenever  $i = k$  and 0 otherwise,  $u_k$  is the production shock common to all grower who settled their flocks in the same tournament  $t$ ,  $g_{it}^k$  is the dummy variable for the tournament defined as  $g_{it}^k = 1$  if  $t = k$  and 0 otherwise,  $T$  is the number of tournaments in each contract, and  $\omega_{it}$  is an individual grower idiosyncratic shock.

The second approach for estimating grower abilities involves the estimation of the settlement cost equation of the following form:

$$c_{it} = \alpha_0 + \alpha_1 M_{it} + \sum_{k=2}^n \mu_k d_{it}^k + \sum_{k=2}^T u_k g_{it}^k + \omega_{it} \quad (3.23)$$

where  $c_{it}$  is the grower  $i$  per pound settlement cost in tournament  $t$ . Other variables are defined as in (3.22).

Before estimating (3.22) and (3.23), we sort all growers by the size of their settlement costs and then estimate the equations by using the worst grower as the reference point when constructing grower dummies. Therefore, by construction, all estimated  $\mu_k$  in (3.22) should be positive since higher ability growers will produce more pounds of live weight, all else equals. The expected sign of  $\alpha_1$  is negative as more output is associated with lower mortality rate (i.e., good-quality input). The expected sign of  $\alpha_2$  is positive since more birds placed will turn into more pounds of live weight. All estimated  $\mu_k$  in (3.23) should be negative because a high-ability grower will have a lower settlement cost. The estimate of  $\alpha_1$  should be positive as the lower-than-average mor-

tality rate (good quality input) should, *ceteris paribus*, result in the lower settlement cost.

In the second step, we use the  $\hat{\mu}_k$  from (3.22) and (3.23) to test whether the strategic input discrimination is supported by the data by estimating:

$$M_{it} = \beta_0 + \beta_1 \hat{\mu}_i + \eta_{it} \quad (3.24)$$

By using  $\hat{\mu}_k$  from (3.22) (i.e., the production function approach),  $\hat{\beta}_1$  should be negative if there is a career concerns type of dynamic incentives. On the other hand,  $\hat{\beta}_1$  should be positive when using  $\hat{\mu}_k$  from (3.23) (i.e., the settlement costs approach).

Alternatively, in order to capture discrimination in series of tournaments, we also estimate the following equation in the second step:

$$M_{it} = \beta_0 + \beta_1 \hat{\mu}_i + \sum_{k=2}^T \beta_k (\hat{\mu}_i g_{it}^k) + \nu_{it} \quad (3.25)$$

where  $\frac{\partial M_{it}}{\partial \hat{\mu}_i} = \beta_1 + \beta_k$  in tournament  $t = k$ ,  $\beta_1$  measures the direct ability effect on the distribution of input quality, and  $\beta_k$  represents the secondary ability effect associated with a particular tournament. The latter coefficient should capture the magnitude of discrimination effect over time as the integrator has learned more about the agent's type.<sup>13</sup>

Using  $\hat{\mu}_k$  from the production function estimates in (3.22), the strategic behavior of the integrator in line with technology A and consequently with the career

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<sup>13</sup>Notice that the procedure followed in the second step can potentially suffer from the errors in variables problem because the regressor in (3.24) and (3.25) is not an observed variable but rather an estimated coefficient from the first step. Ideally, the instrumental variable estimation would be to carried on. However, no socio-economic variable can be constructed as instrument variable from the data set. As a result, we use the estimated coefficient as an explanatory variable as same as Knoeber and Thurman (1994)

concerns type of dynamic incentives will survive the empirical test if estimates of (3.25) exhibit that  $\beta_1 + \beta_k < 0, \forall k = 2, 3, \dots, T - 1, T$ . On the other hand, using  $\hat{\mu}_k$  from settlement costs estimates in (3.23), the career concerns type of dynamic response should be empirically supported if estimates of (3.25) exhibit that  $\beta_1 + \beta_k > 0, \forall k = 2, 3, \dots, T - 1, T$ .

The actual testing of discrimination hypotheses is carried out in the following way. First we test that all  $\beta_1 + \beta_k$  are jointly zero with an F-test. Second, we perform a battery of one-sided t-tests for every tournament with  $H_0 : \beta_1 + \beta_k = 0$  versus  $H_1 : \beta_1 + \beta_k < 0, \forall k = 2, 3, \dots, T - 1, T$  and  $H_0 : \beta_1 + \beta_k = 0$  versus  $H_1 : \beta_1 + \beta_k > 0, \forall k = 2, 3, \dots, T - 1, T$ . The tests give us the direction of discrimination (i.e., whether the integrator strategy stimulates career concerns or ratchet effect). Based on the production function estimates of abilities, in cases where we reject  $H_0$  in favor of  $H_1 : \beta_1 + \beta_k < 0$ , we talk about the career concerns type of response. In cases where we reject in favor of  $H_1 : \beta_1 + \beta_k > 0$ , we talk about the ratchet effect. Based on the settlement cost function estimates of abilities, the inequalities in the alternative hypotheses are reversed.

In addition to the testing  $H_0 : \beta_1 + \beta_k = 0, \forall k = 2, 3, \dots, T - 1, T$ . We can detect discrimination by looking at “the best grower” in each contract. If there is a discrimination, the effect should be captured by the highest ability growers who should have the highest possibility to receive a preferable input in every tournament he was in. We obtain the information about the best grower in each contract by

sorting the estimates of  $\hat{\mu}_k$  from the first step. However, the best grower sometimes has only 1 or 2 observations in the data set, hence, using the first-best grower is not meaningful. If that is the case, we replace the first-best grower with the second-best or the third-best grower and so on. Then, we perform the one-sided t-tests for every tournaments in which the particular grower was in.

### 3.4.3 Estimation Results and Testing

The estimation results of the model (3.22) are presented in Table 3.2 and of the model (3.23) in Table 3.3, respectively. The estimated abilities of each grower  $\mu_i$  are suppressed for brevity. Most of the t-statistics for each grower (not reported) are significant in both specifications. All F-tests reject the null that growers are homogeneous in ability at a 5% significance level in all five contracts. The result of heterogeneity is also found in Knoeber and Thurman (1994); Levy and Vukina (2004). We also found that common production shocks are significant, but similarly, these tests are not reported here. The estimated coefficients on quality of inputs,  $\hat{\alpha}_1$ , in both specification have the predicted signs and most are significant at 5% in the production function but generally not significant in the settlement cost estimation.

The results of estimation of (3.24) are reported in Table 3.4. All coefficients in (3.24) are not significant at any level. There is no dependency between growers' abilities and quality of inputs. Alternatively, the results of estimation of (3.25) are reported in Table 3.5 where the estimated of  $\beta_2, \dots, \beta_k$  are suppressed for brevity.

Table 3.2: Estimation of Abilities: Production Function Approach (3.22)

<i>Contract</i>	$\hat{\alpha}_0$	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$R^2$	F-Test
<b>LB</b>	-38114 * (15036)	-3198.063 * (336.027)	4.613 * (0.0516)	0.99	3.53 ( <i>p-value</i> <0.0001)
<b>RFF1</b>	-47968 * (13045)	-7757.769 * (1652.349)	5.594 * (0.0849)	0.9931	1.52 ( <i>p-value</i> <0.0001)
<b>RFF2</b>	-44019 * (12636)	-5107.716 * (1597.816)	5.585 * (0.0889)	0.9975	1.46 ( <i>p-value</i> <0.0005)
<b>RB</b>	-46386 * (18276)	-1619.533 * (422.723)	4.759 * (0.1426)	0.9945	2.01 ( <i>p-value</i> <0.0001)
<b>RSR</b>	-132314 * (21286)	-4042.242 (3240.153)	5.741 * (0.1122)	0.993	1.45 ( <i>p-value</i> <0.0001)

Estimation of  $\mu_k, u_k$ , are suppressed for brevity.

Standard deviations are given in parentheses.

F-Test is testing  $H_0 : \mu_2 = \mu_3 = \dots = \mu_k$

\* represents that the coefficient is significant at a 5% level

Table 3.3: Estimation of Abilities: Settlement Cost Approach (3.23)

<i>Contract</i>	$\hat{\alpha}_0$	$\hat{\alpha}_1$	$R^2$	F-Test
<b>LB</b>	37.847 * (0.4511)	0.04224 * (0.0211)	0.9334	2.96 ( <i>p-value</i> <0.0001)
<b>RFF1</b>	41.735 * (0.9579)	0.0742 (0.1302)	0.9284	1.36 ( <i>p-value</i> <0.0001)
<b>RFF2</b>	39.963 * (0.6972)	0.1577 (0.09323)	0.9699	2.59 ( <i>p-value</i> <0.0001)
<b>RB</b>	35.403 * (0.505)	0.0502 (0.0291)	0.8466	3.42 ( <i>p-value</i> <0.0001)
<b>RSR</b>	45.631 * (1.059)	0.1386 (0.1825)	0.9546	1.67 ( <i>p-value</i> <0.0001)

Estimation of  $\mu_k, u_k$ , are suppressed for brevity.

Standard deviations are given in parentheses.

F-Test is testing  $H_0 : \mu_2 = \mu_3 = \dots = \mu_k$

\* represents that the coefficient is significant at 5%

The results of the testing discrimination in every tournaments are reported in Table 3.6. We first test if  $\beta_1 + \beta_k$  are jointly zero. We find that F-tests in all five contracts from two models reject the null of no discrimination at 5%. Knowing that the power of this test is small, we computed the number of times that the one-side t-test does not reject the null, rejects the null in favor of the career concerns incentives, and rejects the null in favor of the ratchet effect incentives. In about 80% of the cases the one-sided t-tests did not reject the null. This percentage is approximately equal across all contracts and both specifications. The number of times that t-tests reject the null in favor of either career concerns or ratchet effect varies across contracts. For example, in contract LB with the production function approach, 67 out of 103 tests do not reject  $H_0 : \beta_1 + \beta_k = 0$ , whereas 19 and 17 tests reject the null in favor of career concerns and ratchet effect, respectively. In contract RSR with the settlement cost approach, 102 out of 103 tests do not reject the null and only one test does not reject the null in favor of the ratchet effect.

Table 3.7 presents the results for testing discrimination on the best grower in each contract. For contract LB, the 3<sup>rd</sup> best grower was in 11 tournaments. We are unable to reject that there is no discrimination 10 out of 11 times. For contract RSR, we found no discrimination at all for the 3<sup>rd</sup> best grower. The direction of discrimination changes from tournament to tournament. In contract RFF2 with production function approach, even though 4 out of 5 tournaments exhibit some discrimination, there exist no stable pattern of discrimination over time.

Table 3.4: Estimation of Discrimination Equation - Equation (3.24)

<i>Contract</i>	Production Function Approach			Settlement Cost Approach		
	$\hat{\beta}_0$	$\hat{\beta}_1$	$R^2$	$\hat{\beta}_0$	$\hat{\beta}_1$	$R^2$
<b>LB</b>	-3.114 (672470)	0.00009211 (1531450)	0.0003	-0.05465 (9.052)	-0.01889 (28.016)	0.002
<b>RFF1</b>	6.143 (455902)	-0.0001142 (9116348)	0.0008	-0.01153 (6.368)	-0.00302 (124.0703)	0.0001
<b>RFF2</b>	3.596 (593440)	-0.0000767 (1195712)	0.0002	0.04476 (15.599)	0.00568 (182.938)	0.0005
<b>RB</b>	4.366 (626679)	-0.000693 (4182335)	0.0001	0.0117 (12.551)	-0.00308 (52.375)	0.0001
<b>RSR</b>	-6.115 (676231)	0.0000461 (5067025)	0.0003	-0.1868 (12.72)	-0.01306 (89.006)	0.0001

Standard deviations are given in parentheses.

Overall, results seem to be pointing towards the conclusion that although, the discrimination is somewhat detected, there is not enough empirical evidence that the integrator strategically distributes inputs of varying quality to growers of different abilities such that it creates career concern or ratchet effect.

### 3.5 Conclusions

This research has been motivated by the frequent complaints of contract broiler growers that they have been treated unfairly in the hands of the integrators. Specifically, we investigated a problem of post-contractual opportunism (lack of long-term

Table 3.5: Estimation of Discrimination Equation - Equation (3.25)

<i>Contract</i>	Production Function Approach			
	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2, \dots, \hat{\beta}_T$	$R^2$
<b>LB</b> ( $T=104$ )	0.02114 (0.0653)	-0.00001054 * (0.00000319)	Suppressed	0.1499
<b>RFF1</b> ( $T=104$ )	-0.02671 (0.0447)	-0.00000306 (0.00000166)		0.2325
<b>RFF2</b> ( $T=68$ )	0.00182 (0.05699)	0.0000012 (0.00000191)		0.2263
<b>RB</b> ( $T=46$ )	0.00438 (0.1514)	-0.000000095 (0.000013)		0.2529
<b>RSR</b> ( $T=104$ )	0.0182 (0.0703)	-0.00000026 (0.00000061)		0.1935
<i>Contract</i>	Settlement Cost Approach			
	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2, \dots, \hat{\beta}_T$	$R^2$
<b>LB</b> ( $T=104$ )	0.0242 (0.0857)	0.15074 * (0.0469)	Suppressed	0.1582
<b>RFF1</b> ( $T=104$ )	0.0033 (0.0616)	0.0379 * (0.0182)		0.2476
<b>RFF2</b> ( $T=68$ )	0.0132 (0.1503)	-0.00839 (0.0203)		0.2259
<b>RB</b> ( $T=46$ )	0.000912 (0.1219)	0.0000934 (0.0974)		0.2561
<b>RSR</b> ( $T=104$ )	-0.0679 (0.1295)	-0.00363 (0.0098)		0.1922

Estimation of  $\beta_k$  where  $k=2$  to  $T$  is suppressed for brevity.  
Standard deviations are given in parentheses.

\* represents that the coefficient is significant at 5%

Table 3.6: Results of Testing Discrimination Hypotheses

<i>Contract</i>	<i>Using <math>\hat{\mu}</math> from the Production Function Approach</i>	<i>Using <math>\hat{\mu}</math> from the Settlement Cost Approach</i>
	<b>Number of Times</b>	
LB (T=104)	F-Test=5.17( $p < 0.0001$ )	F-Test=5.50( $p < 0.0001$ )
	Not Reject $H_0$ : 67	Not Reject $H_0$ : 70
	Career Concerns: $\beta_1 + \beta_k < 0$ : 19	Career Concerns: $\beta_1 + \beta_k > 0$ : 17
	Ratchet Effects: $\beta_1 + \beta_k > 0$ : 17	Ratchet Effects: $\beta_1 + \beta_k < 0$ : 16
RFF1 (T=104)	F-Test=3.16( $p < 0.0001$ )	F-Test=3.43( $p < 0.0001$ )
	Not Reject $H_0$ : 84	Not Reject $H_0$ : 87
	Career Concerns: $\beta_1 + \beta_k < 0$ : 10	Career Concerns: $\beta_1 + \beta_k > 0$ : 9
	Ratchet Effects: $\beta_1 + \beta_k > 0$ : 9	Ratchet Effects: $\beta_1 + \beta_k < 0$ : 7
RFF2 (T=68)	F-Test=3.27( $p < 0.0001$ )	F-Test=3.26( $p < 0.0001$ )
	Not Reject $H_0$ : 54	Not Reject $H_0$ : 65
	Career Concerns: $\beta_1 + \beta_k < 0$ : 7	Career Concerns: $\beta_1 + \beta_k > 0$ : 0
	Ratchet Effects: $\beta_1 + \beta_k > 0$ : 6	Ratchet Effects: $\beta_1 + \beta_k < 0$ : 2
RB (T=46)	F-Test=5.87( $p < 0.0001$ )	F-Test=5.98( $p < 0.0001$ )
	Not Reject $H_0$ : 33	Not Reject $H_0$ : 32
	Career Concerns: $\beta_1 + \beta_k < 0$ : 6	Career Concerns: $\beta_1 + \beta_k > 0$ : 6
	Ratchet Effects: $\beta_1 + \beta_k > 0$ : 6	Ratchet Effects: $\beta_1 + \beta_k < 0$ : 7
RSR (T=104)	F-Test=1.93( $p < 0.0001$ )	F-Test=1.92( $p < 0.009$ )
	Not Reject $H_0$ : 101	Not Reject $H_0$ : 102
	Career Concerns: $\beta_1 + \beta_k < 0$ : 1	Career Concerns: $\beta_1 + \beta_k > 0$ : 0
	Ratchet Effects: $\beta_1 + \beta_k > 0$ : 1	Ratchet Effects: $\beta_1 + \beta_k < 0$ : 1

F-Tests are testing  $H_0 : \beta_1 + \beta_2 = \beta_1 + \beta_3 = \dots = \beta_1 + \beta_T = 0$

One-side t-tests are testing  $H_0 : \beta_1 + \beta_k = 0$  for  $k = 2, 3, \dots, T$  at 0.05 level of significance.

Table 3.7: Results of Testing Discrimination Hypotheses - Best Grower Approach

<i>Contract</i>	$H_0$	<i>Using <math>\hat{\mu}</math> from the Production Function Approach</i>	<i>Using <math>\hat{\mu}</math> from the Settlement Cost Approach</i>
<b>LB</b> (Using the 3 <sup>rd</sup> Best Grower)	$\beta_1 + \beta_8 = 0$	Reject in favor of CC	Reject in favor of CC
	$\beta_1 + \beta_{17} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{26} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{35} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{44} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{54} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{63} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{73} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{83} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{92} = 0$	Not Reject	Not reject
$\beta_1 + \beta_{101} = 0$	Not Reject	Not reject	
<b>RFF1</b> (Using the 5 <sup>th</sup> Best Grower)	$\beta_1 + \beta_{33} = 0$	Reject in favor of RE	Reject in favor of RE
	$\beta_1 + \beta_{45} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{57} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{67} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{80} = 0$	Not Reject	Not reject
<b>RFF2</b> (Using the 4 <sup>th</sup> Best Grower)	$\beta_1 + \beta_2 = 0$	Reject in favor of RE	Not reject
	$\beta_1 + \beta_{14} = 0$	Reject in favor of CC	Not reject
	$\beta_1 + \beta_{25} = 0$	Reject in favor of RE	Not reject
	$\beta_1 + \beta_{38} = 0$	Not reject	Not reject
	$\beta_1 + \beta_{60} = 0$	Reject in favor of CC	Not reject
<b>RB</b> (Using the 2 <sup>nd</sup> Best Grower)	$\beta_1 + \beta_9 = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{20} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{30} = 0$	Reject in favor of RE	Reject in favor of RE
	$\beta_1 + \beta_{40} = 0$	Reject in favor of CC	Reject in favor of CC
<b>RSR</b> (Using the 3 <sup>rd</sup> Best Grower)	$\beta_1 + \beta_{14} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{25} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{36} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{48} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{59} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{84} = 0$	Not Reject	Not reject
	$\beta_1 + \beta_{96} = 0$	Not Reject	Not reject

“CC” stands for Career Concerns.

“RE” stands for Ratchet Effect.

commitment) on the part of the principal that can manifest itself in the strategic allocation of variable quality inputs among growers of different abilities. The problem stems from the fact that the integrator-grower relationship is long-term (as determined by the useful life of the contract specific fixed assets acquired by both sides), yet the relationship is governed by the repeated short-term contracts. Observing the performance of contract growers over time, the integrator can make reasonably precise conjectures about grower abilities. Having this information, there is a temptation to deviate from the original explicit contract provisions and discriminate among growers when it comes to supplying them with the production inputs of varying quality.

From the theory developed in Section 3.3, we believe that the incentives clearly exist only for the integrator to supply high-ability growers with high-quality inputs and low-ability growers with low-quality inputs. This strategy would generate a career concerns type of dynamic response from the growers, who would be eager to win in the current period tournament not only because of the direct incentives they face, but also because of the fact that winning in the current period would improve their chances of obtaining the high-quality inputs in the subsequent tournaments. Our analysis shows no empirical support for this type of strategic behavior.

In a case where the production technology would dictate the strategy of supplying the high-ability agents with low-quality inputs and low-ability agents with high-quality inputs, our theoretical results show that such a strategy would be unprofitable for the integrator even if correct ordering of agents according to abilities

could be established. This is because the aggregate two-period profits under discrimination are less than those of under full commitment (when integrator commits to distribute inputs equitably).

The main caveat of this study comes from the fact that we ignore the presence of potentially significant transaction costs that may be associated with the strategic allocation of inputs. The transaction costs in this context would include the tangible costs of segregating inputs into categories (high or low) and the costs of delivering different categories of inputs to different growers, but also “shadow” costs associated with the loss of goodwill and good reputation among growers. The size of the transaction costs associated with the implementation of discrimination strategy may eliminate all potential benefits that the discrimination strategy would generate; similarly, the benefits associated with strategic distribution of variable quality inputs as captured by the improved cost efficiency or larger output may be rather small. The high transaction costs (or small benefits) may prevent the integrator from engaging in this type of strategic behavior and may force him to stay committed to distribute inputs fairly as implicitly understood in the short-term contracts.

## Chapter 4

# Monopsony Power and Relationship-Specific Investments: Evidence from the Broiler Industry

### 4.1 Introduction

The use of contracts to vertically coordinate the production and marketing of agricultural commodities has become common practice in many agricultural industries. For example, commodities such as tomatoes and broilers have been produced almost exclusively under contracts for decades. In the broiler industry, the process of raising broilers is organized via contracting between processors and independent growers. In most of these contracts, processors control almost every aspect of production from the distribution of inputs (chicks and feed) to decisions about when to harvest the mature birds and repopulate the houses with new flocks. Most of the contracts are written such that they cover one flock at the time. In order to receive a contract, a grower is required to construct housing facilities and to equip them according to

a processor's specification. These assets are considered relationship-specific because their value outside the industry is virtually nil, and their value within the industry, but outside the contract is significantly reduced.

There are two important factors affecting the salvage value of the relationship-specific investments in the broiler industry: 1) the physical specificity, and 2) the location specificity. Housing facilities are valuable assets within the contract with the current processor, whereas outside the contract, they need to be modified to satisfy the other processors' specific production technology requirements. Secondly, processors may have monopsony-oligopsony power in the market for grower services in the sense that growers may have limited opportunity to contract with other processors. The fact that live birds cannot be transported over a long distance significantly reduces growers' choice of processors in a given geographical area. In this case, location specificity translates into market power.

In both of these situations, the assets provided by the growers generate appropriate quasi-rents<sup>1</sup> in the sense that they have a low salvage value outside the bilateral contractual relationship. This constitutes a hold-up problem that can manifest itself in two ways. First, after housing facilities have been constructed, the processor may exploit his advantageous bargaining position by frequently requesting upgrades and technological improvements as conditions for contract renewal. Lewin (2000) showed that growers are held up since physical specificity effectively reduces the grower's

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<sup>1</sup>Quasi-rents can be measured by the value of the asset in excess of its next best alternative use (see, Klein, Crawford and Alchian (1978)).

compensation without causing additional moral hazard problems. Second, according to Williamson (1985), appropriable quasi-rents affect the level of investments. Being aware of the possibility that they may be held-up by processors, growers will cautiously invest in specific assets. The under-investment is considered sub-optimal compared to the situation where processors and growers vertical integrate. The magnitude of the under-investment problem varies with factors determining the salvage value of the investment (which affect quasi-rents).

With this research, we focus primarily on the ex-ante manifestation of the hold-up problem (i.e., the problem of under-investment). We hypothesize that the degree of under-investment is related to the number of processors (integrators) competing for grower services in a given area. The stronger the competition, the smaller the under-investment problem. We also address the ex-post manifestation of the hold-up problem by looking at the frequency of the technology upgrade requests as a function of the processor's market power. We empirically test these propositions by using the cross-sectional national survey of broiler growers.<sup>2</sup> The results show statistically insignificant relationships between the regional concentration of processors and the size of the investment or the frequency of requests for upgrades, indicating that the evidence of hold-up is weak.

This chapter is organized as follows. In section 4.2, we review the theories of

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<sup>2</sup>The survey was conducted by the Department of Agricultural Statistics at Purdue University and funded by a Fund of Rural America Grant by the Cooperative State Research, Education, and Extension Service of the USDA. We obtained only portion of the survey responses necessary to test the under-investment proposition.

under-investment; in particular, the transactions cost and incomplete contract theory. Section 4.3 describes the broiler industry. Section 4.4 presents a simple model of under-investment. In section 5, we discuss the data, econometric techniques, and results. The last section of the chapter concludes our research.

## **4.2 Related Literature**

Under-investment can be viewed as a precautionary action of an economic agent who knows that their power to renegotiate the contract term will be reduced after the relationship-specific investment has been made. Two theories explain this rational behavior: the transaction cost theory and the incomplete contract theory.

### **4.2.1 Transaction Cost Theory**

The origins of transaction cost literature can be traced back to Coase's 1937 article "The Nature of the Firm". Coase focused on the costs of transacting in different organization environments, particularly, the cost of writing, executing, and enforcing contracts. He argued that an organization is designed to minimize the transaction costs of doing business between parties. Coase's ideas were expanded and formalized by Williamson (1985). He argued that economizing with transactions costs is the primary motivation for adopting different structures governing the contractual relationship between parties. For example, if the transactions between the two parties

(buyer and supplier) are recurrent and involve high levels of specific investment (i.e., idiosyncratic transaction), the two will have a strong incentive to vertically integrate. Signing the contract to govern this relationship may not adequately prevent the hold-up problem from occurring. The reason for this is that it is impossible to stipulate in advance the exact response to a future contingency (i.e., the complete contract is costly and most of the time impossible to write). Specifically, the buyer may renege on the contract by threatening not to buy from the supplier at the specified contract price should some unanticipated events occur. The supplier, who incurred the investment, has no choice but to accept the unfair lower price. Without the vertical integration between the buyer and the supplier, the rational supplier will be reluctant to invest in the first place because of the fear of opportunistic behavior.

The Coase-Williamson idea has been widely tested. In particular, the theory of relationship-specific investment and the scope of the firm have been extensively tested in the area of industrial procurement. When firms require specialized inputs that have higher value inside the contractual relationship than in a more general market, they must decide if they will produce those inputs themselves or purchase them from either spot market or from entering a long-term contract. The trade-off between production efficiency and the severity of hold-up deals with the choice of the length and flexibility of the procurement contract when transactions involve physically specific assets. Joskow (1985/1987/1990), Masten (1984), Monteverde and Teece (1982), Levy (1985), Maher (1997), and John and Weitz (1998) adopt similar

research strategies and empirically test the theory. The authors collected data on the contractual form and the measures of physical-specificity of assets in various contexts. For example, in Joskow's series of papers, the relevant assets are coal mines and power plants. The author showed that simple spot markets are used less frequent, relative to other organizational arrangements such as long-term contracts or vertical integration when assets are more relationship-specific.

The empirical testing of the transactions costs theory suggests that the direct evidence of one party being held-up involving the specific asset is rare.<sup>3</sup> This is because parties are aware of such problems and have already adopted suitable institutional structures to address the problem of expropriation in advance. For example, coal mines eventually sign a long-term contract or vertically integrate with electricity firms (Joskow, 1987). Without those mechanisms, parties would be reluctant to invest, or their investment level would be sub-optimal.

## 4.2.2 Incomplete Contracts Theory

Much of the theory on incomplete contracts was established by Grossman and Hart (1986), Hart and Moore (1990), and Hart (1995). In this line of literature, a complete contract between two parties involving relationship-specific investment is costly. It is difficult to anticipate all future contingencies, and when unanticipated events occur, it may not be obvious what actions are appropriate until after they have occurred. In

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<sup>3</sup>See Beales and Muris (1995) about the claim that the evidence of hold-up is rare in the context of franchisee and franchisor.

particular, “when it is too costly for one party to specify a long list of the particular rights it desires over another party’s asset, then it may be optimal for that party to purchase all the rights except those specifically mentioned in the contract” (Grossman and Hart, 1986, p. 716). In equilibrium, if 100% of asset ownership means that all portions of the generated ex-post surplus go to the investing party in the bilateral relationship, under-investment will not occur because the investing party receives a full benefit from his investment. On the contrary, the Nash-bargaining solution in the bilateral relationship where the investment of one party is sunk always involves the under-investment (Grout (1984), Hart and Holmstrom (1985), Crawford (1988)). The reason for this is that the cost of the investment is exclusively borne by the party who makes it, but the surplus will be divided 50:50 between two parties.

To correct this problem, both parties may agree on using third party arbitration (i.e., the courts or other outside experts) to designate the proper response should some unexpected contingencies arise. The third party is supposed to make an efficient decision that most closely resembles a complete contract. In doing so, the arbitration encourages the investing party to construct the ex-ante correct amount of specific investment. However, the arbitrator may not possess the relevant information with which to formulate an efficient response. In this respect, the internal arbitration is likely to be efficient if the arbitrator can understand the on-going relationship between both parties at a low cost. The internal arbitrator cannot be both the judge and the contracting party. He must make decisions that conform to the aggregate interests

of the two parties and not favor one to the detriment of the other. Otherwise, the under-investment will persist.

Another way to potentially correct the under-investment problem is to introduce the ex-ante optimal renegotiation design (Hart and Moore (1988), Aghion, Dewatripont and Rey (1994), Noldeke and Schmidt (1995)). If the design allows the allocation of all bargaining power in the renegotiation process to one party, should an unanticipated event occur, and the specification of an appropriate default point that obtains if renegotiation breaks down, then the under-investment may be solved. In Hart and Moore (1988), the *no-trade* between two parties is the default point. Therefore, if the investing party is not the one who possesses all bargaining power, the under-investment will occur. In Aghion, Dewatripont and Rey (1994), the default point is an exogenous value that induces the optimal level of investment decided by the party who has all the bargaining power in the renegotiation process. The results imply that if the default point is correctly guessed, the under-investment will not occur. The ex-ante optimal renegotiation design result is interesting because it corrects the hold-up problem by simply writing a contract with an optimal renegotiation clause. However, it is unclear whether a renegotiation design can be written ex-ante in the world of incomplete information. Thus, it is unclear whether one can define an optimal default point ex-ante.

In summary, we can say that vertical integration nullifies the problem of under-investment by eliminating the possibility of incomplete contracting in the surplus

negotiating procedure. It eliminates the bargaining procedure and internalizes the decision to invest to one optimizing entity. As a result, there is no under-investment. In the incomplete contract theory, the problem is solved if there exists a procedure to let the investing party receive the full benefit from its investment. This can be achieved by either assigning full bargaining power to the investing party or designing the renegotiation game. The former has the same implication as the transaction cost theory in that it leads to the merger of two parties. The latter emphasizes the design of the best contract clause that prevents the hold-up problem arising from unseen future contingencies. From both theories, evidence of ex-post hold-up is very difficult to find because both parties are likely to undertake precautionary actions.

### **4.2.3 Hold-up Theories in Agriculture**

The problem of hold-up in the broiler industry has been studied by Lewin (2000). She provided the theoretical justification that growers are in jeopardy of hold-up by processors. She pointed out that if contract involves physical asset specificity, the fear of contract termination induces the high effort without the need of efficient compensation. The fear of being terminated causes a hold-up since asset specificity has such an effect in substituting the need of compensation. Realizing this, opportunistic processors will require growers to take part in investments that are unnecessarily specific. The more the market power processors have, the more inefficient compensation will be. In other words, a limited market for grower services will be internalized such

that grower compensation can be greatly reduced without inducing low effort.<sup>4</sup>

In this research, the processor's market power determines a salvage value of relationship-specific investments. This can be justified by the fact that many agricultural commodities are produced under the contract offered by few companies who usually set up a local processing plant and buy products from local farmers. When there is only one processors to contract with, farmers are said to be locked in the contractual relationship with processors since they have no alternative choice. Investments have a relatively low value outside the current contract. Realizing this situation, opportunistic processors may attempt to extract rents from contracting such that farmers are held-up.

Our analysis of market power can be supported by Rogers and Sexton (1994). They emphasize the importance of the buyers' concentration in the U.S. food industry. They mention that the buyer market power can be dismissed if we consider generic inputs such as labor or capital. Those input are typically mobile, hence, inelastic supply to individual buyers. However, the view of traditional input markets does not apply to the agricultural commodities. Rogers and Sexton identify the distinctive structural characteristics of agricultural products as: a) products that are often perishable and immobile, thus restrict growers to contract only with few buyers located near their farms and, b) products that involve extensive investment in sunk assets since processors need a specialized product.

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<sup>4</sup>Lewin treats a higher market power as growers having a higher switching cost (i.e., cost of altering the assets to fit in other processor's specification) if terminated.

Therefore, in an area that has few processors offering contracts, processors will have more market power if farmers do not have other processors to contract with in the area. Therefore, farmer's investments are subjected not only to the physical specificity, but also to the location specificity.

### 4.3 The Broiler Industry

Modern broiler industry is a vertically integrated system of production, processing, and distribution. Broiler companies (called integrators) control all stages of production ranging from breeding flocks and hatcheries to broiler grow-out and processing. The finishing stage of production (the final stage of the production process where one-day-old chicks are brought to the farm and grown to market weight) is organized almost entirely through contracts between processors and independent growers. Over the past 40 years, the industry has been moving from a high competitive industry with a large number of processors toward oligopsony. Presently, broiler production is concentrated in the hands of few integrators such as Tyson, ConAgra, and Perdue Farms who run their operations through smaller profit centers spread throughout the country. The industry's ten-firm concentration ratio (CR10)<sup>5</sup> is currently around 71.32 (WATT PoultryUSA, 2003).

Each integrator offers a contract to all prospective growers on a take-it-or-leave-

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<sup>5</sup>The proportion of the market controlled by the 10 largest firms based on the volume of production in the end of 2002.

it basis. The contracts usually do not include provisions specifying the frequency or number of flocks. Many of them are valid for only one flock of birds at a time. Also, terms of the contract can be unilaterally changed by the integrator without any consent from the grower.<sup>6</sup>

Virtually all contracts stipulate the identical division of responsibilities for providing inputs. The integrator's responsibility is to provide baby chicks, feed, medication and services of field personnel. Growers are required to construct and equip broiler houses and supply labor and management. They are also responsible for utilities, repair and maintenance, waste and dead bird disposal. Investments in broiler houses and equipment constitute about half of all invested capital in the broiler industry (Perry et al., 1999). The investment in broiler houses is the single largest expense faced by a grower (Aho, 1988). A house designed for more than 20,000 birds costs roughly \$150,000. A modern broiler house is a well-insulated, environmentally controlled unit equipped with automatic feeders and water lines. The functionalities of broiler houses are specific to the broiler production such that retrofitting them for other purposes (for example, growing turkeys) may be prohibitively costly. Thus, each house will have a relatively low salvage value due to its physical specificity.

The nature of broiler production under contract requires geographical concentration of production units. Contract growers are typically located within a short distance from the integrator's processing plant because live birds cannot be hauled

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<sup>6</sup>It is common for broiler contracts to include terms that might be called "catch-all" provisions, which reserve the integrator the right to take whatever action it feels necessary to protect its financial interest in the contract and the flocks.

more than a 20-mile radius from the farms to the processing facilities (Knoeber, 1989, p. 277). These characteristics are very important because they restrict the grower's choice of integrators. Broiler operations also tend to be concentrated in proximity of feed mills such that integrator's costs of distributing feed to a contract producer is as small as possible. We anticipate that the location specificity of growers' assets, and therefore, their salvage value will be different in different areas. In an area where there are many integrators, grower's assets will have a relatively high salvage value because the same assets can be utilized to produce broilers under contracts offered by another company. On the contrary, grower's assets will have relatively low salvage value in areas where the number of integrators is small.

When contracts are up for renewal, which tacitly happens whenever a new flock of birds is delivered to the farm, the bargaining power of the grower can be substantially diminished, depending on the degree of asset specificity. The integrator may exploit this situation by not changing the nominal payment to the growers for many flocks even if the period has experienced a significant cost inflation. Alternatively, the integrator may require frequent upgrades of facilities and equipment without necessarily making adequate provisions in the contract that will secure the grower's market rate of return on this additional investment. Growers' complaints about this type of opportunistic behavior of integrators is well documented by Ilvento and Watson (1998) and FLAG (2001). As more potential growers become aware of this possibility, those deciding to enter the industry will become more cautious when signing the contract.

This cautious approach may result in an under-investment problem as growers take the salvage value of their investments into consideration. Since the salvage value depends on the physical and location specificity of assets, one should expect the size of individual grower investments to decrease as the monopsony power of the integrator for grower services increases.

#### 4.4 Theoretical Model

The presented theoretical model of under-investment is based on Grout (1984), Crawford (1988), and Hart and Holmstrom (1985). There are two parties to the contract: an integrator and a grower. In order to obtain a short-term production contract with the integrator, a grower must construct broiler house(s). The investment level is  $I$ . There are two time periods. The broiler house is constructed in period 1 while the production begins, and all benefits are realized and payments are made in period 2. The cost of construction for each broiler house is  $c$  and is borne by the grower. The compensation that the grower receives from the integrator for his services is  $p$ . The benefits from the stream of services generated by the grower's investment is the function of the investment,  $b(I)$ , with  $\frac{\partial b(I)}{\partial I} > 0$  and concave. There will be no under-investment if the integrator and the grower vertically integrate, and the optimal level of investment will be such that  $\frac{\partial b(I)}{\partial I} = c$  (i.e., marginal benefit equals marginal costs).

Let  $r(n, \lambda(I))$  be the value of the grower's asset outside the relationship (i.e., the salvage value) if the contract is terminated. This value depends on the degree of

physical specificity,  $\lambda(I) \in [0, 1]$ , and the degree of location-specificity determined by the number of integrators in the area,  $n \geq 1$ .  $\lambda(I) = 0$  is the most extreme form of the physical asset specificity (i.e., the investment is useless outside the current contract), whereas  $\lambda(I) = 1$  means the investment is generic. For simplicity, we assume the differentiable form of salvageable value function such that:

$$r(n, \lambda(I)) = \lambda I \left(1 - \frac{1}{n}\right) \quad (4.1)$$

From equation (4.1),  $r(n, 0) = 0$ , i.e., in case of an extreme physical specificity, the salvage value is zero regardless of the number of integrators in the area. Also,  $r(1, \lambda(I)) = 0$ , that is, in case of a perfect monopsony, the asset has no value outside the current contract regardless of its physical specificity. Moreover,  $\frac{\partial r(n, \lambda(I))}{\partial n} = \frac{\lambda I}{n^2} \geq 0$ , meaning that higher concentration of integrators translates into higher salvage value of the asset, and  $\frac{\partial r(n, \lambda I)}{\partial I} = \lambda \left(1 - \frac{1}{n}\right) \geq 0$ , meaning that the higher the investment, the higher the salvage value outside the contractual relationship. Finally,  $\frac{\partial^2 r(n, \lambda I)}{\partial I \partial n} = \frac{\lambda}{n^2} > 0$ , indicating that the cross partial derivative of the value function is positive and symmetric. The increment in the salvage value increases when the number of integrators in the area increases.

Let  $\Phi \in [0, 1]$  be the integrator's share of the contract. From a Nash-bargaining solution (Hart and Holmstrom, 1985), we assume that the integrator and the grower equally divide the benefits from contracting, hence,  $\Phi = \frac{1}{2}$ .

In the second period, the integrator's profit is given by

$$\pi_P = b(I) - p \quad (4.2)$$

and the grower's profit is given by

$$\pi_G = p + \lambda I \left(1 - \frac{1}{n}\right) \quad (4.3)$$

Thus, the total monetary gain from contracting equals  $\pi_P + \pi_G = b(I) + \lambda I \left(1 - \frac{1}{n}\right)$

and the Nash-bargaining yields

$$p = \frac{1}{2} \left[ b(I) + \lambda I \left(1 - \frac{1}{n}\right) \right] \quad (4.4)$$

which must be a positive value to induce the grower to participate. Assume (4.4) is binding in equilibrium. The grower's decision to invest in the first period is determined by maximizing  $p - cI$ :

$$\max_I \left[ \frac{1}{2} \left( b(I) + \lambda I \left(1 - \frac{1}{n}\right) \right) - cI \right] \quad (4.5)$$

and the first-order condition is

$$\frac{1}{2} \left( \frac{\partial b(I)}{\partial I} + \lambda \left(1 - \frac{1}{n}\right) \right) - c = 0 \quad (4.6)$$

The second order condition for maximization is automatically satisfied since  $b(I)$  is a concave function. Clearly, the investment level that satisfies (4.6) will always be lower than that given by  $\frac{\partial b(I)}{\partial I} = c$  because vertical integration eliminates the possibility that the investments have a low salvage value. Otherwise, the under-investment problem would occur since the grower does not receive the whole benefit from the investments.

The comparative statics results based on (4.6) show that

$$\frac{\partial I^*}{\partial n} = - \frac{\frac{\lambda}{n^2}}{\frac{1}{2} \left( \frac{\partial^2 b(I)}{\partial I^2} \right)} \quad (4.7)$$

and

$$\frac{\partial I^*}{\partial \lambda} = -\frac{(1 - \frac{1}{n})}{\frac{1}{2}(\frac{\partial^2 b(I)}{\partial I^2})} \quad (4.8)$$

The sign of  $\frac{\partial I^*}{\partial n}$  is non-negative because  $\frac{\lambda}{n^2} > 0$  which is positive since  $\frac{\partial^2 b(I)}{\partial I^2} < 0$ .

This indicates that the smaller monopsony power leads to the larger investment in relationship specific asset. The sign of  $\frac{\partial I^*}{\partial \lambda}$  equals the sign of  $(1 - \frac{1}{n})$  which is positive as long as  $n > 1$ , indicating that lower asset specificity causes higher investments and vice versa.

## 4.5 Empirical Investigation

The data set used in this study comes from the national survey of broiler growers (see footnote 2 in this chapter) and covers a total of 1,010 broiler growers in 10 states (Alabama, Arkansas, Delaware, Georgia, Maryland, Mississippi, North Carolina, South Carolina, Texas, and Virginia). The data is reflective of the situation in mid to late 1999. The data set contains the following important variables: 1) the number of integrators offering contracts in the grower's area when he/she started ( $n_{i0}$ ), 2) the age of each house, 3) the number of houses growers have at the time of the survey ( $H_{iT}$ ), 4) the total area (in square feet) of houses a grower has at the time of the survey ( $S_{iT}$ ) and 5) the number of integrators offering contracts at the time of the survey ( $n_{iT}$ ).

The information on the oldest active house on a grower's farm is used to determine

when this particular grower entered the business. We acknowledge the fact that a grower could have entered the business earlier and that those early broiler houses may have already been decommissioned and therefore do not appear in the survey as active houses. In this case, there may be a discrepancy between the timing of two variables: the number of integrators when the grower started ( $n_{i0}$ ) and the number of houses when he/she started the business ( $H_{i0}$ ).<sup>7</sup> The discrepancy between  $n_{i0}$  and the area of houses a grower had when he/she entered the business ( $S_{i0}$ ) is acknowledged as well.

Summary statistics of the variables used in the econometric analysis and their definitions are provided in Table 4.1. The data provides information on houses and number of integrators in two time periods: at the time of the survey and at the time when a particular grower first started in this business. The average grower currently has 3.5 broiler houses, compared to 2.28 houses when he started, and has been growing broilers for 15 years. The average current total area of houses is 57,051 square feet while the average total area of houses when growers entered the business is 35,653 square feet. The average number of integrators offering contract within the grower's area at the time of survey ( $n_{iT}$ ) was 2.48, compared to 2.78 at the beginning, ( $n_{i0}$ ).<sup>8</sup> Approximately 28% of the growers had only one integrator to contract with when they started the operation. The situation did not change much overtime. At the time

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<sup>7</sup>This problem could not be fixed. However, for all practical purposes, it is not going to be important because the entire industry is not more than 40 years old and the number of decommissioned houses is likely to be very small.

<sup>8</sup>Notice that the interval time period is not the same for all growers, only the current time (T=1999). Obviously different growers started growing chicken in different year.

Table 4.1: Summary Statistics of the Data Set

Variable	Definition	Mean	Std.Dev
$H_{i0}$	The number of broiler houses each grower had in his/her farm <i>when started</i>	2.277	1.968
$H_{iT}$	The number of broiler houses <i>currently</i> each grower has in his/her farm	3.496	1.963
$S_{i0}$	The total of square footage of broiler's houses that each grower had <i>when started</i>	35653.83	24815.96
$S_{iT}$	The total of square footage of broiler's houses that each grower <i>currently</i> has in his/her farm	57051.08	32914.35
$A_i$	The average age of the house that the grower has in broiler operation	15.15	9.316
$U_i$	The average number of substantial improvements (upgrades) that each grower has per house	2.354	1.817
$n_{i0}$	The number of integrators offering contracts when growers started the broiler operation	2.783	1.344
$n_{iT}$	The number of integrators currently offering the contracts	2.479	1.483
$D_G$	Dummy variable=1 if grower or spouse has an off-farm job	0.7275	-
$DB_1$	Dummy variable=1 if broiler operation accounts for 0-25 % of source of income to the household	0.1831	-
$DB_2$	Dummy variable=1 if broiler operation accounts for 25-50 % of source of income to the household	0.2693	-
$DB_3$	Dummy variable=1 if broiler operation accounts for 50-75% of source of income to the household	0.2405	-
$DB_4$	Dummy variable=1 if broiler operation accounts for 75% or more of source of income to the household	0.306	-

of the survey (1999), about 27% of growers still had only one integrator in the area.

During the three years prior to the survey (1996-1998), the average grower had received 5.51 flocks per year. Broiler operation seems to be the main source of farm income for most growers since only 18% of all growers reported other farm activities accounting for more than 75% of their gross farm income. About 72% of growers or their spouses currently have an off-farm job. The data also provide the number of times that upgrading was requested by integrators ( $U_i$ ). On average, each grower will have approximately two upgrades on each house.

#### 4.5.1 Testing the Under-Investment Model

From the model and comparative statics of the previous section, it follows that the under-investment varies positively with  $n$  and  $\lambda$  which determine the salvage value of the asset. Keeping physical specificity,  $\lambda$ , constant, in equilibrium, growers facing less competition among integrators would tend to behave more cautiously and under-invest in housing facilities. On the other hand, if the competition for growers is strong, the optimal size of the grower investments will be close to the size that would result under vertical integration. In other words, for any given level of physical specificity of the asset, the size of the investment in this asset is explained by its location specificity where the latter is measured by the degree of competition among the integrators offering contracts. This result can be summarized as follows:

*Proposition 1: The size of the relationship-specific investment is positively related*

to the number of integrators contracting for grower services in a given area.

To test the proposition, we specify the following econometric model:

$$H_{iT} - H_{i0} = \gamma_0 + \gamma_1(n_{iT} - n_{i0}) + \gamma_2DB_1 + \gamma_3DB_2 + \gamma_4DB_3 + \gamma_5D_G + \gamma_6A_i + \nu_i \quad (4.9)$$

That is, the changes in investments ( $H_{iT} - H_{i0}$ ) can be explained by the changes in integrator's monopsony power ( $n_{iT} - n_{i0}$ ), the age of the houses ( $A_i$ ), and some socio-economic characteristics of the grower ( $DB_1, DB_2, DB_3, D_G$ ).<sup>9</sup> We expect the sign of  $\gamma_1$  to be positive. The expected sign of  $\gamma_2, \gamma_3$  and  $\gamma_4$  should be negative because a large increase in the number of houses is expected for those farmers who specialize in broiler production as a major source of their farm income. Also,  $\gamma_5$  should be negative because the increase in off-farm opportunities should reduce additional investments since growers have alternative sources of income. The estimation of  $\gamma_6$  should be positive because the higher the average age of houses, the more the additional houses will be constructed.

The estimation of (4.9) by specifying the dependent variable as the difference between  $H_{iT}$  and  $H_{i0}$  can cause a problem. Since the data on the decommissioned houses does not exist,  $H_{iT}$  is always greater or equal to  $H_{i0}$ . This means that the data is censored.<sup>10</sup> Growers who appear to have added no new houses (i.e.,  $H_{iT} = H_{i0}$ )

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<sup>9</sup>Another possible dependent variable is ( $S_{iT} - S_{i0}$ ). In this case, a larger area of broiler houses signals a larger investment.

<sup>10</sup>Censored samples occur when the only missing information are the values of the dependent variable in the unobservable range. Truncated samples refer to samples for which not only the values of dependent variable are in the unobservable range but also the corresponding values of independent variables are not observed and the number of missing values is unknown. (Kmenta, 1986 p. 561-562)

could have in fact decommissioned some of the old houses before constructing their oldest still active house and this activity would not be reflected in the survey. So, instead of having a negative investment (disinvestment), the data shows zero change.

To overcome this problem, we use Heckman's (1979) two-stage estimation procedure. The Heckman procedure is a consistent method that uses a bivariate normal model for the selection equation, and the ordinary least square to estimate the behavioral equation with the selected sample. In the first stage, the selection equation is estimated by maximum likelihood as an independent probit model to determine the decision to invest using information from the *whole sample* of growers. A vector of inverse Mills ratios, which indicates the estimated expected error, can be generated from the probit parameter estimates. The probit selection equation is defined as:

$$z_i^* = \varphi_0 + \varphi_1(n_{iT} - n_{i0}) + \tau_i; \quad (4.10)$$

where  $\tau_i \sim N(0, 1)$  and  $z=1$  if grower  $i$  has an increasing number of houses and zero otherwise. After obtaining the estimates in the first stage, the inverse Mills ratio will be calculated as:

$$\Psi_i = \frac{f\left(\frac{\hat{\varphi}_0 + \hat{\varphi}_1(n_{iT} - n_{i0})}{\sigma}\right)}{F\left(\frac{\hat{\varphi}_0 + \hat{\varphi}_1(n_{iT} - n_{i0})}{\sigma}\right)}$$

where  $f$  and  $F$  are the *pdf* and *cdf* of normal distribution respectively.

In the second stage, using only the portion of sample for which  $H_{iT} > H_{i0}$ ,  $(H_{iT} - H_{i0})$  is then regressed on all explanatory variables (as equation 4.9) *plus* the vector of inverse Mills ratios ( $\Psi_i$ ) from the selection equation. The second stage regression is performed using the OLS.

Table 4.2: Estimation of Equation (4.9) Using Heckman's

<b>Dependent Variable = <math>H_{iT} - H_{i0}</math></b>		
Variable	Coefficients*	Test of Significance
Intercept	-11.0785 (88.518)	( $t = -0.1359$ )
$n_{iT} - n_{i0}$	-0.5435 (3.1115)	( $t = -0.1746$ )
$DB_1$	-0.4536 (0.24964)	( $t = -1.817$ )
$DB_2$	-0.4120 (0.20241)	( $t = -2.0354$ )
$DB_3$	-0.2108 (0.16507)	( $t = -1.277$ )
$D_G$	-0.0448 (0.17148)	( $t = -0.2612$ )
$A_i$	-0.0178 (0.008602)	( $t = -2.069$ )
$\Psi_i$	20.3630 (118.299)	( $t = 0.1721$ )
* Consistent standard errors are in parentheses.		
$R^2 = 0.0266$ ; F-Value = 1.72 ( $p = 0.1022$ )		
Number of observations in the second stage = 448		

The estimates from the Heckman procedure will be unbiased but inefficient. The standard errors in the second stage that are typically computed by the OLS can either be smaller or larger than the correct standard errors (because they suffer from heteroskedasticity). Greene (1981/2000) derived a simple-to-compute formula for the asymptotic variance-covariance matrix of the OLS estimates. The formula is given in Greene (2000, p. 932-933).

Results of the second stage of Heckman's estimation of equation (4.9) and their

consistent standard errors are reported in Table 4.2.<sup>11</sup> The coefficient on  $(n_{iT} - n_{i0})$  does not have an expected sign and is not significant. Variables that have the correct sign are  $DB_1$ ,  $DB_2$ ,  $DB_3$  where more additional houses associated with growers whose income depends more on broilers. One of the significant variables in this case is  $A_i$ . However, the result indicated that the longer the grower is in the broiler business, the less additional houses will be constructed. Also, the coefficient on the inverse Mills ratio,  $\Psi_i$ , is not significant. The result seems to indicate that grower's relationship-specific investments in the broiler industry are independent of the monopsony power of the integrator.

#### 4.5.2 Testing Post-Contractual Opportunism

The post-contractual opportunism on the integrator side can be investigated by looking at the frequency of the housing facilities upgrades request that different integrators place on their contract growers. We estimate the following model:

$$U_i = \theta_0 + \theta_1 n_{iT} + \theta_2 DB_1 + \theta_3 DB_2 + \theta_4 DB_3 + \theta_5 A_i + \zeta_i \quad (4.11)$$

where  $U_i$  is the average number of improvements that each grower has per house, and all other variables are previously defined. The direct evidence of post-contract opportunism will be captured if the estimated  $\theta_1 < 0$  signalling that the lower the competition among integrators for grower services, the more frequent the request for upgrades will be. The result are presented in Table 4.3. The coefficient of  $n_{iT}$  has the

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<sup>11</sup>We also have estimated Heckman's estimation by using  $(S_{iT} - S_{i0})$  as a dependent variable. The

Table 4.3: Estimation of Equation (4.11)

<b>Dependent Variable = <math>U_i</math></b>		
Variable	Coefficients*	Test of Significant
Intercept	1.4567 (0.22085)	6.60 ( $p < 0.0001$ )
$n_{iT}$	-0.0279 (0.04776)	-0.56 ( $p = 0.5729$ )
$DB_1$	0.39211 (0.22716)	1.73 ( $p = 0.0849$ )
$DB_2$	0.4333 (0.20799)	2.08 ( $p = 0.0377$ )
$DB_3$	0.0091 (0.20383)	0.04 ( $p = 0.9644$ )
$A_i$	0.049 (0.00899)	5.46 ( $p < 0.0001$ )
* Standard errors are in parentheses.		
$R^2 = 0.0716$ ; F-Value = 8.13 ( $p < 0.0001$ )		
Chi-square test for heteroskedasticity, $\chi^2 = 14.55$ ( $p = 0.4098$ )		

expected sign but is not significant. The coefficient on  $A_i$  is positive and significant. Obviously, the longer the grower is in the broiler business, the larger the number of improvements he/she has to perform. The only other significant parameter is  $DB_2$  indicates that growers whose half of the farm dedicating to broilers will have a higher number of improvements. The obtained results do not confirm the absence of the opportunistic behavior on the part of the integrator. They only seem to indicate the absence of a statistically significant relationship between market power (lack of competition) and the frequency of upgrades. The opportunistic behavior is still possible but may be equally exercised in a situation where the competition for growers is low and when competition is high.

## 4.6 Conclusion

We tested the existence of the ex-ante manifestation of the hold-up problem in the broiler industry. We hypothesized that the level of relationship-specific investments will positively correlate with the number of integrators offering contracts in the grower's area. However, our empirical analysis shows no support on the claim. Decisions to invest in the relationship-specific investment is independent from monopsony power. We also found no evidence of actual ex-post contractual opportunism where the number of improvements per house cannot be explained by the integrator's market power. Monopsony power does not add any effects on the specific investments

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results of this estimation are nearly identical to the results reported in Table 4.2.

growers have.

In this paper, we acknowledge some constraints in our analysis. The integrator's market power is measured by the grower's realization of the number of integrators offering contracts in an area. We recognize that each grower's realization about market power may vary which may affect the OLS estimation. We also have missing information about how growers react to the change in market power overtime. One could find that the market power may explain the investments each grower has if the information on the number of integrators at a particular time is available. One possible extension for this paper is to consider the spatial concentration of integrators and growers in different areas and to measure investment levels each grower will have. Under-investment would be detected if growers (who have the same characteristics) have different levels of investment. However, the spatial data is difficult to obtain since we need to know the location of growers and integrators to measure the exact monopsony power of integrators.

## Chapter 5

### Conclusion

The broiler industry is almost vertically integrated. Live birds care is provided exclusively by contract growers who furnish facilities, equipment, and labor under contractual arrangements with broiler companies, called integrators. The integrator's responsibility is to provide baby chicks, feed, medication and services of field personnel. Growers receive payment for raising broilers based on a tournament consisting of a fixed base payment per pound of live meat produced and a variable bonus payment based on the grower's relative performance. The bonus payment is calculated as a percentage of the difference between group average settlement costs and the grower's individual settlement costs. Settlement costs for each grower are calculated by adding chicks, feed, fuel, medication, and other flock costs divided by the total pounds of live broiler produced. The calculation of the group average settlement costs includes growers whose flocks were harvested within the same week. For the below average settlement costs, the grower receives a bonus; for the above average settlement costs, he receives a penalty.

Recently, tensions in the contractual relationship between integrators and growers have received increasing attention nationwide. Growers consistently complain about being held-up by contracts. We can identify two possible sources of market failures that might occur in broiler contracts: integrator market power and imperfect information. Integrators have more bargaining power because growers have already incurred relationship-specific investments (broiler houses). Growers also have imperfect information about the quality of inputs and group composition. They have no way of anticipating how much their payment would be since tournament outcomes are sensitive to the quality of inputs and group composition.

In chapter 3, we directly tested whether integrators discriminate among growers (by distributing inputs of varying quality) in the sequences of repeated short-term contracts. Theoretically, integrators may create an implicit incentive in the broiler contract to extract information about a grower's ability and use that information in the subsequent period. This information can benefit integrators because a short-term contract enables them to freely change input provisions for *some* growers while maintaining the same explicit incentive contract for *all* growers. However, empirically, we found that there is not enough evidence that integrators strategically distribute inputs of varying quality to growers of different abilities such that it creates implicit incentives.

In chapter 4, we tested whether the hold-up problem occurs such that the decision in relationship-specific investments is affected by the integrator market power. In

this case, market power translates to location specificity (since live birds cannot be transported very far). Given the physical specificity of broiler houses, investments vary with the integrator market power in a given area. Empirically, investments in broiler houses are independent of the market power. Moreover, the evidence of actual opportunism does not exist.

We conclude that both sources of market failures are insignificant. Therefore, no regulation is needed to govern the current broiler contracts. This conclusion is also consistent with the prediction from the interest group theory of regulation. The competition between integrators and growers political pressure groups will likely result in an efficient contractual arrangement. The fact that we rarely see federal and state regulations in broiler contracts leads us to believe that the existing contractual arrangements operate efficiently.

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# Appendix A

## Appendix

### Sample Surveys Questions for Testing Monopsony Hypotheses

- 1) How many years have you been a broiler growers? \_\_\_\_\_
- 2) Do you have an off-farm job?
  - Yes
  - No
- 3) Do you work on your farm growing crops or livestock in addition to growing broilers?
  - Yes
  - No
- 4) If you currently married, does your spouse help with crop or livestock production on your farm other than what might needed for the broiler operation?
  - Yes
  - No
- 5) Do your spouse work off the farm?
  - Yes

- No

6) Please provide the age, length and width, of each house you operate, along with how many substantial improvements made to each house over the past five years. By "substantial," we mean improvements costing at least \$3000 each.

House Number	Age (Years)	Length (Feet)	Width (Feet)	No. of Improvements
House 1				
House 2				
House 3				
House 4				
House 5				
House 6				
House 7				
House 8				
House 9				
House 10				

7) When you started growing broilers, how many companies were offering broiler contracts in your area?\_\_\_\_\_

8) How many companies are currently offering broiler contracts in your area?\_\_\_\_\_

9) How many flocks did you average each year?\_\_\_\_\_

10) On average, how many birds were placed in each flock?\_\_\_\_\_

11) What has been the average grow-out weight of the birds?\_\_\_\_\_

12) Do you produce crops or livestock other than broilers on your farm that account for more than 50% of your gross farm income?

- Yes
- No

13) What percentage of your total family income last year was from the broiler operation? By "total family income" we mean income contributed by all members of your household from other farm enterprises, off-farm jobs, rental income and the like

- less than 25%

- 25% to 50%
  - 50% to 75%
  - 75% or more
- 14) How many times over the past 10 flocks have you been ranked better than average in your sellout group?\_\_\_\_\_
- 15) At the end of 1998, what was the total farm debt in your entire operation?\_\_\_\_\_
- 16) Of the total farm debt, what percentage is owed to your broiler operation?
- less than 25%
  - 25% to 50%
  - 50% to 75%
  - 75% or more
  - Don't Know

Source: Department of Agricultural Statistics, Purdue University, August 1999