Analysis of Financial Performance of U.S. Hog Farms Using a DuPont Expansion: Is there a Future for Independent Hog Producers?

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Analysis of Financial Performance of U.S. Hog Farms Using a DuPont Expansion: Is there a Future for Independent Hog Producers? [1]

US swine production has undergone significant structural change in the last two decades, reflecting increasing size and specialization (Key and McBride; Key). In particular, the widespread use of contracting has enabled individual producers to grow by specializing in a single phase of production. Once dominated by small operations that practiced crop and hog farming along with other livestock enterprises, the industry has increasingly concentrated among large operations in most regions that produce hogs on several different sites (especially in North Carolina). Large operations that specialize in a single phase of production have replaced farrow to finish operations. The effects of these changes have extended beyond the industry, with concentration of large hog facilities raising environmental risks and negatively impacting urban areas, precipitating concerns about the integrity of rural communities in depopulating areas and about animal welfare. Until recently, rapid increases in scale of production have been consistent with a sharp increase in the share of production occurring on contractee operations rather than independent operations, raising the question about the long-term profitability and sustainability of independent operations. Population estimates of hog production conducted in 2009 indicate that only about 30 percent of production (on a whole farm basis) now occurs on independent hog operations.

Objectives: We explore 1) economic and technical trends in contractee and independent hog production during 2008 through 2011; 2) estimate assets/debt (inverse solvency), profitability, and asset turnover (efficiency) to calculate return on owner's equity (ROE) in the hog sector by organizational structure and by region; and 3) condition the estimates of profitability and

[1] The views expressed are the authors and should not be attributed to the Economic Research Service or USDA.

efficiency of measures climatic stress on hogs—a temperature humidity index capturing the thermal environment by county and region.

Data and Background

Data Sources and Methods: This study uses data from the 2008-2011 Agricultural and Resource Management Survey (ARMS) Phase III, conducted by the USDA's National Agricultural Statistics Service and Economic Research Service. For 2008-2011, this dataset provides 9,576 usable responses, including 7,159 independent hog operations and 2,417 contractee operations; we sort on hog production greater than zero (the ARMS variable "hogs", or value of production of hogs) to identify hog producers and on "chogs" (the ARMS variable used to identify the value of production of contract hogs) to identify contractee production. For the 2009 Cost of Production (COP) ARMs version for 19 states we identify 1,283 observations, including 549 independent operations and 734 contractee operations. The ARMS collects information on farm size, type and structure; income and expenses; production practices; and farm and household characteristics, resulting in a rich database (allowing such sorting by type of production) for economic analysis of the hog sector. Because this design-based survey uses stratified sampling, weights or expansion factors are included for each observation to extend results to the hog farm population of the largest U.S. hog states, representing 90% of U.S. hog production in 2009. To add more information on hog production in the remaining 48 states and to incorporate information on changes in economic conditions over time we included ARMS phase III data for 2008 through 2011. We compare our DuPont results on this data with that based only on the population estimates for 2009. We use PRISM data from 1990 to 2000 to calculate monthly temperature humidity indices (following St-Pierre, Cobanov, and Schnitkey, J Dairy Science 2002), and monthly heat stress indices at the county level. More precisely we consider monthly growth rates on these climatic measures over 21 years as potential drivers of profitability and efficiency.

We use farm-level data from the USDA's Agricultural Resource Management Survey (ARMS) and the DuPont Expansion method to decompose return on equity (ROE) into three components: *profit margin*, *asset turnover*, and *assets-to-equity*. This allows us to analyze the relative importance of these three key indicators of financial performance using drivers (such as size of operation, location, demographic factors, diversification into crop/livestock enterprises, off-farm income, climatic indices and production system (whether independent or not). Specifically, we estimate, using SAS, three reduced-form equations, one for each of these three components, thus achieving robust estimates; given the survey design.

Background:

Over the past two decades, the number of hog farms fell by close to 70 percent from about 250,000 farms in 1992 to about 70,000 farms in 2010. Meanwhile hog inventory increased from about 60 million to 65 million head. In 2009 more than 60 percent of inventory was in operations of more than 5,000 head, compared to just over 50 percent in 2004 (Ag Statistics) (Also, see Key and McBride forthcoming for more details). Operations producing under contract grew from 3 percent of operations in 1992 to 28 percent in 2004, and close to 50 percent in 2009, and accounted for close to 70 percent of production (sales) in 2009. The rapid growth in hog operations along the east coast of the United States during 1992-98 slowed in subsequent years mostly because North Carolina place a moratorium on expanded hog production in the state. Robust growth in hog production is now centered in Iowa, Minnesota and several Western States. More recently it is estimated that close to 30 percent of operations in Iowa and Minnesota are independent hog producers compared to less than 10 percent in North Carolina.

Analysis of the economics of contractee versus independent hog production is dated, relying on data from 2004 and earlier years. We have examined the economics of independent versus contractee hog production using 2008-11 ARMS phase III data and 2009 COP ARMS data. We are not aware of any economic analysis using such current data. This is particularly important since economic changes have occurred in this market since 2004. Currently, for example the hog/corn ratio price stands at only 9.7, a relatively low number compared to ratios of 12 plus required for profitability. For hog production, climate change or regional differences in climate could affect the costs and returns of production in four main ways: 1) by altering the price and availability of feed crops; 2) by affecting the location and productivity of cropland; 3) by changing the distribution of livestock parasites and pathogens; and 4) by altering the thermal environment of animals and thereby affecting animal health, reproduction, and the efficiency by which livestock convert feed into retained products, that is meat. This paper evaluates the potential economic implications of climate change and regional differences in climate acting through mechanisms 1), 2) and 4), focusing on concentrated U.S. hog operations.

From Appendix Table 3, we see that the hog production in the Corn Belt is most important, representing over 40 percent of the total value of production (using a whole farm analysis and hence, including crop production), with Appalachia, the Lake states, and the Northern Plains accounting for about 10 percent each. (These percentages correspond reasonably well to the population estimates proportion of production represented by the ARMS 2009 COP data shown in Appendix Table 2. Hence, we argue that our DuPont analysis on the phase III data fairly captures financial performance in the major production regions over 2008-2011.) Hog inventory numbers per farm are highest in Appalachia at nearly 5,000 hogs per farm, followed by about 3,000 in the Corn Belt, and close to 2,000 in the Lake States and Northern plains. Off-farm income relative to total income is notably lower in the Corn Belt, Lake states, and Northern plains compared to other regions. Traditional financial measures of return on assets and household returns also indicate higher returns in these hog growing regions compared to other regions.

Methods and Model

The DuPont Corporation (one of the first conglomerates) developed an approach for evaluating the potential of firms which is often called DuPont analysis. The DuPont approach is used along with financial statements of firms to look at important areas of financial performance. The most important of these measures is return on owner's equity. The approach is not only useful in corporate finance but also in analyzing farm business performance. Collins (1985) introduced a slight variation of the DuPont formulation which has become popular in agricultural finance. The DuPont enjoys wide use by farm businesses, extension personnel, and universities to evaluate farm performance. The basic DuPont identity of return on equity decomposes return on equity into earnings, asset turnover, and leveraging decisions;

Return on equity = operating profit margin x *asset turnover* x *leverage*.

The DuPont model as presented by Mishra, Moss, and Erickson (2009) is used to analyze the relationship between the rate of return on equity, asset efficiency, profitability, and solvency, as shown in (1):

(1) $$\frac{R}{E} = \frac{S-C}{S} * \frac{S}{A} * \frac{A}{E}$$

where *R* is agricultural sales *S* less production costs *C*, *E* is agricultural equity, and *A* is the value of agricultural assets. Using the DuPont model, return on equity $\left(\frac{R}{E}\right)$ is measured as the product of (1) the farm's profitability, measured by the operating profit margin ratio$\left(\frac{R}{S}\right)$; (2) the farm's asset efficiency, measured as the asset turnover ratio $\left(\frac{S}{A}\right)$; and (3) the farm's solvency, or in our case inverse solvency, measured as the inverse of the equity/asset ratio, $\left(\frac{A}{E}\right)$.

The rate of return on equity (the farm's rate of net return to farm business equity) equals the farm's rate of return on assets $\left(\frac{R}{A}\right)$ if the farm is debt-free; otherwise, interest must be paid on debt, which is subtracted from net farm income *R*, and $A > E$. As a measure of profitability, a higher rate of return on equity is preferred. As another measure of profitability, a higher operating profit margin ratio is desirable. As costs increase relative to sales, the operating profit margin decreases.

The farm's asset efficiency measures how quickly farm gross revenues cover the capital that has been invested in farm assets. If, for example, the asset turnover equals 0.20, then it would take five years for farm gross revenues to cover the amount invested in assets, so a higher asset turnover ratio is desired. Finally, analyzing solvency determines whether the farm's liabilities could be met if its assets were sold. Solvency as measured by the equity/asset ratio measures the owner's equity capital as a portion of the farm's total assets, so a higher equity/asset ratio is preferred. In our case, we are measuring inverse solvency, so a lower asset/equity ratio would be preferred. Kay, Edwards, and Duffy (2012) provides more information regarding these measures of profitability, asset efficiency, and solvency.

As shown by Mishra, Moss, and Erickson (2009), the DuPont model is linear in logs, as follows:

(2) $ln\left(\frac{R}{E}\right) = ln\left(\frac{R}{S}\right) + ln\left(\frac{S}{A}\right) + ln\left(\frac{A}{E}\right)$

Given (2), a model for analyzing determinants of farm financial well-being estimates the farm's return on equity, operating profit margin ratio, asset turnover ratio, and equity/asset ratio as a system in a seemingly unrelated regression, with these measures serving as dependent variables in a system that corrects for the correlation of the error terms. Since $ln\left(\frac{R}{S}\right)$, $ln\left(\frac{S}{A}\right)$, and $ln\left(\frac{A}{E}\right)$ sum to $ln\left(\frac{R}{E}\right)$, the latter can be dropped from the system due to summing-up conditions, similar to Mishra et al. (2008).

Factors Hypothesized to Impact Farm Financial Viability

The three equations estimated using seemingly unrelated regression include the following:

(3) $ln\left(\frac{R}{S}\right)$=f(*Northeast, Lake, Northern Plains, Appalachia, Southeast, Delta, Southern Plains, Mountain, Pacific, Hog Value, Harvested Acres, Ophours, Sphours, Production Contract Value, Hog Heat Index, and dummies for 2009, 2010, and 2011*)

(4) $ln\left(\frac{S}{A}\right)$=f(*Northeast, Lake, Northern Plains, Appalachia, Southeast, Delta, Southern Plains, Mountain, Pacific, Harvested Acres, Machinery, Hog Value, Production Contract value, Hog Heat Index, and dummies for 2009, 2010, and 2011*)

(5) $ln\left(\frac{A}{E}\right)$=f(*Northeast, Lake, Northern Plains, Appalachia, Southeast, Delta, Southern Plains, Mountain, Pacific, Age, Harvested Acres, Hog value, Ophours, Sphours, Production Contract Value, Heat Index, and dummies for 2009, 2010, and 2011*)

Input endogeneity, selection bias; Input endogeneity has been a concern in the estimation of a system of equations such for the DuPont system; if found, biased estimates result. Some studies have used instrumental variables to correct the problem, while others have argued either that (1) it was not problematic in their studies because random disturbances in production processes resulted in proportional changes in the use of all inputs (Coelli and Perelman 2000, Rodriguez-Alvarez 2007) or (2) no good instrumental variables existed, thus endogeneity was not accounted for (Fleming and Lien 2010). We estimate instruments for each of the off farm labor inputs. The Hausman test was used to test for endogeneity. Since endogeneity was found, the predicted values are used as instruments in the SUR.

In addition to endogeneity concerns associated with SUR inputs, selection bias may be of concern. Since contractee producers self-select into contracts, they may have been more or less productive than independent hog farmers regardless of whether or not they had opted to produce hogs using a production contract. We correct for selection bias in our SUR estimates. Examining the dairy sector Mayen et al. (2010) corrected for organic dairy selection bias by using propensity score matching, while McBride and Greene (2009) corrected for it by estimating the inverse Mills ratio in a first-stage probit equation and including it in a second-stage profit equation. Our probit selection equation predicts the probability of production contract hog production (in the Phase III data). The inverse Mills ratio was significant in the profitability and efficiency equations in the SUR, suggesting selection bias. Thus, it was included in the SUR as a correction for contract selection bias.

Using ARMS Data to Estimate a SUR

Since complex stratified sampling is used with ARMS, inferences regarding variable means for regions are conducted using weighted observations. As discussed by Banerjee et al. (2010), the ARMS is a multiphase, non-random survey, so classical statistical methods may yield naïve standard errors, causing them to be invalid. Each observation represents a number of similar farms based upon farm size and land use, which allows for a survey expansion factor or survey weight, effectively the inverse of the probability that the surveyed farm would be selected for the survey. As such, USDA-NASS has an in-house jackknifing procedure that it recommends when analyzing ARMS data (Cohen et al. 1988; Dubman 2000; Kott 2005), which allows for valid inferences to the population. Thus, econometric estimation of SUR models presents unique challenges when using ARMS data. We use the jackknife replicate weights in SAS to obtain adjusted standard errors. A property of the delete-a-group jackknife procedure is that it is robust to unspecified heteroscedasticity.

The USDA version of the delete-a-group jackknife ARMS survey design divides the sample into 30 nearly equal and mutually exclusive parts. Thirty estimates of the statistic (replicates) are created. One of the 30 parts is eliminated in turn for each replicate estimate with replacement. The replicate and the full sample estimates are placed into the jackknife formula:

(2) Standard Error (β) = $\{29/30\sum_{k=1}^{30}(\beta_k - \beta)^2\}^{1/2}$

where β is the full sample vector of coefficients from the SUR program results using the replicated data for the "base" run. β_k is one of the 30 vectors of regression coefficients for each of the jackknife samples. The t-statistics for each coefficient are computed by dividing the "base" run vector of coefficients by the vector of standard errors of the coefficients.

Model Results

Results of the probit model explaining grouping in production contracts and independent operations are shown in the table below. These results are used to compute the inverse-Mills ratios in the SUR estimates. The model is significant and correctly predicts 36 percent of those farms that are production contract operations and of those hog operations that are independent more than 97% are correctly predicted. We achieve good results in the sense that more than half of the coefficients of the probit model are significant and the covariate is good at distinguishing contractees from independent operations.

The SUR model was estimated using the DuPont inverse solvency, profitability, and efficiency equations as defined above. The results are reported below. Because ophours and sphours used in the inverse solvency equation are likely endogenously determined, predicted values were used from the following equations for ophours and sphours respectively;

Ophours
Estimated Regression Coefficients

Parameter	Estimate	Standard Error	t Value
Intercept	141.4534134	0.37729061	2.34
popacc	-0.1049830	0.00111012	-2.32
vprodlpc_sc	-0.0012420	0.00029806	-2.95
hhasset_sc	-0.0000495	0.00011594	-5.02
accrop	0.6623981	0.12240832	-3.24
acliv	0.6623981	0.12240832	0.63
HH_Wellb_Med	167.6623981	0.12240832	9.59
Year2009	-74.2987450	0.1282014	-1.18
Year2010	-33.3955460	0.0811137	-0.56
Year2011	5.9742540	0.0600971	0.12

Sphours
Estimated Regression Coefficients

			Standard
Parameter	Estimate	Error	t Value
Intercept	310.4534134	0.37729061	9.58
popacc	-0.1049830	0.00111012	-2.07
vprodlpc_sc	0.0012420	0.00029806	0.94
hhasset_sc	-0.0000495	0.00011594	-5.71
accrop	0.6623981	0.12240832	2.27
acliv	0.6623981	0.12240832	1.19
adwage	0.6623981	0.12240832	7.75
Year2009	0.298745	0.1282014	1.42
Year2010	0.395546	0.0811137	0.54
Year2011	0.764254	0.0600971	1.82

While the estimated fits on these two equations are somewhat low—about 20 % r-squared, we were able to find numerous significant drivers for the two variables and thus can reasonably use the predicted values in the SUR.

Seemingly Unrelated Regression Results

	Parmeter est	Std err	T-value
Solvency Int	-0.487204	0.0779436	-6.349007
Northeast	0.031438	0.0339590	0.946000
Lake	0.163438	0.1249590	1.311104
Northern Plains	0.109945	0.0350173	3.124909
Appalachia	-0.019438	0.0185959	-1.090909
Southeast	0.042945	0.0563173	0.737909
Delta	0.026438	0.0395959	0.653104
Southern Plains	0.016438	0.0375959	0.427104
Mountain	0.082945	0.0813173	1.028909
Pacific	0.558438	1.0585959	0.053004
HogValue	0.003714	0.0035970	1.127215
Ha_tot	0.000703	0.0028935	0.250294
Ophours	-0.000124	0.0000028	-1.887895
Sphours	0.000075	0.0000175	4.499879
IMR	-0.043206	0.0210006	-1.970606
HeatIndex	-0.000007	0.0000009	0.086931
Chogsdum	-0.012016	0.0188565	-0.674845
Year2009	0.372745	0.0412014	8.932009
Year2010	0.382546	0.0341137	10.086931
Year2011	0.705254	0.0390971	18.300896
Profit Int	2.01286	0.3265591	6.170369
Northeast	0.062438	0.2009590	0.131000
Lake	-0.109438	0.1609590	-0.689104
Northern Plains	0.007945	0.2133173	0.374909
Appalachia	0.166438	0.1815959	0.919909
Southeast	0.280945	0.2853173	0.998909
Delta	0.103438	0.3545959	0.290104
Southern Plains	-0.085438	0.2755959	-0.320104
Mountain	-0.243945	0.3303173	-0.730909
Pacific	1.129438	2.2995959	0.488104
Ha_tot	0.037757	0.0116039	3.287093
Mach	-0.100002	0.0057478	-18.344373
HogValue	0.119182	0.0181375	6.567879
IMR	-0.083796	0.1020663	-0.810066
Heat	-0.000226	0.0000565	-2.528845
Chogsdum	-0.237016	0.1418565	-1.683845
Popacc	0.000282	0.0001175	2.197879
Year2009	-0.043745	0.1290014	0.332009
Year2010	0.195546	0.1441137	1.346931
Year2011	0.441254	0.1269971	3.470896

Seemingly Unrelated Regression Results (Continued)

Efficiency Int	-0.820451	0.4491188	-1.829731
Northeast	0.041438	0.1299590	0.319000
Lake	-0.014238	0.1239590	-0.114104
Northern Plains	0.182945	0.1073173	1.694909
Appalachia	-0.180438	0.1005959	-1.810909
Southeast	-0.213945	0.2143173	-0.990909
Delta	0.117938	0.1275959	0.928104
Southern Plains	-0.186438	0.1785959	-1.040104

Mountain	-0.074945	0.1763173	-0.428909
Pacific	0.086438	0.6835959	0.124104
Age	-0.734495	0.0983863	-7.432004
Ha_tot	0.017495	0.0053863	3.029004
Hogsvalue	0.220913	0.0165401	13.328873
Ophours	-0.000129	0.0000163	-0.822866
Sphours	-0.000087	0.0000727	-1.240772
IMR	-0.016943	0.0711834	-0.237861
HeatIndex	-0.000074	0.0000595	-1.406968
Chogsdum	0.292038	0.0919395	3.196968
Year2009	-0.391745	0.1122014	-3.482009
Year2010	-0.395546	0.0841137	-4.696931
Year2011	-0.728254	0.0700971	-10.030896

First we note than the IMR results are significant in the efficiency equation, indicating that selection bias is important. Hence the IMR results are included in the final SUR run.

For the inverse solvency equation, the main positive driver is sphours. The main negative driver is ophours. Only the Northern Plains regional dummy is significantly different from the Corn Belt base, indicating significantly lower solvency in the Northern Plains compared to the Corn Belt. All of the time dummies are significant indicating lower solvency over time.

For the profitability equation we find that the main positive drivers are acres harvested, contract production, and value of hogs. The main negative drivers are machinery, a dummy for Chogs=0, the hog heat index. Only the Southern Plains regional dummy is significantly different from the Corn Belt base, indicating significantly lower profitability in the Southern Plains compared to the Corn Belt. Only the 2011 time dummy is significant, indicating higher profitability over time. The negative sign on chogsdum and its marginal significance indicates that independent operations as a group tend to reduce profitability.

For the efficiency equation we find that the main positive drivers are acres harvested, value of hogs, and a dummy for CHogs=0. The main negative drivers are age and the hog heat index. The Northern Plains, Appalachia, Southeast, and Southern Plains regional dummies are significantly different from the Corn Belt base, indicating large regional variation in efficiency.

All of the time dummies are significant and negative, indicating lower efficiency over time. The positive sign on chogsdum and its significance indicates that independent operations as a group boost efficiency.

Conclusions:

Based on the 2008-11 ARMS phase III data contractee hog operations in Iowa/Minnesota and the Northern Plains, exhibited returns on equity of 9.7 and 9.2 percent, respectively, as shown in Appendix Table 1, significantly higher than equity returns calculated for all other contractee and independent regional groupings. The main drivers for this performance appear to be high volume hog production (with inventories averaging close to 3,000 hogs per farm—see Key and McBride 2013 on scale economies) coupled with relatively high corn yields (consistent with high value land with little urban influence), and limited reliance on off-farm labor. Thus, contractee groups showed the highest returns on equity. Some independent producers, however, appear to be competitive. Among the important producing regions shown in Appendix Table 1, for example, independent producers in Iowa/Minnesota exhibited competitive returns on equity of 7.5 percent, followed by independent producers in the Southeast with 6.9 percent returns. In contrast, return on equity was only 5.4 percent among contractee producers in Appalachia.

Looking at traditional financial measures, we find differences in returns on farm assets or household assets between independent and contractee hog producers, generally, but not always favoring contractee operations in the Phase III analysis. In particular, we find that traditional household financial returns among independents in Iowa/Minnesota-and the Northern Plains are competitive with contractee returns in Appalachia. And return on equity derived from the DuPont measures in these groupings are competitive with return on equity among Appalachia contractee producers.

It is useful to compare these Phase III results to those for the population estimates in 2009. First, we see that contractees show higher returns on assets and household returns as shown in Appendix Table 2. Among the DuPont measures shown in Appendix 2 we find that contractees are less efficient than independents, have the same solvency, but higher profitability, and higher returns on equity. But comparing contractees in the East, including North Carolina, with independent producers in the West, we find no difference in household returns. Among the DuPont measures, we find that contractees in the East have significantly lower solvency and efficiency ratios (as reflected in the positive coefficient on chogsdum in the SUR efficiency results) and higher profitability (as reflected in the negative coefficient on the chogsdum in the SUR profitability results) compared with independent operations in the West. And, they have comparable returns on equity compared with independents in the West. In summary these Phase III and COP results indicate that some independent hog producers remain competitive, suggesting the rate of sharp decline in independent hog production that took place between 1992 and 2004 may have slowed. In future research we will sort on DuPont results more thoroughly to account for differences in organizational arrangement—whether farrowing or not---as production contracts tend to be much more prevalent on finish operations.

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Chart 1: Production Contracts as percent of Production by Region; over 50 percent in Regions accounting for 72 percent of hog production

Percent of production

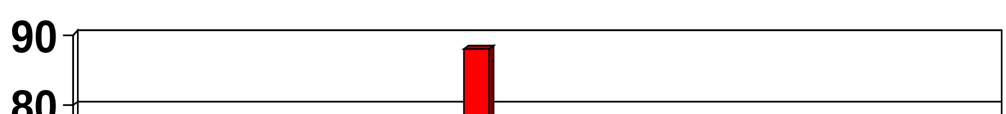
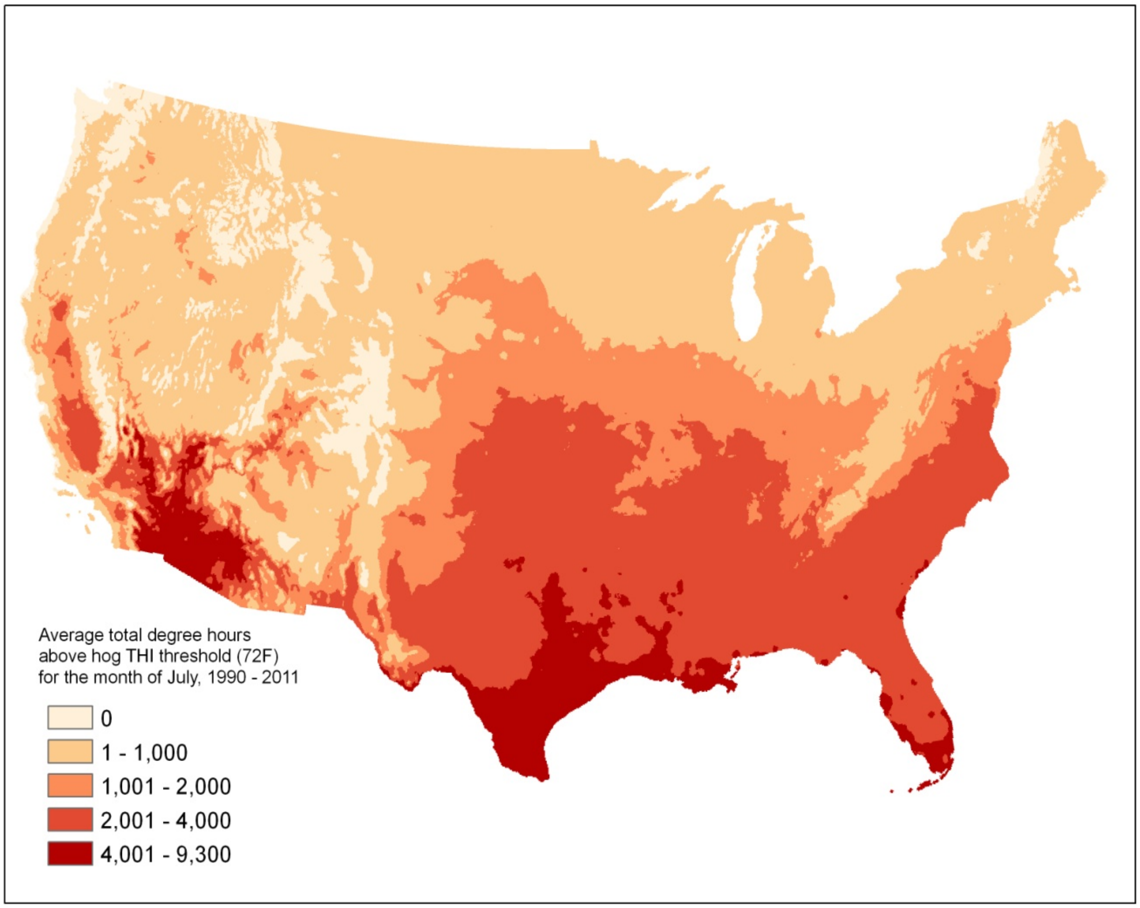


Figure 1: Heat Index for Hogs



Source: Prism and GIS/ERS calculations

1. Appendix table 1 Economic and Technical Data: Means and Statistics by Independent Compared to Contractee Operations in all States 2008-2011

Item	App Ind	App Cont	CB Ind	CB Cont	IAMN Ind	IAMN Cont	NP Ind	NP Cont	SE Ind	SE Cont	West Ind
Number of Observations	936	909	1,776	509	819	695	820	105	1,503	199	1,305
Percent of Farms	20.0	0.9	18.5	1.1	5.4	2.2	5.5	0.4	26.0	0.2	19.9
Value of Production (%)**	5.0	10.5	10.2	9.3	10.4	23.8	10.7	3.0	8.2	1.6	7.3
Hogs per farm	23	5,362	145	2,218	641	3,921	390	2,646	350	2,467	21
Acres op	97	421	155	572	344	682	1,345	704	550	489	592
Popacc (urbanization)	307	214	188	120	71	54	46	40	137	53	172
Corn yield (bu/ac)	125	106	155	65	169	175	141	164	98	158	167
Land price ($/acre)	2,833	2,511	2,483	2,573	2,943	3,441	680	2,264	894	849	843
						17					

Item	App Ind	App Cont	CB Ind	CB Cont	IAMN Ind	IAMN Cont	NP Ind	NP Cont	SE Ind	SE Cont	West Ind
Off-farm income (%)	71.1	6.2	34.6	5.3	9.3	5.0	15.7	4.2	61.0	3.4	57.8
Return on Assets (%)	1.1	5.7	3.2	6.6	8.2	9.8	5.1	9.8	0.7	10.0	1.7
Household return (%)	6.5	5.1	6.8	7.3	8.9	9.5	6.3	11.8	5.7	7.9	4.7
Solvency	78.0	86.1	82.2	91.0	87.3	94.9	86.7	94.0	79.2	82.8	80.2
Profitability	8.5	24.8	14.2	19.1	20.7	27.0	17.7	22.3	8.1	25.7	13.9
Efficiency	13.8	25.2	24.1	37.1	41.3	38.0	29.0	44.1	10.8	39.8	12.6
Return on Equity	0.9	5.4	2.8	6.4	7.5	9.7	4.5	9.2	6.9	8.5	1.4

** Percent of production on hogs only for production contract is 40 percent.

Source: 2008-2011 ARMS Phase III.

Appendix table 2 Economic and Technical Data: Means and Statistics by Independent Compared to Contractee Operations in all States 2009

Item	All Independent	All Contract	West Independent	West Contract	East Independent	East Contract
Number of Observations	549	737	443	408	106	329
Percent of Farms	49	51	44	42	5	10
Value of Production (%)	28	72	27.5	55.1	1.0	16.5
Hogs per farm	1,476	3,571	1,577	3,202	519	5,124
Acres op	747	582	794	631	303	372
Popacc (urbanization)	111	83	99	66	223	152
Corn yield (bu/ac)	173	177	174	180	142	115
Land price ($/acre)	1,499	1,863	1,440	1,866	2,961	1,851

Item	All Independent	All Contract	West Independent	West Contract	East Independent	East Contract
Off-farm income (%)	2.8	2.9	2.7	2.7	7.0	4.2
Return on Assets (%)	3.7	9.6	3.8	10.3	2.2	6.3
Household return (%)	4.7	8.1	4.8	8.8	3.2	4.8
Solvency	87.9	88.6	88.8	90.6	76.5	80.5
Profitability	8.7	25.0	8.6	25.3	11.5	23.3
Efficiency	42.6	38.4	44.3	40.8	18.9	27.2
Return on Equity	3.0	8.4	3.1	9.4	1.7	5.1

Source: 2009 ARMS COP.

Appendix table 3 Economic and Technical Data: Means and Statistics by Region in all states 2008-2011 and 2009

Item	North East	Lake States	Corn Belt	North lains	App	South east	Delta	South Plains	Mount	Pacific
Prod cont (%) of prod	49.0	64.0	71.0	26.0	88.0	26.0	27.0	29.0	12.0	0.0
Number of Observations	428	1,112	2,687	925	1,417	505	430	767	527	783
Percent of Farms	8.9	8.1	18.1	5.9	12.2	7.1	4.0	15.6	11.0	9.2
Value of Production (%)	3.6	12.0	41.0	13.6	11.6	2.4	3.1	3.9	5.8	3.0
Value of Production (%) 2009	1.5	14.8	52.6	11.0	14.9	----	0.6	3.0	---	---
Hogs per farm 2009	1,562	2,119	2,725	2,212	4,955	---	999	2,016	----	-----
Acres op	96	226	291	1,362	122	95	154	868	967	206
Popacc	505	134	147	44	171	163	94	137	75	206
Land price ($/acre)	3,447	2,299	3,005	729	2,487	2,435	1,452	793	574	2,277

Item	**North East**	**Lake States**	**Corn Belt**	**North ains**	**App**	**South east**	**Delta**	**South Plains**	**Mount**	**Pacific**
Off farm income (%)	**55.3**	**15.7**	**16.3**	**13.2**	**60.8**	**59.8**	**43.0**	**63.4**	**50.9**	**58.9**
Corn yield (bu/arac)	**133**	**165**	**168**	**144**	**100**	**107**	**122**	**85**	**164**	**199**
Solvency	82.2	85.6	87.6	87.3	76.9	74.2	75.8	81.3	79.4	81.8
Profitability	14.4	20.9	20.4	19.1	9.6	5.0	25.1	2.7	12.4	13.3
Efficiency	16.3	39.1	31.6	30.6	15.1	13.3	30.0	7.8	14.9	11.3
Return on Equity	1.9	7.0	5.6	5.1	1.1	0.5	5.7	0.2	1.5	1.2

Source: 2008-2011 ARMS Phase III.