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# Productivity Growth Slows for Specialized Hog Finishing Operations

by **William McBride** and **Nigel Key**


The number of U.S. hog farms declined by more than 70 percent over the past two decades while hog production rose by more than 30 percent. The result has been an industry with larger hog enterprises, increased specialization in a single phase of production, greater reliance on purchased feed rather than feed grown on the farm, and an increased reliance on formal contracts that connect farmers, hog owners, and packers to coordinate production. To document how the hog sector changed during the last two decades and to measure hog

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farm productivity gains and its sources, ERS researchers used data from the hog versions of USDA's annual Agricultural Resource Management Survey (ARMS) conducted in 1992, 1998, 2004, and 2009. Hog operations in the ARMS are those with 25 or more hogs on farm-operated acreage at any time during each year.

**Highlights:**

- U.S. hog production has become increasingly concentrated in fewer, larger, and more specialized operations over the last two decades.
- Structural change contributed to substantial productivity gains for hog farms during much of this period, likely benefiting U.S. consumers through lower pork prices and enhancing the competitiveness of U.S. producers in international markets.
- Hog farm productivity growth slowed considerably after 2004 for specialized hog finishing operations. With most hogs now grown on very large operations and with most productivity-enhancing innovations widespread, rapid productivity gains experienced prior to 2004 will likely remain unmatched, absent further technological innovation.

Traditionally, hogs were produced on farrow-to-finish operations that managed production from breeding to sale for slaughter. Today, most hog operations specialize in one of the three major life-cycle phases of production: farrow-to-wean (breeding to weaning), wean-to-feeder (weaning to a 30-80 pound feeder pig), or feeder-to-finish (feeder pig to slaughter weight). In 1992, 65 percent of market hogs came from farrow-to-finish farms. By 2009, only 20 percent came from farrow-to-finish farms and 73 percent of market hogs were produced on specialized feeder-to-finish farms.

Increases in hog farm productivity have been driven by—and were reflected in—the industry's pronounced structural changes. Economic competition and the incentive to maximize profits drive structural changes in the hog industry. If larger operations are more profitable than smaller ones, competitive pressures should result in larger average farm sizes in the long run. Similarly, operations that are first to adopt a cost-saving technology in regions with lower input costs or closer to markets have a competitive advantage that makes them more likely to survive and grow. Relationships between farmers and processors also evolve to reflect more cost-effective modes of production. For example, the use of production contracts—formal agreements between hog growers and owners—to coordinate production has increased.

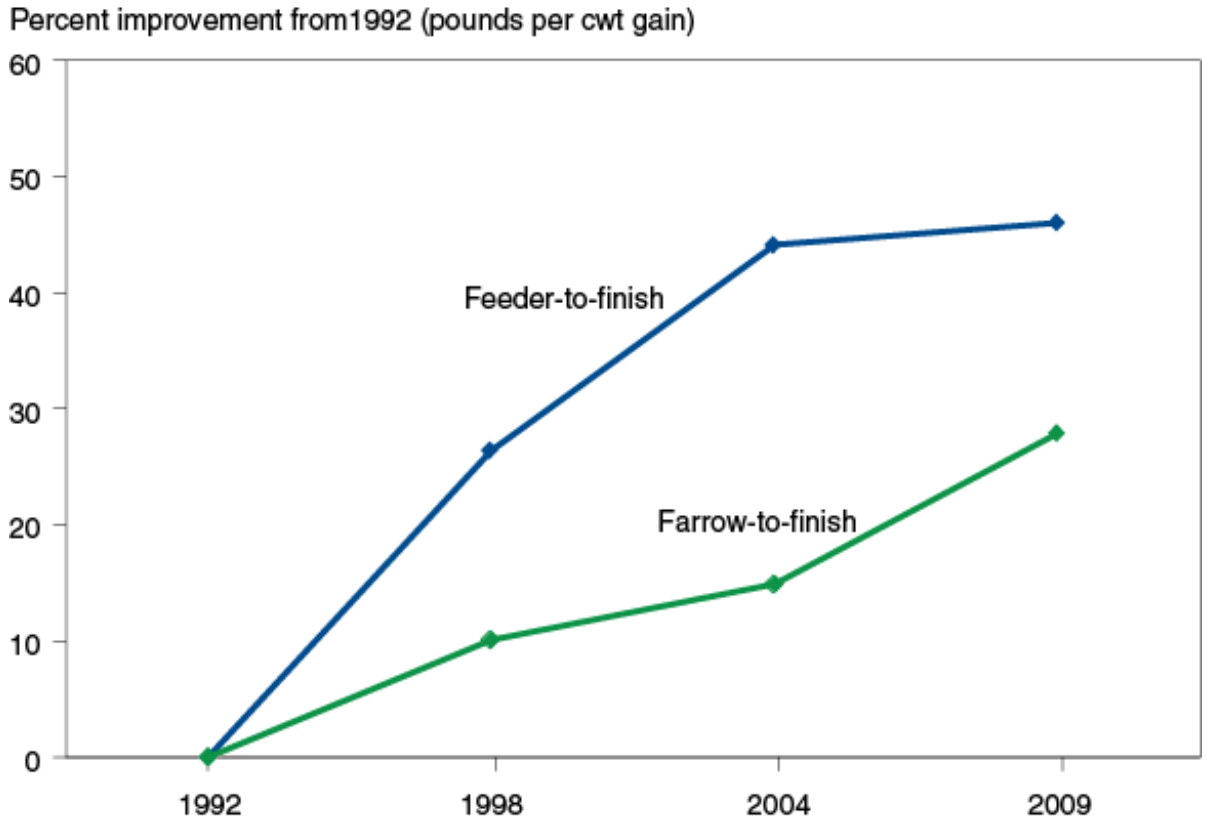
The substantial productivity gains experienced by hog farms during 1992-2009 are primarily attributable to the adoption of innovations —such as confinement housing, contract production, and improved genetics—and increases in the scale of production. However, with most market hogs now finished on very large operations and with most productivity-enhancing innovations widespread, rapid productivity gains experienced prior to 2004 will likely remain unmatched absent new technological and/or organizational innovation.

## Productivity Growth in Hog Production

The average quantity of inputs used to produce a unit of output illustrates how efficiently factors of production are used on the farm (see

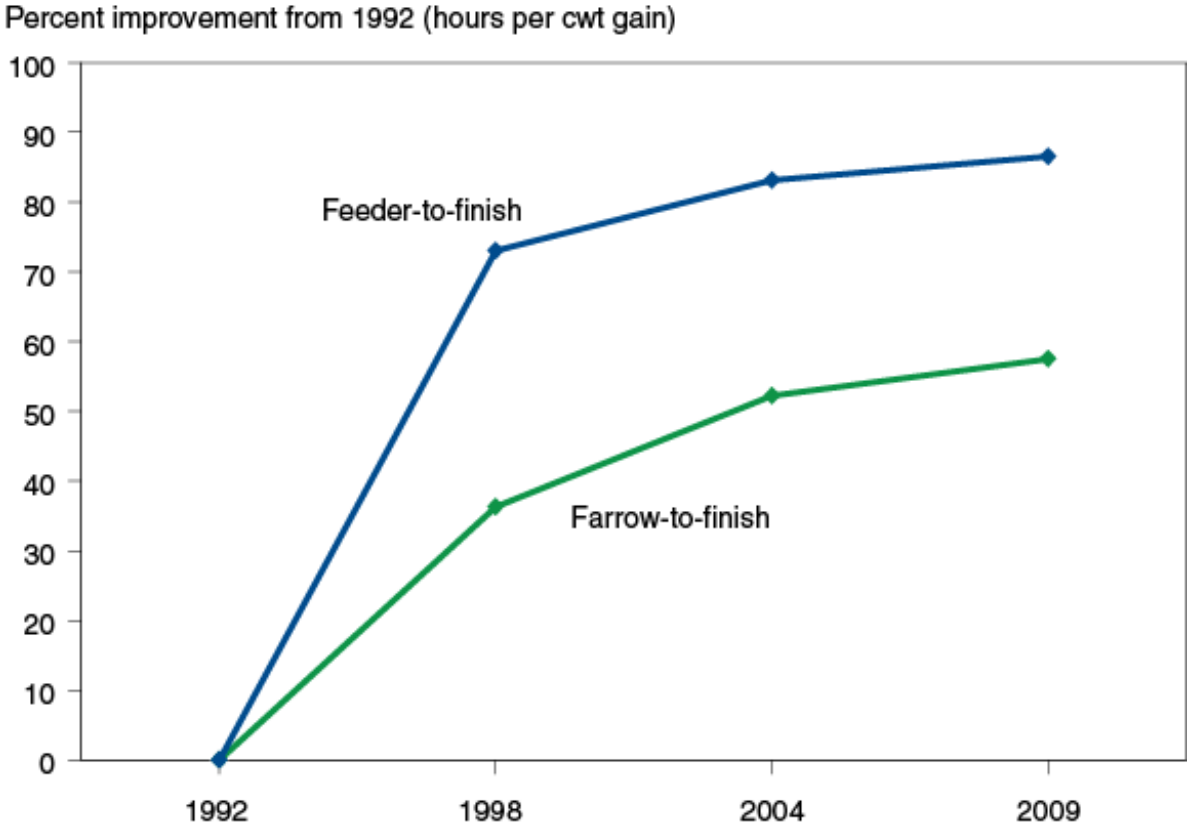
Box: **Measuring Hog Farm Productivity**). Rapid increases in productivity on operations producing market hogs occurred before 2004, especially on feeder-to-finish operations. Between 1992 and 2004, feed efficiency—the quantity of feed required per hundredweight of gain—improved by 15 percent for farrow-to-finish operations and 44 percent for feeder-to-finish operations. The efficiency of labor use—the quantity of labor used per hundredweight—improved 52 percent for farrow-to-finish operations from 1992 to 2004 and 83 percent for feeder-to-finish operations.

**Feed efficiency improvements between 1992 to 2009**
The rate at which feed efficiency improved declined between 2004 and 2009 for feeder-to-finish operations, but increased among farrow-to-finish operations.




Source: USDA,1992 Farm Costs and Returns Survey; 1998, 2004, and 2009 Agricultural Resource Management Survey.

**Labor efficiency improves between 1992 to 2009**
Labor efficiency improved greatly between 1992 and 1998, but less in successive periods between 1998 and 2009 for both feeder-to-finish and farrow-finish operations.



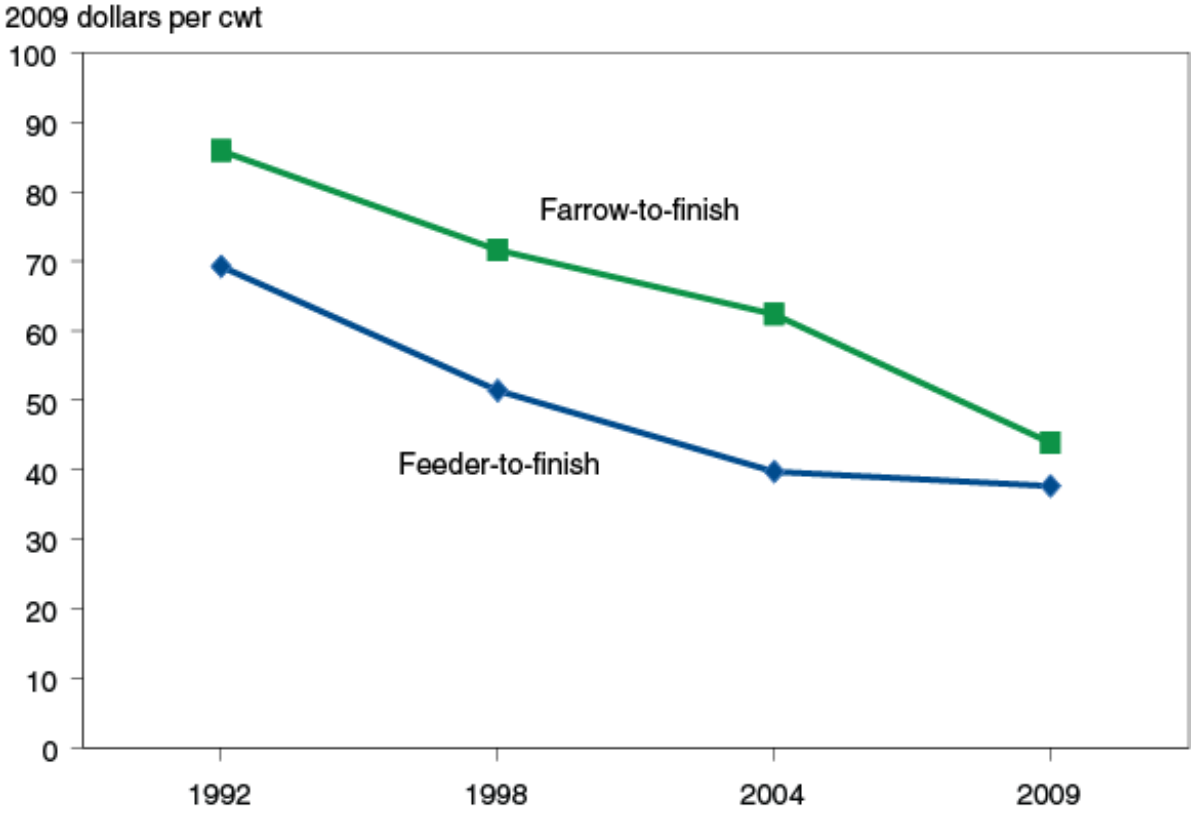

Source: USDA,1992 Farm Costs and Returns Survey; 1998, 2004, and 2009 Agricultural Resource Management Survey.

Since 2004, these trends have changed. Between 2004 and 2009, feed efficiency improved 13 percent on farrow-to-finish operations but only 2 percent on feeder-to-finish operations. Labor efficiency improved only 3 percent between 2004 and 2009 on both farrow-to-finish and feeder-to-finish farms.

Productivity gains contributed to a decline in production costs between 1992 and 2004. For farrow-to-finish hog producers, average production costs per hundredweight of gain, expressed in 2009 dollars, were 27 percent lower in 2004 than in 1992. Inflation-adjusted costs declined faster for feeder-to-finish hog producers, falling 43 percent between 1992 and 2004. Productivity gains continued after

2004 for farrow-to-finish operations: the nominal cost of producing a hundredweight of hogs was only about 3 percent higher in 2009 than in 2004, despite feed prices that increased more than 50 percent. After adjusting for higher input prices, production costs declined by nearly 30 percent among farrow-to-finish operations. In contrast, nominal production costs for feeder-to-finish operations increased 41 percent from 2004 to 2009; after adjusting for higher input prices, production costs declined 5 percent over this span.

**Real production costs per cwt (2009 dollars)**
Nominal production costs were relatively high in 2009 due to high corn prices, but real production costs declined for each type of hog producer because of improved productivity.




Source: USDA,1992 Farm Costs and Returns Survey; 1998, 2004, and 2009 Agricultural Resource Management Survey.

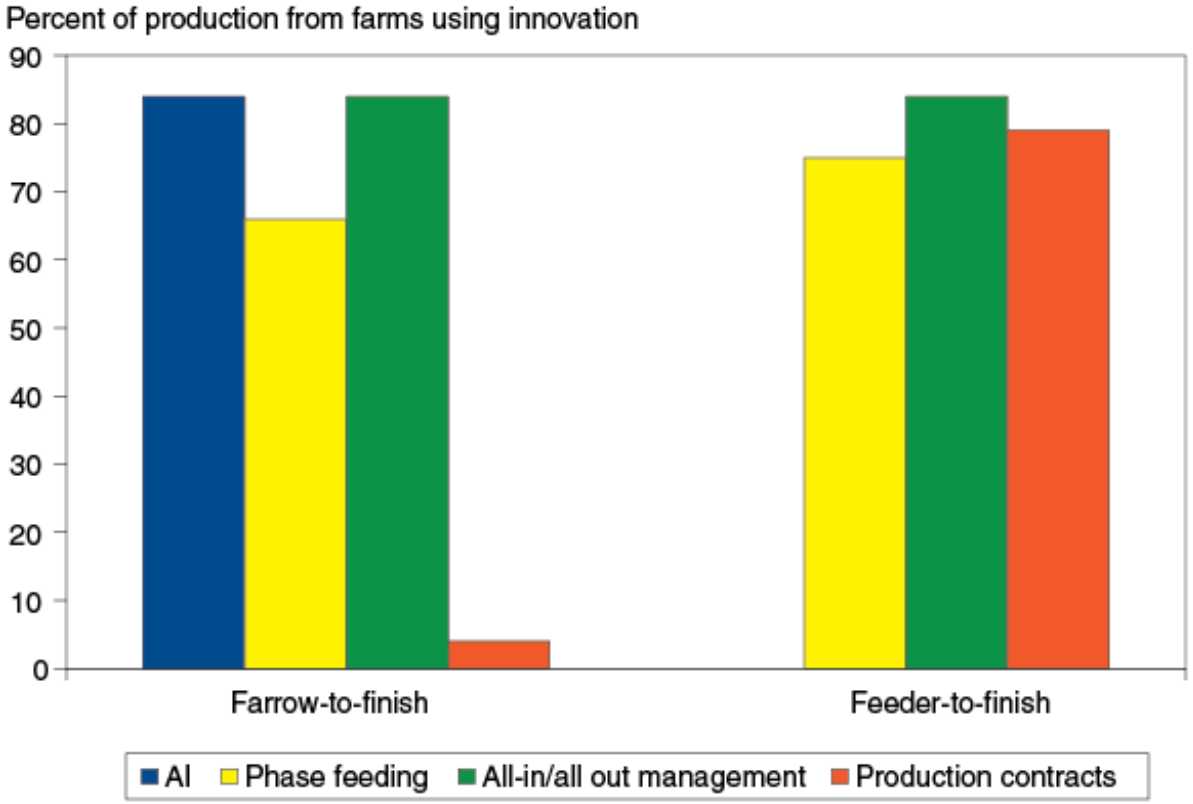
Researchers analyzed the total factor productivity (TFP) of hog farms over the 1992 to 2009 period (see Box: **Measuring Hog Farm Productivity**). Results suggest that the substantial productivity gains experienced by hog farms during this period were primarily attributable to two factors: technical and organizational innovation in hog production, and increases in the scale of production.

## Hog Producers Adopt Technical and Organizational Innovations

Technological innovation in hog production includes advances in genetics, nutrition, housing and handling equipment, veterinary and medical services, and management that improve the health and growth of hogs, the efficiency of the operation, and/or reduce production risk. Data from USDA's National Animal Health Monitoring Service (NAHMS) surveys illustrate the widespread adoption of technological innovation on hog operations with 100 or more head. For example, artificial insemination (AI) improves the genetic potential of the swine herd and the conception rates of breeding animals. The share of farrowing hog operations using AI increased from 7 to 23 percent between 1990 and 2000, and reached about 40 percent in the 2006 NAHMS data. Another innovative practice to enhance productivity, all-in/all-out housing management, commingles pigs of a similar age and weight and keeps the entire group together as it moves through each production phase. The hogs are marketed a room or group at a time, and rooms are washed and disinfected after each group leaves. The NAHMS data reveal that the use of all-in/all-out management for finishing hogs increased from 25 percent of hog operations in 1990 to 71 percent in 2006.

Larger farms used technical innovations more often than smaller farms, as evident by the share of production on farms using these practices. For example, 20 percent of the farrow-to-finish farms examined used AI in 2009, but these farms accounted for 84 percent of farrow-to-finish production. Fewer than 50 percent of farrow-to-finish farms used either AI, phase feeding, or all-in/all-out management in both 2004 and 2009, but a decided majority of farrow-to-finish production occurred on farms using these practices in both years. Phase feeding and all-in/all-out management were used on farms responsible for more than 70 percent of feeder-to-finish farm production in both 2004 and 2009.

**Technological/organizational innovations widespread on hog operations**
Most hog production occurred on farms using technological innovations (artificial insemination (AI), phase feeding, and all-in/all-out management) in 2009, and most feeder-to-finish hogs were produced under contract in 2009.




Source: USDA, Economic Research Service and National Agricultural Statistics Service, Agricultural Resource Management Survey.

Organizational innovation in hog production has largely occurred through the substantial growth of production contract arrangements. Production contracts govern the relationship between growers (hog producers) and hog owners ("integrators," or "contractors"), specifying the inputs provided by each party and the compensation due to each. Contractors typically retain ownership of the hogs on contract operations and provide the feed, veterinary care, and transportation services. Growers typically provide the production facilities and labor, and they are compensated based on a fee-for-service arrangement.

Hog operations organized under production contracts grew from 5 percent of production in 1992 to 67 percent in 2004 and 71 percent

by 2009. The use of production contracts reached 79 percent of the production from feeder-to-finish farms in 2009. Few farrow-to-finish farms produce under contract; operations producing under contract were more likely to specialize in a single production phase. ERS research has shown a direct link between the use of production contracts and improved hog farm productivity.

## The Scale of Hog Operations Expands

An increase in the scale of production is a source of productivity growth when there are increasing returns to scale—that is, when a proportional increase in all inputs results in a more than proportional increase in output. Returns to scale can be represented by the "scale elasticity"—the percentage increase in output obtained from a 1-percent increase in the quantity of all inputs—exhibited by farms of varying sizes, with a scale elasticity equal to 1 representing the optimal scale of production. Estimates of returns to scale explain farmers' incentives to further expand farm size.

Scale elasticities by farm size for feeder-to-finish farms were estimated over the 1992-2009 period. The estimated scale elasticities decline as farm size increases—that is, large farms obtain smaller gains from increasing scale than do small farms. In every year, the mean scale elasticity was greater than one, implying increasing returns to scale in all periods and incentives for farms to get larger. However, as the size of hog operations increased between 1992 and 2009, the share of farms in the larger size categories increased, which caused the mean scale elasticity to decline over time from 1.15 to 1.04. The mean scale elasticity of 1.04 in 2009 indicates that a 10-percent increase in inputs produces a 10.4-percent increase in output for the "typical" farm.

**Scale elasticity estimates by farm size for U.S. feeder-to-finish hog producers, 1992 to 2009**

| Size category[1] (hog sales/contract removals) | 1992 | 1998 | 2004 | 2009 |
|---|---|---|---|---|
| | *Scale elasticity* | | | |
| Less than 500 head | 1.20 | 1.23 | 1.21 | 1.26 |
| 500-1,249 head | 1.12 | 1.14 | 1.14 | 1.13 |
| 1,250-4,999 head | 1.06 | 1.08 | 1.07 | 1.07 |
| 5,000-12,499 head | 1.05 | 1.04 | 1.03 | 1.01 |
| 12,500 head or more | id | 0.97 | 0.96 | 0.97 |

| | | | | |
|---|---|---|---|---|
| All farms (mean) | 1.15 | 1.13 | 1.09 | 1.04 |

[1]Size categories shown in the source report were presented as a measure of hundredweight gain. These were converted to the approximate number of head using an average of two hundredweight gain per head. id=insufficient data for legal disclosure.

By 2009, feeder-to-finish farms producing fewer than 5,000 head could still improve productivity substantially by increasing their scale of production. However, beyond about 5,000 head the productivity gains from expanding farm size were limited. Farms producing between 5,000 and 12,500 head had an average scale elasticity of 1.01 in 2009, suggesting little incentive for these farms to get larger. Farms in the largest size category (12,500 head or more) exhibited slightly decreasing returns to scale (0.97). In 2009, about 91 percent of hog production from feeder-to-finish operations originated on farms producing at least 5,000 head. Hence, there appears to be little scope for additional productivity gains from increases in scale for feeder-to-finish operations given current hog production technologies.

## Productivity Growth Slows

The dramatic productivity gains experienced in U.S. hog production have enhanced national economic efficiency by freeing up land, labor, capital, and other resources for the production of other goods and services. These changes have helped lower pork prices for consumers and contributed to an increase in U.S. pork exports. However, in some States these changes have concentrated livestock manure in regions with relatively little available cropland for spreading, making it difficult to apply as fertilizer in environmentally benign ways.

Productivity growth was greater for farrow-to-finish farms during 2004-2009 in comparison with earlier years mainly because of the increasing scale of these operations—the average size grew 170 percent. Despite greater productivity from farrow-to-finish farms in recent years, the total amount of market hog output from these farms declined significantly during 1992-2009.

Many small, typically high-cost farrow-to-finish operations ceased hog production during this period as greater corn and soybean prices during 2007-2009 raised feed costs substantially. High corn and soybean prices drive change in the structure and productivity of U.S. hog farms by encouraging producers to sell the crops rather than feeding them to hogs.

Most U.S. market hogs are produced on specialized hog finishing operations. Analysis of the 1992-2009 ARMS hog data suggests that the era of dramatic productivity growth among specialized hog finishing operations is likely over, absent new innovation. The data

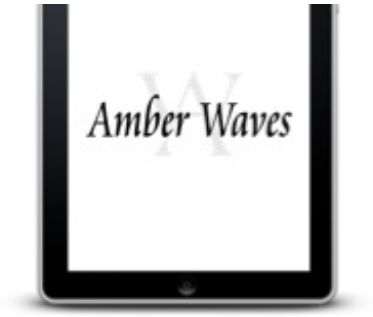
support this conclusion on two fronts. First, productivity gains from exploiting scale economies on feeder-to-finish operations are nearly exhausted, as about 90 percent of hog production takes place at a size of operation where returns to scale are nearly constant. Second, the observed technological and organizational innovations that have contributed to productivity growth (such as confinement feeding, production contracts, artificial insemination, and all-in/all-out management) have been widely adopted. The contribution of production contracts, a primary source of productivity growth, may be reaching a limit on feeder-to-finish operations as 79 percent of hogs were raised under a contract in 2009. As a result there appears to be little scope for additional productivity gains on specialized hog finishing operations unless new technological and/or organizational innovations are introduced and adopted by hog producers.

### Measuring Hog Farm Productivity

Productivity is a measure of how much output can be produced for a given quantity of inputs, or equivalently, how many inputs are required per unit of output. Output can be indicated by the number of hogs sold or removed under contract in a year or, as is done in this analysis, the hogs' weight gain: the weight of hogs sold or removed under contract less the weight of hogs purchased or placed under contract, plus the weight of the inventory change each year.

Productivity can be measured for individual inputs, such as feed and labor per unit of output, called partial factor productivity, or for all inputs combined, called total factor productivity (TFP). TFP is the quantity of farm output per unit of aggregate inputs, where the inputs are usually combined using weights based on prices. A farm's productivity reflects (1) the production technology available (which determines the rate at which inputs can be combined to make outputs); (2) the degree to which the farm is operating at an efficient scale of production; (3) the efficiency with which inputs are combined given the production technology; and (4) the degree to which the farmers take into account the relative prices of inputs.

**This article is drawn from...**
**U.S. Hog Production From 1992 to 2009: Technology, Restructuring, and Productivity Growth**, by William McBride and Nigel Key, USDA, Economic Research Service, October 2013

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