Factors Affecting Contractor and Grower Success in Hog Contracting

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Abstract

This study analyzes a national survey of U.S. hog producers within a principal-agent framework in order to examine factors affecting contractor and grower success in hog contracting. Several factors had differential impacts on contractor and grower returns. Results suggest that there may be a role for public policy in ensuring that contract arrangements are conducted fairly.

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Introduction

The hog industry has rapidly consolidated during the 1980s and 90s. The four largest hog slaughter firms accounted for 54 percent of total commercial hog slaughter in 1997, up from 40 percent in 1990 and 34 percent in 1980 (USDA, GIPSA). Hogs marketed from operations producing 50,000 head or more increased from 18 percent in 1994 to 38 percent in 1997, while hogs marketed from operations producing 500,000 head or more increased from 10 to 24 percent (Lawrence, Grimes, and Hyenga). A key element of this rapid restructuring of the hog industry was the widespread growth of contract marketing and production arrangements. Marketing contracts between packers and large hog operations ensure a large and stable volume of uniform type hogs for packers and reduce the market price risk for large hog producers. To deliver the volume of hogs desired by packers and to achieve economies of size in hog production, large operations (i.e. contractors) often recruit many smaller operations (i.e. growers) to produce hogs under production contracts.

Public concern about these arrangements in the hog industry stem from the increasing market power concentrated among packers and large hog operations (Hyenga, Harl, and Lawrence). Marketing contract arrangements between packers and large operations insulate large producers from some of the hog price variation in the “spot market” to which most small independent producers are subjected. Also, because terms of production contracts are often complex and because the non-market benefits such as risk reduction, transportation costs, coordination services, or credit provisions are not readily transparent, it can be difficult for producers to evaluate the benefits from production contracts. As contracts become more prevalent and as the hog industry becomes increasingly concentrated, it is possible that large operations will use their bargaining power and the opaque nature of contracts to extract more of the economic surplus from contract arrangements at the expense of the contract growers.

This study examines the use of production contacts in the hog industry by casting hog contracting in a principle-agent framework and identifying factors that have affected financial performance in hog contracting. Specifically, this study empirically examines: (1) What characteristics of hog contracts, hog operations, and contract participants are associated with financial performance in the hog contract relationship?; and (2) Do the factors affecting financial performance differ for the contractor and the grower, as might be expected in a principle-agent relationship? These results should identify potential issues of conflict in the contract arrangement and could be useful in defining a role for public policy, if any, in ensuring that these business arrangements are conducted fairly.

Background

In a typical production contract arrangement for hog finishing, the owner of feeder pigs (i.e. contractor) engages a producer (i.e. grower) to take custody of the pigs and finish them in the producer's facilities. The contractor most often furnishes feed and veterinary services. The grower usually receives from the contractor a fee for services, and in many cases some performance incentive (Rhodes). While the use of contract production has increased among all producer types, these arrangements have been predominately used among specialized feeder pig, weanling, and finished hog producers.

Contractors are a diverse group that can have various types of business organizations, but the type of contractor most responsible for the rapid growth of hog contracting is the integrator. An integrator is mainly responsible for coordinating the production from many different growers. This usually involves supplying feed to several different production sites (i.e. grower operations), and moving animals from site to site and to the processor as the animals move through each stage of production. Input suppliers or packers are other types of contractors that may use contract production to vertically integrate business activities, such as feed or hog processing. Farmers can also be contractors that employ other farmers as growers in order to expand or specialize their hog operation.

Contract production is regarded as an effective means for the contractor to achieve economies of size in hog production while requiring minimal capital and labor. In a survey of large hog contractors, the increased financial leverage resulting from substituting grower capital for contractor capital was the most frequently mentioned advantage of contract production arrangements (Lawrence, Grimes, and Hayenga). Other important advantages mentioned in the survey were the mitigation of environmental/regulatory problems and the sourcing of quality labor. The loss of operational control was the leading disadvantage reported by contractors, followed by increased production costs. Having to pay for grower assets and disagreements with growers were also cited by contractors as important disadvantages of contract production.

Growers have embraced contracting as a means of reducing risk, accessing capital, and stabilizing income. Survey results suggest that risk reduction is the leading reason that producers enter into contract arrangements, followed by lack of capital and the need for more income

(Wind-Norton and Kliebenstein). Several studies have demonstrated that risk-averse producers would prefer contracting to independent production (Martin; Johnson and Foster; Parcell and Langemeir). However, there is a risk/expected-return tradeoff involved with hog production contracts and an important part of this tradeoff is the loss of control by growers. Operational control has several dimensions with regard to contract production, such as management responsibilities, contract incentives, and contract duration. There is evidence showing that for some hog producers, autonomy was more important than risk reduction in selecting between contract and independent business arrangements (Gillespie and Eidman). This may explain in part why the growth of contracting has varied among different areas of the country, and why new entrants to the hog industry have been more attracted to contracting than have established independent producers[3].

Hog Contracting in a Principle-Agent Framework

The principle-agent framework, in which the grower can be viewed as an agent of the contractor, has been used to model incentives associated with contracting (Stiglitz; Sappington; Sheldon). This approach recognizes that the interests of the parties in an agreement can diverge, and that incentive mechanisms to maximize performance are difficult to construct when the inputs (e.g. effort) and/or outputs (e.g. product quality) of the agent are not observable by the principle. Problems that the principle-agent approach seeks to model include the issue of disagreements (different agendas), mismanagement, insufficient motivation, and financial risk. These are many of the disadvantages of contracting reported by large-scale contractors and growers (Lawrence, Grimes, and Hayenga; Hennessy and Lawrence).

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[3] The impact of production contracts on hog farm performance is explored by Key and McBride.

The standard static principle-agent problem is one where a principal (i.e. hog contractor) seeks a contract with an agent (i.e. hog grower) that will maximize the principal's expected utility. This is contingent on the agent undertaking some set of actions to maximize his/her own utility, given the compensation scheme and the agent being willing to undertake the contract. The problem has been formally presented by Sheldon, and is presented for hog contracting as follows. Suppose the compensation scheme or fee schedule that the contractor pays the grower depends only on the output of hogs Q that is observable to both the contractor and grower:

(1) $$W(Q)$$

where the function W defines the terms of the contract, often involving a fixed payment per head plus a bonus based upon animal performance. Suppose the output Q is a function of both effort exerted by the grower e, and some random productivity factor θ:

(2) $$Q(e,\theta)$$

where θ represents shocks from such incidents as disease, unfavorable weather, or other disaster (i.e. production risk). The relationship between the contractor and grower can be regarded as a two-stage game where the contractor moves first by establishing the payment scheme W, and then the grower exerts effort e having learned W. The grower will exert effort to maximize expected utility, which is a direct function of both his fee (positive utility) and effort (negative utility):

(3) $$\max_{e} \mathrm{EU}\left[W(e,\theta),e\right]$$

Because the contractor has imperfect information about the grower's effort, he/she cannot determine with certainty whether the level of output resulted from a random event (e.g., disease) or lack of effort by the grower. In other words, the contractor cannot infer the effort of the grower directly from the outcome, so the contractor must design a payment scheme *W(Q)* that depends only on observable output. If the grower is risk-averse and is presented with a payment scheme based solely on animal performance, the grower is forced to bear all the risk of low output and can be expected to under-apply effort. Alternatively, if the contractor completely insures the grower against income risk by offering solely a fixed payment for the grower's services, the grower has no incentive but to minimize his effort[4]. The objective of the risk-neutral contractor is then to maximize expected returns, recognizing that the payment scheme must satisfy both the grower's incentive compatibility and rationality constraints.

(4)
$$\max_{W(Q)} \mathrm{E}\Pi = \mathrm{E}\left[f(Q) - W(Q(e^*,\theta))\right]$$
$$\text{s.t.}\quad \mathrm{EU}\left[W(e^*,\theta), e^*\right] \geq \mathrm{EU}\left[W(e,\theta), e\right]$$
$$\mathrm{EU}\left[W(e^*,\theta), e^*\right] \geq \overline{\mathrm{U}}$$

Returns for the contractor are a function of hog output under contract $f(Q)$ and fees paid to the grower. The first constraint is the incentive compatibility constraint implying that a grower will only undertake optimal effort e* if it is in his/her best interest. The second constraint is the rationality constraint, where $\overline{U}$ is the grower's next best opportunity.

[4] Shavel provides proof of the proposition that for a risk-averse agent, the Pareto optimal fee schedule is one where (a) the agent's payment must depend to some extent on the outcome, but (b) the agent never bears all of the risk of an unfavorable outcome.

Solution of the optimization model determines the fee schedule that induces optimal effort e^* which, after resolution of the random shock, results in the observed returns to the contractor and the observed grower fees:

(5a) $$\Pi = \Pi(e^*, \theta)$$

(5b) $$W = W(e^*, \theta)$$

This conceptual framework provides the basis for estimating the following equations:

(6a.) $$\Pi = X\beta_1 + \tilde{e}\alpha_1 + \varepsilon_1,$$

(6b.) $$\mathrm{W} = X\beta_2 + \tilde{e}\alpha_2 + \varepsilon_2$$

(6c.) $$\tilde{e} = Z\gamma + \varepsilon_3,$$

where Π is the contractor's returns, net of the fees W paid to the grower. X is a matrix of exogenous variables that shift: 1) the contractor's returns on output $f(\cdot)$; 2) the optimal fee schedule $W(\cdot)$; 3) the expected utility of the grower $EU(\cdot)$; 4) the grower's reservation utility $\overline{U}$; and 5) the type and extent of the shock θ. Optimal effort e^* is unobservable. However, optimal effort is correlated with output productivity – increased effort results in higher output, holding other inputs fixed. Hence, productivity $\tilde{e}$ can be used as a proxy for the optimal effort level. The effort put forth by the grower depends on Z, a matrix of variables that influence effort, including the payment scheme offered by the contractor. The vectors, ε_1, ε_2, and ε_3 are errors that may be correlated as discussed below.

Data and Methods

Data for the analysis comes from a detailed survey of U.S. hog producers conducted in 1998 as part of USDA's annual Agricultural Resource Management Study (ARMS). The survey collected information about hog production arrangements and performance, hog costs of production, and the farm financial status. On hog contracting operations, the survey collected specific data on the costs and returns of the grower and the contractor, the type of contractor, the nature of the contract arrangement, and characteristics of the grower and the grower's operation. Data on 248 operations finishing hogs under contract were used in the analysis.

In order to estimate the general model specified in (6a-c) for hog contracting operations, a measure of effort exerted by the grower was needed. Quantifying effort in terms of hours and animal husbandry was not possible from the survey data. Instead, the rate of feed conversion achieved on the operations, measured as pounds of feed fed per pound of gain, was used to quantify effort. Hog contractors often base performance bonuses on feed conversion relative to a standard, and it has been used in other studies to evaluate performance payments and risk sharing in hog contracting (Johnson and Foster; Martin). However, a problem with using feed conversion to estimate contractor and grower net returns is that they are determined jointly, which if left uncorrected, would result in simultaneous equation bias. Feed conversion directly affects contractor returns by lowering input costs, and can directly influence grower returns through the incentive mechanism. Thus the error terms in (6a-c) may be correlated. This problem was overcome by estimating (6c) with feed conversion as the measure of effort and using the predicted value of feed conversion as an instrument in estimating (6a) and (6b). Parameter estimates obtained from this specification are both consistent and free of simultaneous equation bias.

Independent variables specified in the effort equation (6c) included those describing the payment scheme offered by the contractor, contract characteristics, and characteristics of the grower and the grower's operation (table 1). The payment scheme was specified using binary variables indicating whether the grower was paid a fixed amount, a fixed amount with an incentive bonus, or according to a profit sharing incentive. Payment schemes with performance incentives were expected to increase grower effort. Contract characteristics included contract size, binary variables for whether the contractor provided feed to the operation and monitored animal health, and the placement and removal hog weights. Grower characteristics were specified as indicators of the managerial time and ability of the grower, and included grower experience, education, and a binary variable that indicated if the grower's major occupation was off-farm employment. Also included was the degree to which the grower's operation was specialized in hog production and the age of the grower's production facilities[5].

Financial performance equations for the contractor (6a) and grower (6b) were estimated using gross returns net of operating and asset ownership costs, excluding land and unpaid labor, as the dependent variable. Since the contractor owns and sells the final product, gross returns of the contractor were defined by the value of the finished hogs[6]. Gross returns of the grower were mainly the fees paid by the contractor for grower services, which is a cost to the contractor.

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[5] The genetic capability of the hogs would also have a significant impact on their feed conversion. However, the genetic capability of hogs is very difficult to quantify and was not available from the survey data.

[6] Actual market hog price received by the contractor was not collected in the ARMS and so State average prices were used to value the finished hogs. This "spot market" cash price is likely to be less than what many contractors received under marketing arrangements with packers. However, this method of valuing the hog production should not affect the analysis of the contract arrangement since the contractor typically bears all of the price risk in these type of arrangements (Rhodes; Knoeber and Thurman).

Other costs, including feed, other variable inputs, and capital, were charged to each participant according to their contribution. A detailed breakdown of the average costs contributed by growers' and contractors' are shown in table 2. Contractors' incurred nearly all the operating costs by providing the feed and feeder pigs, while growers' paid for most of the fuel and electricity, repairs, and hired labor. Growers' main costs were the ownership costs associated with the production facilities.

Regressors specified in the performance equations included the type of contractor, years under contract with the current contractor, services provided by the contractor, and characteristics of the grower and the grower's operation. A set of binary variables were used to specify the services provided by the contractor as part of the arrangement, including whether the contractor provided facility financing, provided facility specifications, monitored animal health, and/or provided planning and other assistance with manure management. Also included were variables for whether the grower was located in North Carolina where hog contracting first gained widespread use, and grower effort, as indicated by the predicted feed conversion from (6c).

The parameters of equations (6a-c) were estimated with the ARMS survey weights using weighted ordinary least squares. Due to the complex design of the ARMS sample, standard errors were estimated using a jackknife replication approach (Dubman, 2000).

Results

Parameter estimates for the equation used to describe the effort exerted by growers are shown in table 3. Feed conversion, measured as pounds of feed fed per pound of gain, was used to approximate grower effort. A negative parameter estimate implies that an increase in the explanatory variable results in less feed being fed per pound of gain, and thus an improved feed conversion. Using a fixed payment scheme with a bonus incentive lowered feed conversion relative to a strictly fixed payment scheme. This implies that this incentive mechanism was positively correlated with grower effort, as postulated in the principle-agent framework. However, the profit sharing incentive did not significantly impact feed conversion. Principle-agent theory suggests that a profit sharing incentive may shift more risk to growers who are risk-averse than is optimal to induce effort.

The negative coefficients on size of contract and grower experience means that increasing these items improves feed conversion, an indication of greater grower effort. Grower effort could be expected to increase with size of the contract because the grower has a greater financial stake in the outcome on larger operations. Grower experience may be an indicator of the grower's husbandry and/or managerial ability, and thus quality of the effort. Feed conversion also improved if the contractor provided the feed, possibly because contractors used higher quality feed items or because contractors were better at matching feed composition with animal nutritional requirements over the life of the animal. Feed conversion was expected to increase with animal weights because animal physiology dictates that with all else being equal, more feed is required to add gain at greater hog weights. Higher placement weights were associated with a higher feed conversion, but greater removal weights lowered feed conversion. Differences in the genetic capability of the hogs may have influenced this relationship.

Parameter estimates for the financial performance equations for growers and contractors are shown in table 4. The grower model explained 25 percent of the variation in the net returns of growers, while the contractor model explained 41 percent of the variation in contractor returns. Several explanatory variables were significant in both models.

Contractor type and location were included as shifters in the financial performance equations. Estimates on the variables for contractor type indicate that contractors who were integrators had significantly higher net returns, about $10 per hundredweight, than did vertically integrated contractors and other farmers. Growers for integrators had significantly lower net returns than did those for vertically integrated firms, about $3 less per hundredweight. Integrators have generally been in the business of hog contracting longer than the other contractor types and are the most specialized type of hog contractor. This experience and specialization in hog production may have enhanced their ability to design contracts that extract more of the economic surplus from these business arrangements.

Most of the variables describing the contract arrangement had a significant impact on financial performance, although in some cases the impacts differed for the contractor and grower. Contract size was associated with higher returns per unit for growers, but not contractors. Since growers bear nearly all of the fixed facility costs, larger contracts allow them to spread these fixed costs over more units of production. This is probably why facility capacity utilization was also positively related to grower returns.

Increasing the length of time that growers were with contractors had a positive impact on contractor returns, but decreased grower returns. Contractor returns increased about 40 cents per hundredweight for each year the grower was under contract, while grower returns declined by about 21 cents each year. This suggests that contract terms may have changed over time in favor of the contractor. Also, older production facilities were associated with lower contractor returns. Technological advances in the design of hog production facilities improve animal productivity, making older facilities less efficient. Contractor returns fell by about 69 cents per hundredweight each year that the grower facilities aged.

The services provided by contractors also impacted both grower and contractor financial performance. Both growers and contractors had lower returns when the contractor provided financing for the facilities. However, the provision of facility specifications by the contractor resulted in higher net returns for the grower, but lower returns for the contractor. Contractors earned about $7 less per hundredweight when they provided the facility designs, while grower returns were more than $3 higher. Providing plans or assistance for manure management was also associated with lower contractor returns, about $3 less per hundredweight.

Among grower characteristics, greater formal education improved returns to the grower but had a negative impact on contractor returns. For each year of grower education, grower returns increased by nearly $1 per hundredweight, while contractor returns fell by almost $2. Grower specialization in hog production also enhanced grower returns. However, grower effort, as approximated by feed conversion, did not have a significant impact on grower returns but was significant to the contractor. Nearly half of the contracts examined in this study were based on fixed payments without a bonus mechanism. Principal-agent theory suggests that these contracts lack an incentive structure that promotes grower effort. The negative coefficient on grower effort in the contractor equation indicates that contractor returns increased as grower effort lowered the pounds of feed fed per pound of gain. Evaluating this result at the mean feed conversion level indicates that contractor returns increased by nearly 5 percent for a percentage improvement in feed conversion. This is the incentive that contractors had to design a fee structure to encourage grower effort.

Conclusions

A primary source of potential conflict in the hog contract arrangement appears to be how contract terms may change over time. Contract growers are required to make a substantial investment in production facilities. At the average size of the grower operations examined in this study, more than 5,000 head produced annually, the investment in production facilities would likely range from $250,000 to $500,000 depending upon building design and geographic location. An investment of this magnitude generally takes a grower 8-12 years to recover. However, average contract duration is usually about 2-3 years (Grimes and Rhodes). Therefore, contract terms could be redefined several times during the capital recovery period. Oftentimes growers have few alternatives to the contract offered. This means that growers are vulnerable to contract terms that change in favor of the contractor. Evidence from this study suggests that contractors may have used their relatively stronger bargaining position at contract renewal in order to extract concessions from growers.

Another source of potential conflict in the contract arrangement concerns services provided by the contractor. Contractors appear to have a disincentive to provide most of the services examined in this study, including facility financing and design, and assistance with manure management. Growers appear to benefit from having specific requirements from contractors regarding the production facilities. Once the contractor specifies this information, it may be more difficult to later alter contract terms. Providing plans or assistance for manure management was also associated with lower contractor returns. Incorporating these terms into the contract may require contractors to fully or partially absorb any costs associated with additional regulations on manure management.

Education appears to be means by which growers strengthen their position in the contract arrangement relative to contractors. Contractors are typically endowed with nearly all of the bargaining power in contract arrangements and are often able to make "take-it-or-leave-it" offers to growers. Education may enhance the bargaining ability of growers by helping to identify contract terms that have the most influence on returns. More education may also encourage growers to utilize other sources of support, such as extension or legal advice, in order to ensure that contract terms are fair.

The results of this study suggest that there may be a role for public policy in ensuring that production contract arrangements are conducted fairly. Issues about contract duration and contract terms appear to be important determinants of contractor and grower success. Moreover, these issues appear to be sources of disagreement in the contractor-grower relationship. Growers without meaningful alternatives as contracts come up for renewal are vulnerable to pressure from contractors to accept terms that would not be acceptable were competition present. As the industry becomes more concentrated among fewer and larger operations, growers will become more vulnerable to the market power of contractors.

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Table 1. Mean values of the variables used in the model, 1998

Variable	Unit	Mean
Contractor type:		
Integrator	Percent of farms	31
Vertically integrated firm	Percent of farms	44
Other farmer	Percent of farms	25
Contract payment scheme:		
Fixed	Percent of farms	46
Fixed plus bonus	Percent of farms	42
Profit sharing	Percent of farms	12
Contract size	Head removed per year (X100)	5.23
Contract years	Years with contractor	4.35
Contractor service:		
Facility financing	Percent of farms	5
Facility specifications	Percent of farms	39
Provides feed	Percent of farms	88
Monitoring herd health	Percent of farms	73
Manure management	Percent of farms	39
Animal weights:		
Placement weight	Pounds	44
Removal weight	Pounds	251
Grower experience	Years producing hogs	14.75
Grower education	Years of formal schooling	12.95
Grower non-farm occupation	Percent of farms	23
Grower in North Carolina	Percent of farms	20
Grower specialization in hogs	Percent of production value from hogs	66
Facility age	Years	9.55
Facility capacity utilization	Head removed per head of capacity	2.21
Feed conversion	Pounds of feed fed per pound of gain	2.42

Table 2. Estimated costs and returns for participants in feeder-pig to finish contract arrangements, 1998

Item	Grower	Contractror
	Dollars per cwt gain	
Gross returns:		
Market hogs	1.70	37.46
Contract fees	4.87	-
Other income[1]	0.83	1.17
Total gross returns	7.40	38.63
Operating costs:		
Feed	1.09	18.37
Feeder pigs	0.59	14.55
Veterinary and medicine	0.02	0.19
Marketing	0.07	0.95
Custom services and supplies	0.08	0.31
Fuel, lubrication, and electricity	0.53	0.05
Repairs	0.26	0.01
Contract fees	-	4.87
Hired labor	0.34	0.00
Operating capital	0.07	0.82
Total operating costs	3.08	40.12
Ownership costs:		
Depreciation and interest[2]	5.66	0.00
Taxes and insurance	0.26	0.02
Total ownership costs	5.91	0.02
Total operating and ownership costs	8.99	40.14
Gross returns less operating and ownership costs	-1.59	-1.51

[1]Other income includes other hog sales (feeder pigs, cull stock, etc.) and the value of the inventory change on the operation during 1998.
[2]Computed using the capital recovery method.

Table 3. Regression results for the effort exerted by growers in the feeder pig-to-finish contract arrangement, 1998

Variable	Description	Estimated Coefficient	Standard Error
Intercept	-	12.3844**	4.6406
Payment scheme[1]:	Fixed payment plus bonus	-0.4163*	0.2292
	Profit sharing	-0.3413	0.1964
Contract size	Head removed per year	-0.0042**	0.0016
Contract years	Years with contractor	0.0070	0.0050
Contractor service:	Provides feed	-0.8118**	0.4053
	Monitoring herd health	-0.0430	0.0313
Animal weights	Placement weight	0.0384**	0.0154
	Removal weight	-0.0356**	0.0136
Grower experience	Years producing hogs	-0.0288**	0.0140
Grower education	Years of schooling	-0.0431	0.0273
Grower occupation	Off-farm employment	-0.0355	0.0266
Grower specialize	Farm value from hogs	-0.0036	0.0025
Facility age	Years	0.0023	0.0017
R-squared	-	0.13	

Notes: Effort was defined by feed conversion measured by pounds of feed fed per pound of gain.
[1]Coefficients interpreted relative to the deleted group, fixed payment scheme.
Single and double asterisks (*) denote significance at the 10% and 5% levels, respectively.
Using the jackknife variance estimator with 15 replicates means that the critical t-values are 2.145 at the 5% level, and 1.761 and the 10% level.

Table 4. Regression results for the financial performance of contractors and growers in feeder pig-to-finish contract arrangements, 1998

		Grower		Contractor	
Variable	Description	Coefficient	Std. Error	Coefficient	Std. Error
Intercept	-	-23.3221**	7.6864	44.5904**	15.9601
Contractor type[1]:	Vertically integrated	3.5116**	1.4218	-10.0703**	4.3859
	Other farmer	0.5826	0.4098	-9.4029**	4.3853
Location	North Carolina	0.9046	0.5798	-4.9412	3.0473
Contract size	Head removed per year	0.0113*	0.0060	-0.0075	0.0052
Contract years	Years with contractor	-0.2071*	0.1173	0.4148**	0.1856
Contractor service:	Facility financing	-2.2560*	1.0561	-6.1377**	2.9352
	Facility specifications	3.2188**	1.3723	-7.3251**	3.0550
	Monitoring herd health	-0.7625	0.5629	-0.0585	0.0438
	Manure management	-0.0198	0.0148	-3.0089*	1.5934
Facility age	Years	-0.0563	0.0342	-0.6877**	0.2499
Capacity utilized	Hd removed / hd space	0.5757**	0.1988	1.1657**	0.3608
Grower experience	Years producing hogs	0.0309	0.0217	0.0553	0.0376
Grower education	Years of schooling	0.9841**	0.4315	-1.8072**	0.5810
Grower occupation	Off-farm employment	-0.1555	0.1132	-1.9207	1.1823
Grower specialize	Farm value from hogs	0.0477*	0.0238	-0.0249	0.0156
Grower effort	Feed conversion[2]	0.0786	0.0562	-2.9182**	1.1278
R-squared	-	0.25		0.41	

Notes: Financial performance was defined as returns above the operating and ownership costs per hundredweight of gain for each participant (see table 2).

[1]Coefficients interpreted relative to the deleted group, integrators.

[2]Predicted value from effort equation

Single and double asterisks (*) denote significance at the 10% and 5% levels, respectively. Using the jackknife variance estimator with 15 replicates means that the critical t-values are 2.145 at the 5% level, and 1.761 and the 10% level.