Local Monopsony Power in the Market for Broilers? Evidence from a Farm Survey

Nigel Key and James M. MacDonald*

Selected Paper at the Annual Meeting of the AAEA,
Orlando, Florida, July 27-29, 2008.

Abstract. The exercise of monopsony power by broiler processing firms is plausible because production occurs within localized complexes, which limits the number of integrators with whom growers can contract. In addition, growers face distinct hold-up risks as broiler production requires a substantial investment in specific assets and most production contracts do not involve long-term purchasing commitments by integrators. This paper provides an initial exploration of the links between the local concentration of broiler integrators and grower compensation under production contracts using data from the 2006 broiler version of USDA's Agricultural Resource Management Survey. Results of this preliminary study, which accounts for characteristics of the operation and specific features of the production contract, suggest a small but economically meaningful effect of concentration on grower concentration. Limitations of the current analysis and future possible model extensions are discussed.

Key words: poultry, broilers, market power, monopsony, production contracts

*Economic Research Service, U.S. Department of Agriculture. The views expressed are those of the authors and do not necessarily correspond to the views or policies of ERS, or the U.S. Department of Agriculture. Direct correspondence to: Nigel Key, nkey@ers.usda.gov, (202) 694-5567.

Local Monopsony Power in the Market for Broilers? Evidence from a Farm Survey

High and growing concentration in meatpacking has raised concerns that firms could exercise market power in input markets for livestock or in product markets for meat. Most empirical analyses have attempted to test for oligopsonistic behavior by beef and pork processing firms in the livestock procurement market (Marion and Geithman, 1995; Koontz Garcia and Hudson, 1993; Steigert, Azzam, and Brorsen, 1993; Muth and Wohlgenant, 1999; Quagraini, Unterschultz, Veeman and Jeffrey, 2003; Inoue and Vukina, 2006). Some research has attempted to disentangle the gains in economic efficiency resulting from scale economies, from the potential negative consequences of increased market power (Azzam and Schroeter, 1995; Azzam, 1997; Morrison Paul, 2001).

As with beef and pork processing, the broiler industry has become increasingly concentrated in recent years. In 2005, the industry's four-firm concentration ratio based on the volume of production reached 54 (USDA/GIPSA). However, nationwide concentration indexes likely understate concentration in procurement markets, which remain quite localized because of the high costs of shipping live poultry and animals.

Unlike the cattle and hog markets, there have been relatively few studies of monopsony power in the market for broilers (Vukina and Leegomonchai, 2006). Common tests of monopsony power are not feasible in the poultry sector because there is no market price paid for product – almost all procurement takes place under production contracts. Under production contracts, farmers are paid for their growing services, not for the commodity, and are often compensated based on their performance relative to other producers in a pool: pool members with higher feed efficiency and lower mortality earn higher fees (Knoeber, 1989). Procurement markets in broilers are not markets for live poultry, but instead are markets for growers' services, and the market prices are the payments made to growers.

Broiler production occurs within localized complexes operated by integrators. Complexes include one or more feed mills, slaughter plants, and further processing plants that are usually owned and operated by the integrator. A complex will also feature one or more hatchery operations as well as operations producing replacement birds for the hatcheries, which may be operated by the integrator or by farmers who contract with the integrator. Integrators then contract with nearby farmers to grow chicks to market weight, and provide them with chicks, feed, and veterinary services from their own facilities. Economies of scale in slaughter, hatcheries, and feed mills provide incentives to construct large facilities near the center of a production complex. Because transportation costs for feed, chicks, and birds are significant, grow-out costs can be reduced by locating them close to hatchery, slaughter, and feed facilities. There may also be some scale economies in grow-out. These pressures for geographic concentration are limited by negative effects associated with concentration of poultry litter, which can exacerbate pollution risks to water and air resources, and by the biosecurity risks that would arise with concentrating all grow-out with a few very large operations.

The exercise of monopsony power by broiler processing firms is plausible because the localized nature of the production complex limits the number of integrators with whom a grower can contract. Moreover, growers face distinct hold-up risks (Vukina and Leegomonchai, 2006). Houses require a significant investment that is quite specific to broiler production (the cost of modern two-house facility can easily exceed $300,000). In addition, contracts provide very limited guarantees for growers: most specify a very limited term of coverage (a single flock is most common), and most do not include a quantity commitment on the part of the integrator.

The lack of alternatives in broiler production has led to producer complaints about production contracts, and to legislative and regulatory proposals to regulate contracts. For example, Title X (S. 2302) of the Senate version of the 2007 Farm Bill (the Food and Energy Security Act of 2007) expanded protections under the *Agricultural Fair Practices Act* to livestock associations and farmers who use production contracts. Recently legislation (Competitive and Fair Agricultural Markets Act of 2007) was introduced in Congress to, among other things, prohibit unfair or deceptive agricultural commerce acts or practices regarding agricultural production and marketing contracts and set forth agricultural and production contract and enforcement provisions. In addition, GIPSA has recently proposed a rule (Poultry Contracts; Initiation, Performance, and Termination, 9 CFR Part 201, at http://archive.gipsa.usda.gov/rulemaking/fr07/8-1-07.pdf) to require poultry companies to deliver a copy of an offered contract to growers; to include information about any Performance Improvement Plans in contracts, to include provisions for written termination notices in contracts, and allow growers to discuss contracts terms with designated individuals.

This paper provides an initial exploration of the links between the local concentration of broiler integrators and grower compensation under production contracts using data from the 2006 broiler version of USDA's Agricultural Resource Management Survey. Our basic approach is to estimate how the number of locally available integrators influenced the fees that grower's received. The analysis attempts to control for factors that could affect grower compensation. In particular, differences in the technology used on broiler operations will likely affect their relative performance, and so affect compensation. There also appear to be important differences in contract features across growers; some features affect production costs directly, while others assign responsibility for expenses, for assets, or for valuable byproducts to integrators, growers, or third parties. These features are likely to generate offsetting variations in the fees paid to growers under contracts. We expect that these contract features may themselves reflect elements of integrator competition, and these features are also included in the analysis.

The current analysis should be considered a preliminary exploration. In the final section, we discuss some of the limitations of the current approach, and some future possible model extensions.

Survey Data on Broiler Production Operations

Our data are drawn from a large-scale representative survey of broiler producers conducted early in 2007. The survey is part of the Agricultural Resource Management Survey (ARMS), an annual survey of US farms that is the US Department of Agriculture's primary source of information on the financial conditions of farm businesses and farm households, and the production practices of farms. In any given year, several versions of ARMS are distributed; two versions focus on all types of farms, while others focus on producers of specific commodities. A broiler version was included, for the first time, in an ARMS that was conducted early in 2007, with a focus on performance during 2006.[1]

The 2006 broiler version focused on commercial producers of broilers grown for meat--excluding operations who raise broilers for show or for private consumption, as well as egg-laying, hatchery, and broiler breeder operations. To meet that goal, a sample was drawn from a target population consisting of all operations that produced broilers for meat and that had at least 1,000 broilers on-site at any time during 2006. In order to efficiently conduct the survey,

[1] Further information about ARMS, including downloadable copies of the questionnaires used, can be found at http://www.ers.usda.gov/Briefing/ARMS/. Standard ARMS nomenclature refers to the survey by its reference year; thus the survey conducted in 2007, that gathers data on operations during 2006, is referred to as the 2006 ARMS.

standard practice in commodity-specific ARMS versions was followed, and the sample was limited to major production states--in this case, 17 states that accounted for 94 percent of US broiler production in the 2002 Census of Agriculture.[2]

In order to obtain more reliable estimates, some types of farms have a higher probability of sample selection. For example, larger operations are more likely to be selected for inclusion than smaller, and selection probabilities also vary across geographic areas. Each sample farm then represents a number of other farms from a similar geographic location and size class. In the broiler version, weights (the number of farms that each sample point represents) range from 3 to 40 operations. When sample observations are weighted to reflect selection probabilities, population estimates for production and other industry characteristics can be generated.

Out of 2,100 operations in the target sample for the broiler version, 1,602 useable survey responses were received. But 34 of the respondents, while they were still in farming, did not produce broilers for meat during 2006, leaving 1,568 broiler producers for analysis (a 75 percent response rate). Once the weights are recalibrated for nonresponse, the sample of useable responses represents 17,440 producers, and production of 8.4 billion broilers in 2006 (table 1).

Our analysis focuses on 1,546 respondents who reported having a production contract for broilers—the other 22 were independents, processor-owned, or didn't respond to the question. Three of those with production contracts reported no broiler removals in 2006, so we exclude them from our later analysis. Farms with production contracts accounted for 98.5 percent of broilers produced in the 17-state sample for 2006 (table 1).

[2] The states are Alabama, Arkansas, California, Delaware, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, and Virginia. We focus on commercial growers of broilers raised for meat so as to have a large sample of like operations for analysis.

There's a wide range of farm sizes in the industry, with some operations reporting as many as 18 broiler houses. But sixty percent of broiler operations had 1-4 houses in 2006, and they accounted for just under one-half of production, as measured by birds or by liveweight pounds (table 2). While production has been shifting to larger operations, very large operations, with 10 or more houses, still represent a small share of the industry—2.8 percent of production contract operations and about 10 percent of production.[3]

Concentration in Local Markets for Growers

Our concentration measures are grower-reported: that is, survey respondents were asked for the number of broiler companies that were active in their area. By this measure, local markets tend to be highly concentrated. Monopsony (a single integrator in the grower's area) accounts for almost one quarter of operations (table 3), while another 28.7 percent report having two integrators, and 21.7 percent report having three. The highest number of companies reported is nine, and just over one fifth of operations report four or more in their area.[4] Operations who report having many companies in their area tend to be somewhat smaller and older than those reporting 1-3 companies.

Structural monopsony doesn't necessarily imply the exercise of monopsony power, in the form of lower fees paid to growers. In a market for grower services, the alternatives open to current and potential growers may also include other types of farm production as well as off-

[3] Half of broiler production came from farms with at least 605,000 broilers removed (equivalent to 5 houses), and half came from smaller operations. Hoppe et al (2007) show that this midpoint farm size was 300,000 broilers in 1987, and has been increasing since then. Nevertheless, the rate of increase is much less than in other commodity sectors, and the midpoint farm is still relatively small (600,000 broilers, at the average bird size, generates total grower revenues of just over $120,000 in a year).

[4] These estimates are consistent with those reported in Vukina and Leegomonchai (2006), for a 1999 survey of growers in 10 states. In that survey, 28 percent of growers reported a single integrator in their area, and the mean response was 2.48, compared to a mean response of 2.65 across the operations in this survey.

farm employment, so even a monopsony integrator in an area may not have the ability to impose lower fees on growers.

Nevertheless, growers in monopsony locations do appear to receive slightly lower payments, on average, than do growers in areas with more integrators (table 3). Growers with a single broiler company in the area received average fees of 4.82 cents per pound of broilers (liveweight) removed, about 6 percent less than the 5.14 cents received by growers in regions with four or more companies. Growers who report two or three broiler companies receive average fees of just over 5 cents per pound.

The survey provides us with two ways to calculate average fees. Respondents report their total fees received from broiler production during 2006, as well as the total number of birds removed and their average weight. That allows us to calculate a "unit value" fee per pound, which is what's reported in table 3 and in most of the paper. The survey also asks respondents directly for their average fee per pound. We expect that the latter might be more subject to error since growers deliver multiple flocks during the year, and the fees that a grower receives will usually vary across flocks. The two measures provide almost exactly the same average values (5 cents a pound for each median, and the overall means differ by 0.002 cents), and they are strongly correlated with one another (a correlation coefficient of .90). Our models provide a modestly better fit for the unit values than for the average fees, although the effect of competition is slightly stronger for average fees.

Technology, Contract Terms, and Fees

Other factors may affect the fees received by growers. Growers typically receive a base payment, but their total compensation also depends on their relative performance. That is, when a flock is delivered, growers are placed in a pool with other growers delivering flocks in the same period, and those who realize lower chick mortality and lower feed conversion rates realize greater payments. As a result, payments would vary with those features of the farm's technology that encourage greater efficiency.

Base payments may also vary across growers, and growers may receive additional lump-sum annual payments. Our data suggest that contract features vary noticeably across growers and regions. Some features may impose higher costs on growers, which may be compensated with higher base payments. Other features may assign more expenses to integrators, which may lead to lower contract fees paid, while others assign valuable litter byproducts to integrators, growers, or third parties, with consequent impacts on fees.

Table 4, which reports descriptive statistics for the variables used in the analysis, also provides useful summaries of the technological features of broiler operations and the terms of trade observed in production contracts. With regard to technology, the survey asked questions about the operation's broiler housing. Newer houses tend to be larger, and to have climate controls that allow for greater capacity utilization and greater efficiency. The average age of an operation's housing stock is 17.9 years, with a wide variation across operations. Just over 70 percent of housing capacity was fitted with tunnel ventilation, which allows for better climate control in houses.[5] A few operations (1.8 percent) had contracts for organic broilers--while integrators usually bear feed costs, organic production may impose higher costs on growers too.

While integrators provide feed and veterinary services under most production contracts, they may also pay for other expenses, and these features ought to affect base payments. For

[5] Operations usually had tunnel ventilation in all or none of their houses, so the 71.2 percent estimate is also a good estimate of the proportion of operations with the technology. The survey also gathered information on housing construction (solid walls or curtains) and other technology, such as evaporative cooling. These tended to be strongly correlated with tunnel ventilation.

example, growers usually finance their own houses, but integrators own houses on about 2.3 percent of production contract operations. In nearly one-quarter of contracts, the integrator pays for at least part of the grower's fuel or litter expenses, while the integrator bears custom work expenses, for catching or clean-out, in nearly half of contracts.

With regard to contract features, just over one-half of operations had a HACCP food safety plan required in the contract, while just under half reported that there were no antibiotics in the feed that they provided to their birds. A HAACP plan likely imposes higher costs on growers, while doing without antibiotics may lead to higher mortality and poorer feed conversion. Some contracts (12.7 percent) tie fees to indexes of broiler market prices, while most (56.2 percent) adjust fees seasonally for changes in fuel prices. A few (5.2 percent) have tying features, in that they specify a dealer for contractor fuel purchases.

Statistical Inference with ARMS Survey Data

We want to explore how grower compensation varies with features of technology, contracts, and integrator concentration. We begin with several linear regressions, and in each one a measure of contract fees is the dependent variable (we use the unit value fee per pound, the log of that measure, and the log of total annual compensation). The set of explanatory variables includes the measures of contract features, technology, and operation characteristics reported in table 4, as well as the binary competition measures in table 3.

ARMS data are derived from a complex survey design which includes stratification, clustering, dual frames, and unequal probability sampling, and the general consensus among statisticians is that analytical inference needs to account for the design (National Research Council, 2008; Deaton, 1997). There is less consensus as to how to do this.

Most ARMS regression analyses derive weighted least squares parameter estimates using the provided sampling weights, and then estimate the variability of parameter estimates under the sampling distribution. The variance estimation is typically performed using a delete-a-group jackknife procedure, which can be accomplished using a set of 15 replicate weights provided by USDA with the research database. Unfortunately, degrees of freedom in the variance estimator are directly related to the number of replicate weights, which at 15 greatly limit the use of models that are either complex or that include substantial numbers of parameters. Since it appears that contract features vary among producers, that they affect fees, and that there may be several relevant features, this feature of the jackknife approach limits our ability to develop inference tests for individual parameters.

We've taken three approaches to the issue. First, we care about the magnitude of the point estimates of the parameters, and we take some time to talk about them, and to argue that they are substantively important. Second, where the features of contracts and technology are concerned, we are not particularly concerned about statistical significance for individual parameters, although we do care whether groups of variables have statistically significant effects on fees. In those cases, we report a series of F-tests on relevant groups of parameters (table 6). Third, we do care about tests of inference on the individual competition parameters in our model. We ran an initial regression without the competition variables, and in a second regression ran the residuals against the three competition variables. In the second regression, we could estimate error variances for the competition variables using the delete a group jackknife with three parameters. In table 6, jackknife standard errors are reported in bold for the integrator competition variables.

Statistical Analyses of Contract Fees

In our regression analyses, we dropped some observations with extreme values of the dependent variable, while others had to be deleted because they had missing values for some variables. Specifically, we dropped any observation with reported fees (in unit values) of less than 2.5 cents or more than 20 cents per pound, on the grounds that fee revenues, broiler removals, or accounts receivable were likely misreported. In total, 37 of the 1543 observations were dropped for this reason. In addition, 46 respondents did not provide data on housing characteristics, leaving us with 1,460 observations for analyses of the links among technologies, contract features, competition, and fees.

We analyzed several exploratory regressions aimed at explaining variations in fees (per pound) received by growers. All observations were weighted to reflect their sampling probabilities. We analyzed variations in fees per pounds, in the logarithm of fees per pound, and in the log of total fees (while controlling for total output). Results are reported in tables 5 and 6. In evaluating the results, it's important to bear in mind the range of fee payments received by growers. The mean fee was 5.04 cents per pound, while 90 percent of the observations fell in a range of 2.3 cents, from 3.89 to 6.19 cents per pound. Several patterns stand out.

- The characteristics of the broiler operation matter, in an economically substantive way. Operations producing larger birds realize greater fees per bird, but lower fees per pound. On average, a one pound increase in the size of the bird is associated with a 0.12-0.16 cent decline in fees per pound (bird sizes range widely in the data, from 3 to 9 pounds). Organic operations receive about a penny per pound more than those producing conventional birds. There's some evidence that those who apply litter to their own fields, and hence place a higher value on the litter byproduct, receive lower contract fees, although the effects are small and marginally significant.

- Housing characteristics affect fees received in statistically significant and economically meaningful ways. An F test for the joint significance of the set of four housing variables, when added to a regression with only operation characteristics, yields a test statistic of 37.7 (table 6). Operations with tunnel ventilation realize higher fees—about 0.45 cents per pound, or a nine percent increase, on average.[6] Given tunnel ventilation, older houses realize lower fees; a farm with 20 year old houses realize fees that are about 0.4 cents, or 8 percent, below a farm with new houses. Those in which the integrator owns the house realize fees that are half a cent lower.
- Terms of trade (contract features) matter, in economically meaningful and sensible ways. We included nine features of contracts in the model, all specified as 0-1 dummy variables, and they were highly significant in a joint F test for inclusion (table 6). Among the more important effects, operations with long term contracts (5 years or more) received fees that were about 0.18 cents, or 4 percent, higher than others. Operations who reported that there were no antibiotics in their feed received fees that were 0.15 cents higher, while those whose fees were adjusted for changes in fuel prices received 0.1 cents more per pound in 2006. Operations whose contracts tied them to specific energy dealers received noticeably higher fees (0.34 cents per pound), and those whose litter or fuel expenses were paid for by the integrator received lower contract fees (0.19 cents per pound). Those whose custom work

expenses were paid for by the integrator received noticeably higher fees (0.15 cents per pound), perhaps because custom work involved litter cleanout, and transfer of the litter to the integrator or a third party.

- Competition, as measured by the number of integrators in a local area, matters, although the effects are not very large. Compared to areas with 4 or more integrators, growers in areas with a single integrator receive fees that are 0.33 cents per pound lower (about 6.6 percent). Growers who face two or three integrators receive fees that are 2.6-4.0 percent lower than those with 4 or more competitors.[7] What's striking about these estimates is that they are little changed from the comparison of simple means. While measures of housing, contract, and operations characteristics improve the fits of the equations, and these measures appear to affect fees paid, their inclusion has little impact on the estimated effects of the number of integrators.

Conclusions

We draw three conclusions from our initial exploration of the data. Local markets for grower services are highly concentrated. There appears to be small but economically meaningful effects of concentration on grower compensation. But compensation is also affected by contract features, and they vary considerably across growers.

We've characterized this research as exploratory. What's left out? First, within the context of the modeling approach we've taken, concentration is assumed to be exogenous. It may

---

[6] Better climate control raises grower costs, but should raise fees because they increase feed efficiency and reduce mortality. When all growers in an area adopt improved controls, they no longer realize a relative advantage over other growers, and added compensation would have to go into the base pay.

[7] These findings are consistent with other studies of concentration and price (Weiss, 1989; MacDonald, Handy, and Plato, 2002). It's not uncommon to find that concentration has a statistically significant association with price, that is nevertheless rather small in comparison to the predicted effects of pure monopoly or monopsony, nor is it uncommon to find that the effects vary with the number of players, within markets that are quite concentrated.

not be. Suppose some local areas have substantial alternative options for growers, such that integrators of all types must pay more to attract them. In those areas, integrator costs will be higher and presuming that they sell in a national market, integrator profits will be less. Some integrator may exit, raising concentration. In short, the error term may be inversely associated with concentration. If this matters, we may need to think about developing an instrument for concentration.

Second, we haven't developed a comprehensive model of the local market for grower services, in which we would account for grower alternatives and, ideally, identify a grower supply function and estimate the degree to which concentration might allow for the suppression of grower returns.

Third, contract features are not themselves exogenous. For example, we note (in table 4) that few growers have long term contracts. We also note (in table 5) that those who do have long term contracts get higher compensation, even after accounting for the technology used on the operation. But long-term contracts are not offered randomly. They are far more likely to be offered to new operations that are also large operations (MacDonald 2008). While there may be efficiency-based explanations for this pattern, it could also reflect price discrimination in the market for growers--higher prices offered to (marginal) entrants, and lower prices offered to inframarginal existing producers. In input markets for livestock, terms of trade vary widely and matter for analyzing prices. It may be that "terms of trade" also vary widely in markets for grower services, and that they matter for analyzing prices paid in those markets as well.

References

Azzam A.M. **"**Measuring Market Power and Cost-efficiency Effects of Industrial Concentration." *Journal of Industrial Economics* 45(4) December 1997 377-386.

Azzam A.M. (1998) "Captive supplies, market conduct, and the open-market price." *American Journal of Agricultural Economics*. 80:76–83

Azzam, A. M. and J. Schroeter. 1995. "Oligopsony power-cost efficiency tradeoffs in horizontal consolidation: An example from the beef packing." *American Journal of Agricultural Economics* 77 (3): 825–36.

Deaton, Angus. *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. Baltimore MD: Johns Hopkins University Press, 1997.

Farmers Legal Action Group. Comments on Proposed Rule to Amend Packers and Stockyards Act Regulations Concerning Initiation, Performance, and Termination of Poultry Contracts, 72 Fed. Reg. 41,952 (August 1, 2007)

Inoue, A. and T. Vukina "Testing for the principal's monopsony power in agency contracts." *Empirical Economics*. (2006) 31: 717-734

Knoeber, Charles R. "A Real Game of Chicken: Contracts, Tournaments, and the Production of Broilers," *Journal of Law, Economics, and Organization* 5 (Fall, 1989): 271-92.

Koontz. S., P. Garcia and M. Hudson. 1993. **"**Meatpacker conduct in fed cattle pricing: An investigation of oligopsony power." *American Journal of Agricultural Economics* 75 (3): 537–48.

MacDonald, James M. *The Economic Organization of U.S. Broiler Production.* US Department of Agriculture. Economic Research Service. Economic Information Bulletin No. xxx. Forthcoming, 2008.

MacDonald, James M., Charles Handy, and Gerald Plato. "Competition and Prices in USDA Commodity Procurement". *Southern Economic Journal* 69 (July, 2002): 128-43.

Marion, B. and F. Geithman. 1995. **"**Concentration–price relations in regional fed cattle markets." *Review of Industrial Organization* 10: 1–19.

Morrison Paul, C.J. "Cost Economies and Market Power: The Case of the U.S. Meat Packing Industry" *The Review of Economics and Statistics,* Vol. 83, No. 3. (Aug., 2001), pp. 531-540.

Muth, K. M. and M. K. Wohlgenant. 1999. "Measuring the degree of oligopsony power in the beef packing industry in the absence of marketing input quantity data." *Journal of Agricultural and Resource Economics* 24 (2): 299–312.

National Research Council. *Understanding American Agriculture: Challenges for the Agricultural Resource Management Survey*. Panel to Review USDA's Agricultural Resource Management Survey. Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academies Press. 2008

Quagrainie, K., J. Unterschultz, M. Veeman and S. Jeffrey. (2003) Testing for Processor Market Power in the Markets for Cattle and Hogs in Canada. *Canadian Journal of Agricultural Economics* 51:3, 397–411

Stiegert, K. A. Azzam and B. Brorsen. 1993. **"**Markdown pricing and cattle supply in the beef packing industry." *American Journal of Agricultural Economics* 75 (3): 549–58

U.S. Department of Agriculture. Grain Inspection, Packers and Stockyards Administration. *Assessment of the Livestock and Poultry Industries*. *FY 2006 Report*. March, 2007.

Vukina, T. and P. Leegomonchai "Oligopsony power, asset specificity, and hold-up: Evidence from the broiler industry." *American Journal of Agricultural Economics* 88(3) (August 2006): 589-605.

Weiss, Leonard W., ed. *Concentration and Price*. Cambridge, MA: The MIT Press, 1989.

Table 1. Broiler Production in 2006, by Type of Operation

	All Farms		Farms reporting broiler removals		
Type of Operation	Obs.	Farms	Obs.	Farms	Removals
Production Contract	1,546	17,200	1,543	17,183	8,310,308,738
Processor-Owned	12	163	12	163	84,166,446
Independent	6	52	6	52	31,411,423
More than One Type	2	14	2	14	8,219,932
Refusal/Don't Know	2	11	2	11	5,265,540
All Operations	1,568	17,440	1,565	17,423	8,439,372,079

Note: The number of observations is columns labeled "Obs.", while columns labeled "farms" and "removals" report weighted population estimates. Note that 3 sample farms, who reported that they had production contracts, failed to report the number of birds removed.
Source: 2006 Agricultural Resource Management Survey, version 4.

Table 2: The Size Distribution of Broiler Operations in 2006

Number of Houses	Farms	Broilers removed	Pounds removed	Capacity (Square feet)
		-Percent of column total-		
nr	0.5	0.2	0.2	0
1-2	27.3	11.6	10.7	11.0
3-4	43.1	38.0	37.4	38.0
5-6	18.7	25.4	26.0	25.0
7-8	6.1	10.9	11.3	11.8
9-10	1.7	4.2	4.2	4.2
11-12	1.2	3.4	3.6	3.5
13-18	1.6	6.4	6.7	6.6
All Farms	100.0	100.0	100.0	100.0
Total	17,183	8,310 million	44,815 million	1,221 million

Note: Observations are weighted by inverse sampling probabilities to yield population estimates. Source: 2006 Agricultural Resource Management Survey, version 4, production contracts only. The row labeled "nr" includes operations that refused to provide information on houses, or that reported that they had no houses.

Table 3: Concentration in Broiler Grow-out

	Number of Integrators in Grower's Area			
Item	1	2	3	4 or more
Share of all:				
Broiler Operations	24.5	28.7	21.7	25.1
Birds Removed	24.7	29.8	22.7	22.7
Mean:				
Number of houses	4.2	4.3	4.2	3.9
Age of houses (years)	17.7	17.5	18.4	18.5
Fees received (cents/lb)	4.82	5.05	5.03	5.14

Note: Producers were asked for the number of broiler companies in their area.
Observations are weighted by inverse sampling probabilities to yield population estimates.
Source: 2006 Agricultural Resource Management Survey, version 4, production contracts only.

Table 4: Descriptive Statistics for Variables Used in the Analysis

Variable description	Units	Mean	S.D.
Fees from broiler production	dollars	133,141	343,968
Total pounds removed (liveweight)	pounds	2,669,094	6,736,339
Fees per pound	cents	5.04	3.50
Average broiler weight	pounds	5.57	4.85
Capacity utilization (pounds removed)	lbs/sq ft	36.69	44.88
Age of housing stock	Years	17.9	29.3
Share of capacity with tunnel ventilation	0-100%	.712	1.455
Share of capacity owned by integrator	0-100%	.023	0.364
Share of litter spread on fields	0-100%	.402	1.419
Organic operation	0-1	.018	
Flock to flock contract	0-1	.444	
Contract of 5 years or more	0-1	.136	
HACCP plan required	0-1	.545	
No antibiotics in feed	0-1	.429	
Contractor reimburses litter or fuel	0-1	.236	
Contractor reimburses custom work	0-1	.456	
Fees depend on market prices for broilers	0-1	.127	
Fees adjusted seasonally for fuel prices	0-1	.562	
Fees tied to fuel purchase	0-1	.052	

Note: Observations are weighted by inverse sampling probabilities to yield population estimates.
Source: 2006 Agricultural Resource Management Survey, version 4, production contracts only.

Table 5: Effects of Integrator Concentration and Contract Terms on Contract Fees

	Regression Coefficients and Standard Errors			
Dependent variable	Fee/lb	Fee/lb	ln (fee/lb)	Ln (fees)
Intercept	5.8274	6.1806	1.8126	-2.2189
	(0.1159)	(0.2197)	(0.0410)	(0.1270)
Operation characteristics				
Number of birds removed (log)				0.9680
				(0.0082)
Average weight of birds (lbs)	-0.1188	-0.1563	-0.0289	0.8144
	(0.0181)	(0.0201)	(0.0037)	(0.0209)
Organic operation	1.0414	0.9786	0.1551	0.1444
	(0.2004)	(0.1970)	(0.0367)	(0.0366)
Litter applied to fields (%)		-0.0958	-0.0201	-0.0238
		(0.0620)	(0.0116)	(0.0115)
Number of integrators				
One	-0.3656	-0.3339	-0.0656	-0.0598
	(0.0742)	(0.0741)	(0.0138)	(0.0137)
		(0.1159)	**(0.0221)**	**(0.0220)**
Two	-0.0884	-0.1139	-0.0261	-0.0231
	(0.0716)	(0.0727)	(0.0136)	(0.0135)
		(0.1155)	**(0.0219)**	**(0.219)**
Three	-0.1660	-0.1693	-0.0392	-0.0366
	(0.0770)	(0.0759)	(0.0141)	(0.0141)
		(0.1020)	**(0.0218)**	**(0.0218)**
Housing characteristics				
Mean age (log)		-0.1245	-0.0253	-.0376
		(0.0519)	(0.0097)	(0.0101)
Percent tunnel ventilated		0.4519	0.0885	0.0999
		(0.0686)	(0.0128)	(0.0130)
Pounds removed per sq ft		-0.0080	-0.0015	-0.0010
		(0.0020)	(0.0004)	(0.0004)
Owned by integrator		-0.5360	-0.0942	-0.0741
		(0.2342)	(0.0437)	(0.0437)
Contract terms				
Contract is flock to flock		0.0309	0.0063	0.0065
		(0.0562)	(0.0105	(0.0104)
Contract is 5 years or more		0.1822	0.0398	0.0416
		(0.0821)	(0.0153)	(0.0152)
Fee adjusted for market prices		-0.0976	-0.0189	-0.0234
		(0.0821)	(0.0153)	(0.0152)
Fee adjusted for energy prices		0.1079	0.0299	0.0280
		(0.0552)	(0.0103)	(0.0102)
Tied energy purchases		0.3430	0.0617	0.0586
		(0.1216)	(0.0227)	(0.0225)
HACCP plan required		0.0598	0.0132	0.0137

		(0.0557)	(0.0103)	(0.0103)
No antibiotics in feed		0.1469	0.0267	0.0266
		(0.0563)	(0.0105)	(0.0104)
Fuel/litter expense reimbursed		-0.1854	-0.0521	-0.0557
		(0.0694)	(0.0129)	(0.0129)
Custom work reimbursed		0.1548	0.0291	0.0266
		(0.0535)	(0.0100)	(0.0099)
Observations	1506	1460	1460	1460
R^2	0.06	0.15	0.17	0.94

Note. Bold-faced standard errors are jackknife estimates, from secondary regression described in text, page 12.
Source: 2006 Agricultural Resource Management Survey, version 4, production contracts only.

Table 6: Tests of significance for adding variable clusters to pricing model

Model	Description	Critical value	F statistic
1	Operation variables only	3.88	21.32
2	Adding housing variables to (1)	3.40	37.70
3	Adding contract terms to (2)	2.52	8.48
4	Adding competition terms to (3)	3.88	7.87

Note: Variables are identified in table 5. Critical values are for the upper 1% of the F distribution.
Source: 2006 Agricultural Resource Management Survey, version 4, production contracts only.