



Source: New York Times

# Valuing Localized Externalities: Hog Operations in North Carolina

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## Introduction

Beginning in the early 1990s, eastern North Carolina experienced a boom in industrial hog production.

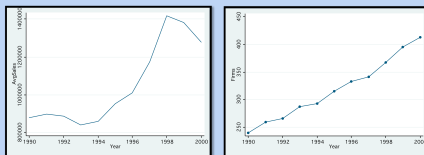
- From 1989 to 1995, the percentage of the state's hog population in ten Coastal Plains counties jumped from 39% to 67%
- In 1998, 92% of the state's 10 million hogs were raised on operations of at least 2,000 animals<sup>1</sup>

Negative externalities include: foul odors, excess nutrients that can contaminate ground and surface water, respiratory ailments for workers, awful quality of life for confined hogs, and depressed property values for residents nearby.

House price capitalization techniques make it possible to measure the economic externalities of operations. The marginal value (or disvalue) of an environmental characteristic can be extracted from its contribution to the value of a house. By using housing data from years just *before* the boom in hog production and data from directly *after* for 250 tracts and over 50,000 blocks, I test for a negative relationship between median housing prices and hog operations.

## Industry Trends- Eastern NC

Chart 1: Average Sales 1990-2000      Chart 2: Number of Firms 1990-2000



In 1996, Bill 1217 required all new or expanded lagoons to be 500 ft. from a property boundary. In 1997, House Bill 515 imposed a moratorium on the construction of all new or expanded operations with 250+ hogs.<sup>2</sup> The new firms that entered after 1997 brought average sales down because these were operations with less than 250 animals.

## Empirical Method

Using data on hog operations from Dun and Bradstreet and data on housing characteristics from the U.S. Census Bureau, I employ ordinary least squares regression analysis to extract the contribution of operations to the value of a median house. Specifically, I use exact latitudes and longitudes of operations to determine 1) which tract the operation lies in or 2) how many operations lie within certain distance radii of block centroids. I then regress median property value on structural and neighborhood characteristics of houses and counts of hog operations.

I perform both cross-sectional regressions for 1990 and 2000 for census tract-level and block-level data. I then control for unobservable variables for both samples by running fixed-effects regressions. Two sample equations are shown below.

### Cross-Sectional Specification

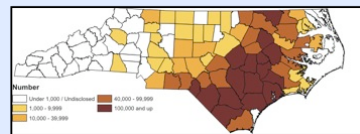
$$\ln(\text{MedianHouse Value}_{it}) = \alpha_0 + \beta_1 \text{HogOperations}_{it} + \beta_2 \text{PctMobile}_{it} + \beta_3 \text{AfricanAmerican}_{it} + \beta_4 \text{AmericanIndian}_{it} + \beta_5 \text{Electricity}_{it} + \beta_6 \ln(\text{MedianHHIncome}_{it}) + \beta_7 \# \text{Bedroom}_{it} + \epsilon_{it}$$

### Fixed Effects Specification

$$\Delta \ln \text{MedValue}_{it} = \alpha_0 + \beta_1 \Delta \text{Operations}_{it} + \beta_2 \Delta \text{AfricanAmerican}_{it} + \beta_3 \Delta \text{Bedroom}_{it} + \beta_4 \Delta \ln \text{MedHHInc}_{it} + \beta_5 \Delta \text{Electricity}_{it} + V_i + \epsilon_{it}$$

## The Study Area

Largest hog producing counties in dark brown, as of mid 1990



Source: North Carolina Department of Agriculture

## Results

### Tract Level

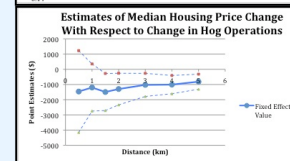
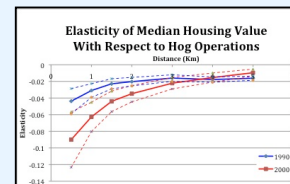
- A significant, negative relationship between hog operations and median tract housing values could *not* be determined, both with and without location fixed effects
- The tract level is too large a geographic area to measure such localized externalities
- High R<sup>2</sup> and significant independent variables in all models suggest that included regressors explain much variation in median housing value

Table 1: Tract-Level Regressions

Variable	(1) 1990 Cross-Section	(2) 1990 Cross-Section	(3) Fixed Effects
Intercept	5.11	3.62	4.00
Operations	-0.0075	-0.0041	-0.13
Percent Built Last 5 Years	(0.0017)	(0.0076)	(0.004)
Percent Mobile Homes	(0.181)		
	-0.004**		
	(0.122)	(0.114)	
Percent Black	-0.118**		-0.41
	(0.058)		(0.225)
Percent American Indian	-0.256**		
	(0.095)		
Percent w/0-2 Bedrooms	-0.238**	0.588*	-0.554**
	(0.108)	(0.171)	(0.21)
Log Median Household Income	1.23**	1.66**	1.14**
	(0.17)	(0.199)	(0.13)
Percent w/0 Electricity	0.147*	0.23**	0.26
	(0.068)	(0.098)	(0.154)
Number of Observations	249	249	249
Adjusted R <sup>2</sup>	0.7	0.67	0.4

### Block Level

- In both cross sections, all coefficients on hog operations at distances up to at least five kilometers were significant and negative
- At smaller distances, the effect was stronger: this implies that operations closest to block centroids have a more noticeable effect
- The 2000 effect was almost twice as strong as the effect in 1990, most likely explained by hog industry growth during the decade
- Controlling for unobserved variables differing across blocks but constant over time resulted in a small, but significant, negative effect of operations at distances greater than 2 kilometers
- As expected, with larger operations in 2000, residents would be much more sensitive to the externalities of farms generating thousands more pounds of manure



## Conclusions

My hypothesis that block-level data would yield much more accurate results than tract-level data was correct. This study demonstrates that it is possible to use housing values to back out how much residents are willing to pay for environmental amenities.

Census data allow for *both* large sample sizes and a fine geographic level over time. The tract level is too large to measure localized externalities, which suggests that studies that used this type of data may not have yielded accurate results. The use of median block data, especially at very close distances to hog operations, allows for a negative relationship between swine operations and property values to be determined.

The literature on swine operation effects on housing values generally finds a negative correlation to be anywhere from 3.1% - 16% depending on operation size, wind direction, and operation concentration in the area. None of the studies have used block data, and most focus only on small cross sections. My results at the block level are in line with the figures found in current literature. I would assume that using the same model with 2010 census information would yield smaller negative effects, as manure management technology and updated regulations ought to decrease the environmental externalities. Extending the analysis to other types of confined animal feeding operations would also have implications for government regulation and compensation for residents nearby.

## Literature Cited

1. "Facing the Facts About Hogs." North Carolina Coastal Federation, September 1998.
2. "Major North Carolina Laws Related to Hog Factory Farms." Environmental Defense, 2002.



Source: Woodstock Farm Animal Sanctuary