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# Duration in Production Contracts

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**Abstract:** We use 2003 and 2004 ARMS data to analyze variations in contract duration among growers of broilers who hold production contracts. Most contracts cover just a single flock, but many extend for 1-2 years, and a significant minority of broiler contracts specify lengths of 5, 10, and even 15 years. We find that grower debt and production volume are inversely related to the choice of a short term (a year or less) contract, while lengthy prior experience with the contractor promotes short term contracts. Some contract terms appear to act as substitutes or complements to duration.

## Introduction

Formal contracts cover a steadily growing share of agricultural production. In our recent report, we use USDA survey data to estimate that contracts covered 39% of production in 2003, up from 29% in 1989 (MacDonald and Korb). Contracting's expansion has occurred largely at the expense of spot market exchanges of commodities.

Yet contracts can cover a wide range of agreements and commitments. Some bind buyer and sellers for a short time, covering arrangements for the sale of a fraction of a single harvest. Others commit each side to long-term investments in physical and human capital. For example, growers who enter into hog or poultry production contracts typically invest several hundred thousand dollars in land, structures, and equipment, while contractors usually invest in nearby feed and processing, while also investing in or linking to a network of other growing operations. Such investments bind growers and contractors into long term relationships: in our report, we found that contract broiler producers had typically contracted with their present contractor for 10 years.

The substantial investments and long-term relationships observed in livestock and poultry production contracts also points up an interesting phenomenon: despite the substantial and long-term investment made by growers, production contracts often cover a very short period of time, seemingly exposing the grower to significant risks from non-renewal.

The issue can be illustrated with the data shown in table 1, which is drawn from MacDonald and Korb (2006). In spite of the substantial financial investments that operators make in production contracts, many contracts specify very short durations--the median length of contracts are just 12 months for broilers and for hogs (thus, growers typically recontract each year with the same contractor). However, there's another interesting pattern; while the typical

contract is short-term, there's a wide variation in observed durations. Over 20 percent of broiler contracts and over 30 percent of market hog contracts do not specify a length.<sup>1</sup> Such contracts typically cover a single flock of broilers or a single group of feeder pigs delivered to the producer. Over half of broiler contracts and over a quarter of hog contracts specify a short-term contract, of less than a year. But many producers have contracts with long durations; about 15 percent of broiler contracts and about 37 percent of hog contracts specify contract durations of 5 years or more. Several sample broiler contracts have 15-year durations.

Moreover, larger producers tend to have longer contracts. While only 37 percent of contract hog producers reported that they had a contract of at least 5 years duration, those operations accounted for more than half (56 percent) of contract hog production. Similarly, while one-seventh of contract broiler producers held long-term contracts, those operations accounted for almost one-quarter of contract broiler production. Nevertheless, most broiler contracts, covering two-thirds of contract production, are covered by contracts for a single flock or for short specified durations of less than a year. Since each producer makes substantial long-term investments in structures and equipment (note that over 90 percent of poultry contracts have specific equipment investments specified in the contract), the short term specified in many contracts, the wide range of observed durations, and the differences between broiler and hog contracts, are quite striking.

In this paper, we expand our sample of broiler contracts, and look more closely at the factors behind contract duration. We focus on broilers because we have much larger samples of contract broiler producers.

## **A Theory Framework--Transactions Costs and Contract Duration**

There are thousands of broiler producers in US agriculture, and about 40 major processors—on the face of it, a competitive industry. However, transportation costs (including the mortality risk to chicks and broilers from truck transport) make for local markets in live poultry, greatly reducing the number of potential buyers. Moreover, the industry is organized through a series of production contracts, under which contractors provide growers with feed, chicks, and veterinary and transportation services, while growers contribute on-farm labor, energy, and capital investments in the form of broiler houses and their associated equipment (Knoeber, 1987). Integrators, who are usually also processors, retain title to the birds and transport the grown broilers to processing plants. Payment under broiler production contracts usually takes the form of a tournament, in which growers are paid for their performance relative to that of a comparison group. Performance reflects feed conversion and mortality, and growers usually receive a base pay, and may receive separate reimbursement for capital expenditures.

Investments in broiler houses are relationship-specific investments, in the sense that they have limited value in alternative uses. Most growers have few alternatives once they enter into a contract: only 40% of the growers in our sample report that there is another contractor in their area. Moreover, the investment can be significant: a modern broiler house (66 feet wide by 600 feet long), can cost \$9.50 a square foot for grading, construction, and equipment, or over \$375,000. Growers rarely have a single house, and three houses will require an investment of over \$1,000,000, in addition to the commitment of the growers human capital to learning the business.

Once the investment is made, growers face the risk of opportunistic behavior by integrators, who may have considerable monopsony power at that point. Without a contract,

integrators may force prices down to just cover marginal expenses, thus appropriating investments. With a short-term contract, integrators may adjust payment schemes, or hold up growers for additional investments, as a condition of renewal.

These combined factors, of relationship-specific investments and opportunism, can limit the effectiveness of spot markets and lead to reliance on contract and vertical integration, and transactions-cost economics has had considerable success in using these concepts to explore choices among these different ways of organizing production and exchange (Williamson, 1985; Knoeber, 1987; Allen and Lueck, 2002). However, once market participants decide to rely on contracts to govern exchange, they still have a wide variety of choices to make when designing the contract.

Given the long-term nature of investments in broiler production, one would expect contracts to be long-term, in order to match the flow of revenues to that of the investment.<sup>2</sup> But there are alternatives to contract duration, that can also ensure commitment. For example, integrators can offer to pay, partially or fully, for growers' capital investments, through reimbursement or through ownership of the facilities, thus reducing growers' risks. Conversely, contracts may commit growers to more investments beyond production facilities, increasing the risks from opportunism and requiring offsetting payments or guarantees through duration. Alternatively, the parties may develop trust through a long-term working relationship that limits the need to specify long durations.<sup>3</sup>

Our analyses in this paper are preliminary; we seek to explore whether and how elements of the investment and the contract affects choices of duration. We will focus on the debt incurred by the grower, the size of the investment as indicated by annual production, the familiarity

between grower and integrator (the number of years they have contracted), and contract features that complement or substitute for duration choices.

## **Our Data**

For this study, we relied on data drawn from the 2003 and 2004 Agricultural Resource and Management Surveys (ARMS). Conducted annually, ARMS provides information on a stratified random sample of U.S. farms and is USDA's primary source of information on the financial condition, production practices, resource use and economic well-being of U.S. farm households.<sup>4</sup> The 2003 survey, collected during the winter and early spring of 2004, collects data on farm operations during calendar year 2003, while the "2004" survey captures data for farm operations during calendar year 2004. Some farms complete a core version of the survey, distributed and returned by mail, while others complete longer versions through personal interviews with trained enumerators. Each version asks farmers about the use of production or marketing contracts, and the volume of production, receipts, and unit prices or fees received for each commodity under contract. The longer version includes more detailed questions on contractors, contract terms, and alternatives available to farmers. We were able to obtain data for 526 contract broiler operations in 2004 and 409 such operations in 2003, and those observations form the dataset we analyze in this paper.<sup>5</sup> Further information on ARMS, including downloadable questionnaires, can be found at [www.ers.usda.gov/Briefing/ARMS/](http://www.ers.usda.gov/Briefing/ARMS/).

For purposes of this paper, we should note one drawback of the survey. It is aimed at contract producers of any commodity, and so we must ask rather generic questions that can apply rather broadly, and must forego questions that might be quite specific to producers of specific commodities.<sup>6</sup> For this analysis, the specific question that forms the dependent variable is: "How

long is the length of the contract?” (in months). Enumerators carry a manual that provides them with background on each question, and in this case enumerators are given examples of lengths, and advised to enter the length of a typical production cycle if the contract is specified in that way (such as one flock of chickens), and to record zero if the contract doesn’t specify a length. Responses to this question tend to cluster at zero, and at 1, 2, 3, 6, 12, 24, 36, 60, 120, and 180 months (the shorter intervals are probably specified in terms of production cycles). We should point out one distinct difference between the two survey years: the 2003 survey contained far more observations with 10-15 year contracts (23) than the 2004 survey (1). We’re not certain why, and are still exploring that issue.

### **Differences Among Short, Medium, and Long-Term Contracts**

Table 2 summarizes our data, and begins to give some hints of the factors that may drive duration on contracts. We have sorted our samples into the three categories of duration listed in table 1: short term contracts are 12 months or less; long term contracts are 5 years (60 months) or more; and medium term contracts fall in between, from 13-59 months.

Annual quantities rise, although not dramatically, with length of contract. Operators with long term contracts (5+ years) produce about 1/3 more birds, on average, than those with short term contracts, and quantities increase steadily across size classes. Similarly, debt appears to be associated with contract length: those with long term contracts have much higher levels of debt (at the median, almost four times as much) as growers with short term contracts, and debt also increases steadily across the three duration classes.

We asked respondents to list the number of years that they had grown for their existing contractor, and mean responses were much higher for growers with short-term contracts—12.5



years--as compared to 9 years for medium term contracts and 7 years for growers with long term contracts (here, means and medians were not far apart).

Because the survey covers the whole farm, we can also identify production from any of the farm's other agricultural enterprises. Here, the distinction between means and medians matters. Most operations specialize in broilers. At the median, nonbroiler receipts amount to only 2 percent of broiler receipts for operations with short term contracts and zero (completely specialized) for those with median term contracts, while operations with long term contracts appear to have some other relatively modest operations. But means are much larger than medians, suggesting that a few operations have large non-broiler farm enterprises.

We asked about several aspects of the contracts themselves, and report on those that showed some variation across duration classes. Only some contracts specifically require the producer to identify and access specified cropland for litter distribution, but long-term contracts are a little more likely to have that requirement. We also asked respondents if there were other contractors for the commodity available in their area; most responded that there were none, with a distinct difference in response (fewer reporting alternative contractor availability) among medium term respondents.

Finally, we asked about equipment and structures, although the questions varied between 2003 and 2004. In 2003, we asked whether the contract required respondents to use specific types of equipment or structures; most responded that the contract did, with the requirement less likely to appear in short term contracts. In 2004, we asked a distinctly different question: did the contractor reimburse the respondent for equipment or structures expenditures specifically required by the contract? Such reimbursement was common, but much more common among respondents with short term contracts.

## **Analysis of Contract Duration**

For an initial exploration of the data, we sorted our responses into two duration classes—12 months or less (short-term), and more than 12 months. This approach splits the data in an interesting and feasible way, leaving a finer analysis of response clusters for later work.

With the dependent variable specified as a (0-1) choice, with the “1” being a short-term contract, we used a logit model to examine the factors driving choice of a short-term contract.

We expect that those growers, and their lenders, who have substantial sunk investments at risk in a relationship will want the protection of a long term contractual guarantee. Hence, we expect that grower debt and annual broiler quantity will each be negatively related to the choice of a short-term contract.

However, contractors may be able to offer alternatives to contract length, as a way of demonstrating commitment. One alternative is demonstrated past commitment, and we expect that those growers who have had long working relationship with their contractor will be less likely to require a long-term contract.<sup>7</sup> Alternatively, contractors may signal commitment by providing partial or full financing for the grower’s investment. In the 2004 survey, we asked respondents whether they had received reimbursement from the contractor for equipment or structures expenses, and we expect that those who did were more likely to carry a short-term contract.

We report our logit results, for combined data from the 2003 and 2004 surveys, in table 3, and they are quite promising. In equation (1), debt and annual production are inversely associated with the choice of short-term contracts, while familiarity (years contracting with contractor) is positively associated with short-term contracts. The associations are statistically

significant, and also substantively significant. Consider how predicted probabilities (that a contract will be short-term) relate to various combinations of explanatory variables. Where debt and quantity are relatively small (\$50,000 and 300,000, respectively), and the grower and contractor have a long-standing relationship (15 years), the probability that the contract will be short term is quite high—79%.<sup>8</sup> As we successively change each of the three drivers, to 300,000 in debt, 500,000 in output, and a 4 year relationship with the contractor, the probabilities drop to 68%, 65%, and 55%, respectively.

Some contractual terms also have substantive impacts; for example, if the contract also specifically requires the grower to identify land that the grower can access for litter distribution, the short-term probability drops further, to 45% (from 55%, with relatively high debt and output and a short relationship). The effect appears to be statistically significant in equation 1, when we use two years worth of data, although it shrinks in size and significance when we restrict the sample to 2004 data only, in equation 3.

We did not ask about reimbursement of capital expenditures in 2003, so we limited the sample to the 2004 observations to assess that impact. Results from that estimation are reported in equation 3. Coefficients on contract quantity, and on grower debt and experience with the contractor, have the same signs as they had in estimations using the larger sample, and very similar magnitudes. The coefficient on capital reimbursement is positive, statistically significant and substantive—starting at the values for other variables noted above, a contract with capital expense reimbursement raises the short-term probability by 5-6 percentage points.

We explored an alternative specification in equation 2, by altering how the length of the grower-contractor relation might affect duration. Instead of using a continuous measure (years holding contracts for this commodity with this contractor), we alter to a 0-1 measure (equal to 1

for a short relationship of five years or less). This specification implies that additional years of experience, after five years working together, have no extra impact on duration. The choice of a five year cut-off is arbitrary, and we will explore this choice in more detail in later analyses. We then interacted the dummy variable with debt and with output size, to allow the effect of each to vary with familiarity.

When we use the alternative specification, we can see that the coefficient on debt changes, and is substantially larger for less experienced growers—that is, less experienced growers with high debt loads are less likely to use short-term contracts and more likely to choose long term contracts. This is a suggestive finding, but one that we’ll need to explore in greater detail as we consider alternative model specifications.

## **Next Directions**

This is a preliminary look at the data and the issue. We obtained some promising results—specified contract durations appear to be linked to the investment risks incurred by the grower, and they appear to be influenced by other aspects of contract design. The effects appear to be economically substantive, and they are also consistent with the framework offered by transaction cost economics. But a number of important issues remain to be explored. They include:

- Tests of inference. We haven’t adjusted logit standard errors to reflect the complex nature of the design of the ARMS survey. Adjustment will not affect coefficient estimates, but will affect estimated standard errors.
- Functional form. The logit model imposes a fairly restrictive functional form on the data, and forces our variables to be complementary in their impact on duration. That

is, the impact of debt, for example, is greater, the greater are the values of quantity and years with the contractor. But the factors may actually substitute for one another in contract choice; as a result we need to explore the functional form of this simple model more closely.

- The measure of duration. At this stage, we've simply analyzed a two-way choice—long or short term contracts, with the split at 12 months or less. But our data cluster at 0 (no length specified), 1, 3, and 12 months, in addition to specific clusters among the long-term contracts. We need to assess whether those clusters are meaningful.
- Location. Markets for growers are local. In locations where growers have more alternatives, contractors may have to offer more assured deals. We have information on the location of growers, but have not exploited that data yet.
- Contractors. We do not know the identity of contractors, and we do not know which growers have the same contractors. Some contractors may simply follow idiosyncratic contracting strategies, irrespective of the factors listed above. With these data, we cannot focus on contractor-specific decisions.

Table 1: Duration of production contracts for broilers and market hogs, 2003

Length of contract	Commodity under contract	
	Broilers	Market hogs
	<i>Percent of Contracts</i>	
No length specified	21.5	30.1
Short term: 12 months or less	55.7	27.9
Medium term: 13-59 months	8.1	5.1
Long term: 60 months or more	14.7	36.9
	<i>Percent of Contract Production</i>	
No length specified	20.9	19.4
Short term: 12 months or less	46.3	21.1
Medium term: 13-59 months	8.9	3.5
Long term: 60 months or more	23.8	56.0

Source: MacDonald and Korb (2006).

Table 2: Contract and Grower Differences by Length of Contract

Contract & operator characteristics	Length of Contract		
	Short	Medium	Long
Annual quantity removed	<i>Broilers (000)</i>		
Mean	414	505	560
Median	360	390	484
Debt (000)	<i>Dollars (000)</i>		
Mean	188	284	387
Median	74	243	287
	<i>Years (mean)</i>		
Experience with contractor	12.5	9	7
Farm Business Diversification	<i>nonbroiler/broiler receipts</i>		
Mean	.27	.47	1.08
Median	.02	.00	.11
	<i>percent of contracts:</i>		
Land requirement for litter	18.4	20.0	23.8
Other contractors available	40.5	21.5	39.6
Contract specifies equipment <sup>a</sup>	88.0	100.0	98.6
E&S reimbursement <sup>b</sup>	82.0	56.3	45.9

Source: Data developed by authors from 2003 and 2004 USDA Agricultural Resource Management Surveys.

<sup>a</sup>Only asked in 2003—Does the contract require you to use specific types of equipment or structures?

<sup>b</sup>Only asked in 2004—How much did the contractor reimburse you this year for current or previous equipment or structures expenditures specifically required by the contract?

Table 3: Logit analysis of incidence of short term contracts

Variables	2003 & 2004	2003 & 2004	2004 only
	Coefficients and standard errors		
	(1)	(2)	(3)
Intercept	7.845 (2.0034)	13.6569 (2.3306)	8.3062 (3.4645)
Contract quantity (log)	-0.3151 (0.1203)	-0.7898 (0.3411)	-0.3145 (0.1519)
Debt (log)	-0.3104 (0.0503)	-0.2206 (0.1073)	-0.3177 (0.0488)
Years with contractor (log)	0.2961 (0.0885)		0.4764 (0.0969)
5 years or less with contractor (0-1)		-11.7669 (4.2941)	
Interacted with quantity		1.2509 (0.4332)	
Interacted with debt		-0.3856 (0.1429)	
Another contractor (0-1)	0.4420 (0.2007)	0.4724 (0.2021)	0.7660 (0.3853)
Diversification	-0.0850 (0.0536)	-0.0760 (0.0538)	-0.3879 (0.1637)
Land requirement (0-1)	-0.4259 (0.1124)	-0.5012 (0.0991)	-0.1108 (0.0964)
Low off-farm income (0-1)	0.2198 (0.0758)	0.2890 (0.0911)	0.1406 (0.0848)
2004 (0-1)	0.9126 (0.1593)	0.9701 (0.1617)	
Capital Reimbursement (0-1)			0.2374 (0.0577)
Number of observations	906	906	487

Source: Analysis, by authors, of 2003 and 2004 USDA ARMS data



## References

Allen, Douglas W., and Dean Lueck. *The Nature of the Firm: Contracts, Risk, and Organization in Agriculture*. Cambridge, MA: The MIT Press, 2002.

Corts, Kenneth S., and Jasjit Singh. "The Effect of Repeated Interaction on Contract Choice: Evidence from Offshore Drilling." *The Journal of Law Economics and Organization* 20 (April, 2004): 230-260.

Crocker, Keith J., and Scott E. Masten. "Mitigating Contractual Hazards: Unilateral Options and Contract Length." *Rand Journal of Economics* 19 (Fall, 1988): 327-343.

Joskow, Paul L. "Contract Duration and Relationship-Specific Investments: Evidence from Coal Markets." *American Economic Review* 77 (March, 1987): 168-85.

Key, Nigel and William McBride "Production Contracts and Productivity in the U.S. Hog Sector." *American Journal of Agricultural Economics*. February 2003, vol. 85, no. 1, pp. 121-133

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.

MacDonald, James, and Penni Korb. *Agricultural Contracting Update: Contracts in 2003*. USDA Economic Research Service. Economic Information Bulletin No. 9. January, 2006.

Ollinger, Michael, James M. MacDonald, and Milton Madison. "Technological Change and Economies of Scale in U.S. Poultry Slaughter". *American Journal of Agricultural Economics* 87(February, 2005):117-30.

Pirrong, Craig. "Contracting Practices in Bulk Shipping Markets: A Transactions Cost Approach." *Journal of Law and Economics* 36 (October, 1993): 937-76.

Williamson, Oliver. *The Economic Institutions of Capitalism*. New York: The Free Press. 1985.

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<sup>1</sup> Our survey data source (described below) asked respondents to state the length of their contract, in months, and to report zero for those contracts that didn't specify a length.

<sup>2</sup> Pirrong (1993) uses that concept—investments that vary in specificity and the duration of the linkage—to explain differences in shipping finance and contracting across commodities.

<sup>3</sup> Allen and Lueck (2002) show that leases of cropland tend to be less formal when the parties have a prior relationship.

<sup>4</sup> The ARMS does not contain a longitudinal component and to reduce year-to-year respondent burden a statistical procedure is used to minimize the probability of selection of large farms in consecutive years. Thus the broiler data for 2003 and 2004 are drawn from independent samples.

<sup>5</sup> We usually obtain data for much smaller samples of contract feeder-to-finish hog operations (40-60) in ARMS surveys, because production contracting is less widespread in hogs than in broilers, because there's a wider variety of production types in hog production, and because hog production may be more concentrated on fewer operations.

<sup>6</sup> Our data are drawn from the CRR (costs and returns) version of the enumerated surveys, which cover producers of all commodities. In each year, USDA also distributes up to three commodity-specific versions, which direct questions to a specific commodity enterprise, and targets producers of those commodities. ERS is currently analyzing data from a 2004 hog version and collecting data from a 2005 dairy version, while preparing a 2006 broiler version. For an example of analysis using a commodity-specific version, see Key and McBride (2003).

<sup>7</sup> We asked the question "For how long [years] have you had contracts for this commodity with this contractor?"

<sup>8</sup> With all other variables set to 0.