Determinants of Swine Farm Sale Prices Under a De Facto Moratorium

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Background:

This paper reports outcomes of economic analysis of a new data set containing swine farm sale prices and a rich set of descriptive variables used in appraisal of the farms. The data from 130 farm sales are particularly interesting because they occurred under a *de facto* moratorium on new or expanded swine production capacity in the state of North Carolina between 1997 and 2010. Appraisers assigned values for "premium" to most of the farm appraisals based on the fact that total farm sales price exceeded the appraised value of the components of the respective farms.

Swine farms can be considered as complex assets that include highly specialized depreciating assets such as buildings, equipment, and land improvements that are designed for swine production. Swine farms also include potentially appreciating assets such as land of various types. Farms that include swine production facilities may also include production facilities for other livestock, poultry, and crops; some of which are highly specialized and others that are of more general use. Furthermore, swine farms may include other fixed assets such as residential buildings and improvements as well as more liquid assets such as standing timber and tractors. Buyers and sellers, appraisers and lenders all seek to estimate the market value of farms. Standard methods of appraisal have been developed by the appraisal industry. One method commonly used is the asset based or cost method and the second is an income focused method. Typically the asset based method seeks to establish the Fair Market Value (FMV) of improvements (buildings and equipment) using Replacement Cost New (RCN) reduced by observed condition of the improvements to arrive at the estimated appraised depreciated value (Pinal County Assessors office). The second method, using an income valuation may take one of two paths depending on the industry: gross income multiplied by a factor or net income multiplied by a factor. The factor values are usually industry dependent as well (e.g. Brueggeman & Fisher). Appraisers use standardized methods of valuation and employ tools such UAAR® (Uniform Agricultural Appraisal Report (AgWare, Inc. 2010)). UAAR® is a proprietary computer software program used to prepare appraisal reports on agricultural property being sold. Data analyzed in this study were compiled by professional appraisers using the UAAR®. The data studied here were generated by an appraisal system that values swine buildings, equipment, and land improvements at their Replacement Cost New (RCN) reduced by a percentage that reflects remaining economic life or depreciation. The percentage depreciation embodies the appraiser's assessment of the physical condition of the assets. The RCN value is provided by experts in swine facility construction.

The question addressed by this study arose from appraisers' observations that actual swine farm sales prices in North Carolina between 1997 and 2010 were exceeding the values of farm components arising from the usual appraisal methods.

Swine farms in North Carolina include a wide variety of production systems. While there are some pasture raised swine operations in North Carolina, most pigs are raised in highly specialized, large buildings. The set of farm sales being analyzed here is made up of large, indoor swine operations. These swine farms are usually specialized in one phase of pig production. 'Farrowing' operations house sows for breeding and nursing pigs and typically include clusters of buildings with capacity for 1,000 to 4,000 sows and their nursing pigs. 'Nursery' operations house pigs from weaning to feeder pig stage; between 12 and 50 pounds in weight and between 3 and 11 weeks of age, typically in one or two buildings that each have capacity for 2,600 pigs. 'Finishing' operations house pigs from feeder pig to market hog stage; between 50 and 270 pounds and between 11 and 26 weeks of age, typically in 2 or more buildings that each have capacity for 800 or 1,200 hogs. Some farms include capacity in two or all three phases of production.

Building design varies significantly across specialized swine farms in North Carolina. Floors may be totally slatted, partially slatted, or solid. Slats are concrete gang slats that allow manure to fall through gaps between slats into a shallow pit or flush gutter below. The finishing buildings in this study have been identified by appraisers as either partially slatted or totally slatted. The flooring type in North Carolina finishing buildings is usually indicative of other differences in building design including manure removal system, ventilation design, side-wall and curtain design, roof and ceiling design, and building materials. Two primary types of finishing buildings in North Carolina reflect the fact that most construction followed one of two building designs that were popular between 1985 and 1997. Differences in building type may also imply differences in labor and maintenance requirements as well as differences in production efficiency. Similarly, the nursery buildings included in this study are classified as tunnel-ventilated or naturally ventilated. Tunnel ventilated buildings typically have a bank of exhaust fans at one end of the building to pull air through. Naturally ventilated buildings may feature roof vents and retractable curtains in the side walls as well as smaller fans in the walls and in the interior. Again, the ventilation type is indicative of a range of design distinctions. The farrowing or sow farms in this study are not distinguished by type although considerable variation exists in the general population.

A *de facto* 'moratorium' on new and expanded swine production capacity is imposed by state law in North Carolina. The state law was originally adopted in 1997 and renewed several times before

eventually being made permanent in 2009. It requires that any new or expanded swine production capacity must meet five specified stringent criteria intended to minimize risk of damage to the environment and public health and to limit nuisance from odor. To date, one swine manure treatment system has been recognized as meeting the five criteria but it remains too expensive for commercial adoption. Variations of that technology have been installed on a few existing farms with the support of subsidies. The effect of the law has been to cap North Carolina swine production capacity at the level that had been permitted when the law went into effect in 1997.

A permitting system for swine farms in North Carolina pre-dates the 1997 law and requires all farms with more than 250 pigs capacity to acquire a permit for land application of manure. The permit specifies the maximum Steady State Live Weight (SSLW) of pigs that may be maintained at that site. SSLW is a regulatory and statutory definition intended to represent the average weight of animals in inventory over the course of a year. The regulatory definition of SSLW includes specific weights per animal capacity for various types of swine production facilities. One sow of farrowing capacity is specified as 433 pounds SSLW and that weight includes per sow allowances for the nursing pigs, gilts, and boars that typically populate farrowing operations. One pig of nursery capacity is specified as 30 pounds SSLW and one pig of finishing capacity is specified as 135 pounds SSLW. The 'moratorium' law allows farmers to change the types of pigs they are raising at a site as long as the total number of SSLW does not increase. The law also allows rebuilding and modification of facilities as long as they remain in the original physical 'footprint' or location. In effect, the moratorium law attaches the permits to specific sites and caps the number of pigs that may be housed at each site.

Interested parties and particularly appraisers and lenders in a few of the major swine producing counties in North Carolina have observed that the price of swine farms sold there since 1997 has exceeded the sum of the appraised value of assets on those farms. Appraisers have labeled this difference a 'premium' and have typically assigned it to the swine production buildings and equipment on each farm.

The specific problem addressed by this analysis is that there is lack of understanding of the source and determinants of observed premiums on swine farm sales in North Carolina between 1997 and 2010.

Objectives:

This paper has three objectives. One is to describe the reported dataset in terms of components, mean values, variability, and trends observed. The second objective is to specify and estimate the relationship between total farm sales price and a set of variables describing components of the farm excluding the

premium assigned by appraisers. The third objective is to specify and estimate the relationship between the stated premium and a set of explanatory variables. The general goal addressed by objectives two and three is to begin to understand the sources of the stated premium. Appraisers, buyers and sellers of swine farms, lenders, and many others are interested in this topic.

Data

The data set includes information on 130 swine farm sales that occurred between 1997 and 2010 in southeastern North Carolina. The data were obtained from the Cape Fear Farm Credit Association of North Carolina (CFFC). Three Farm Credit Associations in North Carolina manage over half of the agricultural loan portfolio in the state.[1] Most of the farm sales in the data set occurred in Bladen, Duplin, Pender and Sampson counties with a few in eleven other counties in southeastern North Carolina. Duplin and Sampson are two of the largest swine producing counties in the United States. The data were extracted from the Uniform Agricultural Appraisal Report (UAAR®) for each sale. UAAR® (AgWare, Inc. 2010) is a proprietary computer software program used by CFFC to prepare appraisal reports on sales of property that CFFC is funding through a mortgage. The CFFC appraisal service is also used by individuals who seek to purchase farms financed by other lenders and some such sales are included in the data set. The UAAR® report consists of several sections: Sale Analysis, Land Mix Analysis, Income Analysis, Improvement Analysis, and Comments.

Variables extracted from the Sale Analysis section of the UAAR® include farm type (e.g. farrow to wean), deeded acres, sales date, county, sales price, other contribution, net sales price, $US per deeded acre, type of swine unit, effective unit size, and other descriptive details. Variables from the Land Mix Analysis section include the numbers of arable acres, forested acres, and other use acres such as the building site. The Land Mix Analysis also provides the estimated fair market value (FMV) for the land by type. The Income Analysis section includes actual or estimated income for selected assets, generally calculated as the product of a Stabilized $US per unit price and Stabilized yield to determine the Owner's share of income. Estimated costs as a share of income are also reported. Income variables were not used in the analysis reported here. Variables extracted from the Improvement Analysis section of the UAAR® included the Replacement Cost New (RCN) less percent physical depreciation, contribution value of the improvements to the total sales price as a whole and per unit for the stated number of pigs

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[1] Per personal conversation with Mr. Gene Charville, President of AgCarolina Farm Credit following presentation to Agri_Business/NAMA Club at North Carolina State University, October 2009.

capacity of the farm. Information was extracted from the Comments section from observations by the appraiser about the farm and his or her appraisal. Examples include appraiser references to the "moratorium" and a "premium" calculated after the sales price exceeded the appraised value. The reports were also the source for other variables including the value of other capital improvements, the value of standing timber and other liquid assets, and the appraised premium.

The sample size, mean, and standard deviation for Farm Sales Price, Appraised Value of Swine Buildings and Equipment, Appraiser Assigned Premium, and Total Appraised Value of Land are reported in Table 1. for 5 categories of swine farm type. The five categories of swine farm type are Farrowing (or farrow to wean), Naturally Ventilated Nursery, Tunnel Ventilated Nursery, Fully Slatted Finishing Floor, and Partially Slatted Finishing Floor.

Evident in Table 1 is the fact that standard deviation is a large proportion of the mean farm sales price ($/farm) for all farm types. This may be expected considering that the amount of land and the capacity of the swine farm vary within farm types. The ratio of standard deviation to mean price for Swine Buildings and Equipment viewed on a per unit ($ per head) basis reveals differences across farm types. The farrowing farms exhibit relatively high degree of variation while the Tunnel Ventilated Nurseries reveal very little variation in buildings and equipment value per head capacity. Large variation may be attributed to variation in the design, age, and condition of facilities. It may also reflect decreased demand for smaller farrowing facilities due to changes in industry organization and animal flows.

Preliminary summary of the data was reported in van der Hoeven et al. (2011). They identified a problem in the per unit or per head denominator: aggregating head capacity across different phases of production (farrowing, nursery, finishing) introduces distortion into the per head values within farm type categories. For example, a farm that is predominantly a farrowing farm but also has some capacity in nursery and finishing may have a large increase in the denominator (number of head capacity) and a disproportionately smaller increase in numerator (e.g. $ value of buildings and equipment), than if only the farrowing capacity were considered. SSLW as a denominator substantially corrects the 'mixed farm type problem' by weighting the head capacity by the relative SSLW for each phase of production (e.g. 433 pounds per sow versus 30 pounds per nursery pig). This effect can be seen in Table 1 by comparing the standard deviation to the mean for each farm type. For example, consider the value of swine buildings and equipment for farrow to wean farms: the ratio of sample standard deviation to mean is .27 on a per unit (head) basis and 0.21 on an SSLW basis. Nonetheless, relative variation in Buildings and

Equipment value per pound of SSLW remains higher in the Farrowing farm sample and in the Partially Slatted Floor Finishing farm sample than in other farm types.

The Appraised Premium values reported in Table 1 also provide some insight. When considered on a $/pound SSLW basis, the premium as a proportion of appraised value of buildings and equipment is highest for Nurseries and least for Finishing farms.

Furthermore, van der Hoeven et al. (2011) reported that nominal gross farm sale prices ($/farm) were generally increasing over time for all types of farms. However, the nominal appraised value of swine buildings and equipment converted to a per unit ($ per head) basis revealed a declining trend over time for partially slatted finishing floors and a negligible upward trend for Tunnel Ventilated Nurseries.

Model Specification and Empirical Approach

Two simple hypotheses are proposed and tested in this study: 1) the sale price of swine farms sold in North Carolina between 1997 and 2010 is well explained by characteristics of the farm excluding the Appraised Premium, and 2) the Appraised Premium for those farms is highly correlated with selected characteristics of those farms. A secondary hypothesis is that the coefficients estimated for Swine Farm Sale Price may be inflated for the variables that are most correlated with the Appraised Premium, thus supporting the idea that the premium exists and is determined by certain farm characteristics.

A conceptual basis for a premium is that the supply of hog farms in North Carolina has been constrained by state law and the demand for hog farms over the past 14 years resulted in an unconstrained equilibrium quantity demanded that exceeded the constrained equilibrium quantity supplied. In other words, the only method of entry or expansion in a capped supply market is through acquisition of existing capacity. The aggregate swine farm price and quantity terms are not homogeneous since quantity can be disaggregated by farm type and condition among other variables. For example, it might be hypothesized that Finishing farms would command a greater premium than other farms because North Carolina has more farrowing capacity than finishing capacity. Contrarily, it might be hypothesized that North Carolina has a comparative advantage in weaned pig production such that Farrowing farms would command a greater premium. Another dimension of heterogeneity in the stock of swine production facilities is their size, age and condition. It can be hypothesized that newer larger farms command a greater premium because they can be operated more efficiently. A competing hypothesis is that some older farms may command a premium because they can be retrofitted and shifted to other phases of pig production with less loss of remaining asset value. Other hypotheses include that swine

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farms with more land command a premium because they offer greater buffering against changes in rules constraining land application of manure and rules regarding property line set-backs to reduce nuisance. Previous work suggests that premiums are larger for smaller tracts of land (Schurle, 1996). A preliminary regression analysis of nominal Appraised Premium ($/farm) found it to be significantly, positively correlated with five types of swine production capacity and year of sale and negatively (marginal significance) correlated with land area and a swine Producer Price Index (van der Hoeven et al., 2011). Given the number of plausible hypotheses, some of which conflict, the conceptual approach adopted here is to conduct a simple econometric analysis including variables with potential explanatory significance and evaluate the results.

Among explanatory variables are quantities of depreciating specialized assets such as swine buildings and equipment, quantities of permanent and potentially appreciating assets such as land, the value of land as an indicator of quality, the value of site improvements as an indicator of specialized swine assets not included in buildings and equipment, year of sale to account for changes in interest rates, and a construction Producer Price Index to account for changes in construction cost that may have been excluded from RCN. An aggregate percentage depreciation of swine buildings and equipment serves as indicator of the overall condition of the swine farm. Since few farms in the sample had liquid assets such as timber and tractors, they are subtracted from gross Farm Sales Price to create a net Farm Sales Price variable.

The definition of a 'premium' is important and potentially problematic for this study. An economic premium may be defined as the sale price in the restricted market minus the sale price in an unrestricted market; in effect, an economic rent or capitalized rent created by a market constraint. The Appraised Premium reported in this study may not be an economic premium. The Appraised Premium is the difference between an actual sale price in the constrained market and a calculated estimate of fair market value including appraiser estimates of depreciation and expert estimates of Replacement Cost New. It is possible that the appraisal methods being employed undervalue or exclude elements of cost that constitute part of Fair Market Value. The hypotheses tests reported here can indicate which variables are correlated with the Appraised Premium but say nothing that distinguishes an economic premium from other differences between sale value and appraised value. Additional data and analysis that might identify an economic premium is discussed in the future work section below.

Two linear equations are specified.

Dependent Variable: Equation 1:   Net Farm Sale Price (Nominal $/Farm) where "net" indicates that liquid assets such as tractors and standing timber have been subtracted.

                                               Equation 2:   Appraised Premium (Nominal $/Farm)

Explanatory Variables: (same variables for Equations 1 and 2).
        Deeded Acres: Total acres occupied by the farm
        Sale Year: Year the farm was sold
        Farrowing :   Capacity of the farrowing buildings (Number of Sows)
        TV Nursery: Capacity of Tunnel Vented Nursery facilities (Number of Pigs)
        NV Nursery: Capacity of Naturally Vented Nursery facilities (Number of Pigs)
        PS Finishing: Capacity of Partially Slatted Floor Finishing facilities (Number of Pigs)
        FS Finishing: Capacity of Fully Slatted Finishing Finishing facilities (number of pigs)
        PPI Construction: a Producer Price Index for Construction inputs (Index number)
        Total Land Contribution (site excluded): Total appraised value of land excluding the value of the swine farm site (nominal $/farm)
        Site Improvement Contribution: Appraised value of the swine farm site (nominal $/farm)
        Percent Depreciation: RCN weighted average of the percent depreciation assigned to swine facilities.

All data were extracted from the new database with the exception of the Construction PPI. The PPI series was obtained online from Numbrary (accessed November, 2010). Some variables not included in the list above were tried and then dropped. The primary example of excluded variables is a series of dummies for county in which the sale occurred. Four main counties were identified separately and others were aggregated into an other category. None of the dummies were close to being significant.

A simple linear Ordinary Least Squares model with an intercept is specified for each equation. Several variations on the reported equations are discussed in the results section.

Results & Discussion

Regression results are reported in Table 2. The results include high R^2 and statistically significant coefficients with correct signs for most variables in both equations. Exceptions include that the estimated coefficients for Deeded Acres and for PPI Construction are not statistically significant in Equation 1 (Net Sales Price is the dependent variable). In equation 2 (Premium is the dependent variable), the sign of the estimated coefficient is incorrect for Farrowing and the estimate is not statistically significant. The estimated coefficient for Percent Depreciation is also not significant in

equation 2. Multicollinearity is a potential problem with so many related explanatory variables. A few additional variations on these equations were estimated and not fully reported here. For example, when Site Improvement Contribution is excluded from Equation 2, Farrowing becomes significant with the correct sign. The apparent substitutability between Farrowing Capacity and the Site Improvement Contribution may raise a question about valuation of the respective variables, particularly when the same relationship does not appear to exist as strongly for other swine farm types. The insignificance of Deeded Acres in Equation 1 may also indicate poor specification with both Acres and Land Contribution in the equation. Average land price may be a preferable indicator of the quality of land rather than gross value. The insignificance of PPI in equation 1 may indicate that annual adjustments in RCN are capturing changes in construction costs.

The estimation results do not refute the existence of an Appraised Premium and Equation 2 suggests that the Appraised Premium is positively and significantly correlated with each type of swine production capacity except Farrowing, positively correlated with Land Contribution (value of land) and with Site Improvement Contribution. This result generally suggests that the Appraised Premium may arise from swine production capacity but that conclusion is weakened somewhat by the Land Contribution variable and the Farrowing variable. An improved specification may resolve this ambivalence. The product of each coefficient and variable mean provides an indication of the contribution of each variable to expected premium. The Land Contribution variable appears to loom large in this respect.

Results for Equation 1 support the hypothesis that farm characteristics can explain the variation in farm sale prices. The very high R^2 value for Equation 1 suggests multicollinearity or a near definitional equation. The coefficient of 1.02 on Land Contribution suggests this variable does not have an appraised premium attached to it. By contrast, the coefficient near 4 on the site improvement contribution variable suggests that it is serving as an indicator for an excluded contributor to Farm Sale Value. The coefficients on swine production facilities are generally below their respective sample mean prices per unit, suggesting that their marginal contribution to Sale Price is less than hypothesized. It may be that Site Contribution is closely correlated with swine farm capacity. An improved specification will be sought for this equation as well.

SUMMARY AND CONCLUSIONS

A new data set on swine farm sales in North Carolina between 1997 and 2010was summarized and described. The presence of an Appraised Premium in most of the farm sales raises interesting questions

about the market for swine farms in the presence of a *de facto* moratorium. Issues arising from these questions include the existence of an economic premium and the completeness and accuracy of the cost estimation procedures being used in appraisal. Simple OLS regression analysis was applied to two equations in an initial attempt to identify sources of the appraisal premium. The existence of the premiums is not refuted, However, the results are ambiguous withrespect to identifying sources of the premium and their relative contributions. Improved specification of equations will be pursued in future work. Analysis currently underway includes the use of selected Price Indexes to deflate the time series dimension of the data set. Another avenue of research is to obtain comparable sales data for states that did not have a de facto moratorium in place over the same period. A third avenue of research that is underway is the analysis of crop farm sales in the same counties over this period to determine if land pricing is consistent across farm types. Some pragmatic information is emerging from this work. Appraisers informed the authors that farmers often have a price per unit (head capacity) in mind when they assess a swine farm's value and that may affect their valuation of other components of the farm that are of less interest to them. Furthermore, tax Issues arise from how the appraised premium is classified. If attached to depreciable assets, it too may be depreciated by the buyer but pose a tax liability to the seller. If attached to land, the premium may be long term capital gain for the seller and may be taxable at use value for property tax purposes. A number of interesting questions remain to be addressed.

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Table 1. Summary Statistics in Nominal US Dollars by Swine Farm Type: per farm, per unit and per pound SSLW for Farm Sales 1997 – 2010.

		Nominal US Dollars					
		Per farm		**Per unit**		**Per SSLW lb**	
Farm type	**n**	**Average**	**STD DEV**	**Average**	**STD DEV**	**Average**	**STD DEV**
TOTAL FARM SALE							
Farrow - Wean	25	2,320,155	1,383,210	912	218	2.17	0.36
Natural Vent Nursery	26	527,752	358,759	123	36	4.11	1.20
Tunnel Vent Nursery	16	743,267	417,683	128	36	4.28	1.21
Full Slat Finishing	40	1,033,727	752,333	184	43	1.36	0.32
Partial Slat Finishing	23	765,391	467,772	163	33	1.21	0.24
BUILDINGS AND EQUIPMENT							
Farrow - Wean	25	1,356,488	835,312	521	143	1.24	0.26
Natural Vent Nursery	26	243,544	138,179	56	8	1.88	0.28
Tunnel Vent Nursery	16	362,659	151,595	62	4	2.08	0.13
Full Slat Finishing	40	554,348	401,178	95	16	0.70	0.12
Partial Slat Finishing	23	351,812	237,607	70	14	0.52	0.10
REPORTED PREMIUM							
Farrow - Wean	25	509,232	430,132	184	96	0.44	0.21
Natural Vent Nursery	26	122,869	144,043	26	14	0.87	0.46
Tunnel Vent Nursery	16	130,265	89,240	24	18	0.80	0.59
Full Slat Finishing	40	111,775	116,452	18	14	0.13	0.10
Partial Slat Finishing	23	98,215	106,845	19	13	0.14	0.10
TOTAL LAND VALUE							
Farrow - Wean	25	432,455	238,974	177	69	0.42	0.14
Natural Vent Nursery	26	156,043	100,786	38	23	1.28	0.78
Tunnel Vent Nursery	16	215,740	209,642	34	17	1.15	0.57
Full Slat Finishing	40	351,082	277,525	62	19	0.46	0.14
Partial Slat Finishing	23	292,200	169,100	64	20	0.48	0.15

Table 2. Ordinary Least Squares Regression Results for Equations 1 and 2

Explanatory Variable	Equation 1. Dependent Variable: Nominal Net Sale Price ($/farm) n =130		Equation2. Dependent Variable: Nominal Appraised Premium ($/farm) n=130	
	Parameter estimate	P value	Parameter estimate	P value
Intercept	-7.53e+07	0.039	-448730.5	0.059
Deeded Acres	-305.42	0.368	-3.75	0.089
Sale Year	37880.22	0.040	227.03	0.058
Farrowing	553.14	0.000	-0.162	0.546
TV Nursery	38.28	0.001	0.697	0.000
NV Nursery	46.32	0.000	0.746	0.000
PS Finishing	65.25	0.000	0.622	0.000
FS Finishing	40.79	0.001	0.669	0.000
PPI Construction	-2337.93	0.394	-37.92	0.033
Total Land Contribution	1.021	0.000	0.0036	0.002
Site Improvement Contribution	4.831	0.000	0.0107	0.012
Percent Depreciation	-474196.5	0.007	1177.02	0.302
R^2	0.964		0.848	
Chi^2	3538		725	