



United States Department of Agriculture

Economic
Research
Service

Economic
Information
Bulletin
Number 126

June 2014

Technology, Organization, and Financial Performance in U.S. Broiler Production

James M. MacDonald





United States Department of Agriculture

Economic Research Service

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Recommended citation format for this publication:

MacDonald, James M. *Technology, Organization, and Financial Performance in U.S. Broiler Production*, EIB-126, U.S. Department of Agriculture, Economic Research Service, June 2014.

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Abstract

Broilers, young chickens bred for meat, account for nearly all U.S. chicken consumption. U.S. production of broilers grew rapidly until the mid-1990s, but growth then began to slow and production declined in 2009, with very modest growth since then. The industry's distinctive organization—with a high degree of vertical integration, nearly complete reliance on contract growers to raise chickens for poultry companies, and grower compensation based on relative performance—helped fuel growth in the early period, and growth provided good returns and low risks for growers. However, slowing growth has placed new financial pressures on the industry and its organization. The industry is the subject of several important policy debates relating to competition, environmental regulation, international trade, and public health, which require an understanding of its organization. This report uses comprehensive USDA survey data to delineate the key features of the industry's organization and to analyze the industry's recent financial and productive performance, with a focus on contract growers.

Keywords: broilers, chicken industry, contract growers, production contracts, cost of production, farm finances.

Acknowledgments

The following individuals from the U.S. Department of Agriculture provided reviews and many suggestions: Dave Harvey, Dan Milkove, and Sandra Hoffman from the Economic Research Service, Andrea Beam from the Animal and Plant Health Inspection Service, Jason Karwal from the Agricultural Marketing Service, Miste Salmon and Bruce Boess from the National Agricultural Statistics Service, and several anonymous reviewers from the Grain Inspection, Packers and Stockyards Administration. Reviews, advice, and assistance were received from Tom Vukina of North Carolina State University, Brian Fairchild and Dan Cunningham of the University of Georgia, and Damona Doye of Oklahoma State University.

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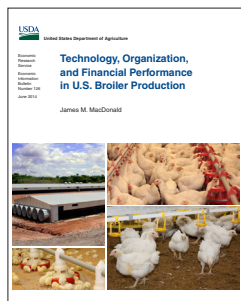
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Technology, Organization, and Financial Performance in U.S. Broiler Production

James M. MacDonald

What Is the Issue?

Between 1960 and 1995, U.S. broiler production grew by 5.6 percent per year, driven in part by rapid productivity growth, which led to falling real retail prices, and in part by the introduction of a wide range of new chicken products. However, annual growth was cut nearly in half during 1995-2008; production declined in 2009 and has grown very slowly since. The industry's distinctive organization—with a high degree of vertical integration, nearly complete reliance on contracts with independent growers who provide labor and housing capital, and grower compensation based on relative performance—helped fuel growth early on, and that growth provided good returns and low risks for growers. The cessation of broiler industry growth, due to slowing growth in population, per capita consumption of chicken, and exports, places new financial pressures on contract growers and new stresses on industry organization.

The broiler industry also faces a range of public policy issues, covering competition, international trade, environmental regulation, and human/animal health. Concerns about the exercise of market power by poultry integrators have prompted merger litigation, USDA regulatory initiatives, congressional proposals, and investigations by Federal agencies. Poultry has featured in disputes over tariffs and trade restrictions between the United States and several other countries. The industry's environmental performance has been a focus of regulation and litigation under the Clean Water Act. The industry also plays a role in some health policy issues, such as the use of antibiotic drugs to prevent animal disease and promote more efficient conversion of feed to meat. The public policy issues are all complex and would benefit from a proper understanding of the broiler industry's organization, structure, production practices, and finances.

What Did the Study Find?

- The broiler industry relies almost exclusively on production contracts, with 97 percent of broilers raised on contract operations in 2011. Compensation for most producers is based on their production performance relative to other producers delivering broilers to the same processor in a given week. Such contracts greatly reduce some types of risks (like price) for growers, but they can introduce other risks, like timely placement of flocks.
- Production of broilers, measured in live-weight pounds, grew by 5.2 percent per year between 1960 and 2003, but growth since 2003 slowed to just 1.3 percent per year, and production declined in 2009 and 2012. Slower growth creates new risks for growers who get fewer flock placements, and for their lenders. Greater risk can deter growers from investing in new technologies.

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- Contract broiler growers report higher annual household incomes, on average, than other U.S. households and other U.S. farm households. However, the range of household incomes across contract growers is wider, reflecting the risks that growers bear, the range of technologies and management skills in the business, and variations in off-farm income.
- Larger contract operations generate better financial returns than smaller farms, in part because they are able to realize greater output per hour of labor. Production continues to shift to larger growers, with more than half of production in 2011 occurring on farms with at least five broiler houses; however, most contract growers are still relatively small and specialized, compared with other U.S. farms.
- Average 2011 rates of return on equity for contract growers were below those estimated for large commercial farm operations and for nonfarm industries like manufacturing. Continued productivity improvements and capacity expansions will require competitive returns on their invested capital.
- Production continues to shift to larger birds to meet growing consumer demand for more processed chicken products and chicken parts. In 2011, 42 percent of broilers weighed at least 6.26 pounds, compared with 26 percent in 2006. Because farms operate most efficiently by specializing in broilers of a given size, and because processing plants operate most efficiently by processing uniformly sized birds during any given week, integrators must closely coordinate the weekly flow of chicks from hatcheries to farms, and of uniformly sized birds from farms to processing plants.
- Measures of industry productivity continue to improve. For example, average feed conversion—the amount of feed consumed per pound of weight gain—shows persistent modest gains, as broilers consumed 1.91 pounds of feed for every pound of live-weight gain in 2011, a 2-percent improvement over 2006.
- Improvements in productivity reflect developments in poultry genetics and feed formulations, but also the development and adoption of new housing technologies and production practices on farms. Most new broiler houses today are fully enclosed and incorporate tunnel ventilation, evaporative cooling technologies, improved lighting, and automated controls to manage temperatures, airflows, and lighting within houses.
- Most growers operate in highly concentrated markets for their services, with few integrators in any given region. High local concentration and slow industry growth can deter new growers from entering the industry. Contracts offered to new growers now often feature stronger integrator commitments in order to reduce the risks perceived by new growers and their lenders.
- Most poultry litter is removed from the contract grower's operation, usually for use as fertilizer on other farms. With rising prices for commercial fertilizer, 33 percent of all litter was sold by growers for a fee in 2011, compared with 22 percent in 2006.

How Was the Study Conducted?

This report uses industry-level data from four USDA agencies: the National Agricultural Statistics Service (NASS), the Agricultural Marketing Service (AMS), the Animal and Plant Health Inspection Service (APHIS), and the Economic Research Service (ERS). However, the primary focus is on farm-level data on individual broiler grow-out operations derived from the annual Agricultural Resource Management Survey (ARMS), conducted jointly by ERS and NASS.

The ARMS, USDA's primary source of farm financial information, links farm- and field-level production practices to farm financial outcomes and to farm household attributes and finances. The 2011 ARMS included a version aimed at broiler producers, which allowed for comparisons to data drawn from an earlier (2006) ARMS broiler version. Each survey gathered data from over 1,400 broiler grow-out operations in the 17 largest broiler production States. The surveys gathered detailed data on production outcomes, resource use, technologies and production practices, attributes of production contracts between growers and poultry companies, and farm finances.

Technology, Organization, and Financial Performance in U.S. Broiler Production

Introduction

Broilers, young chickens bred for meat, account for nearly all U.S. chicken consumption. U.S. broiler production grew rapidly between 1960 and 1995, spurred by increased consumption that was driven in part by falling (inflation-adjusted) retail prices and in part by the introduction of a wide range of new chicken products. However, growth slowed after 1995, and production in 2013 was only barely above that in 2008. The industry's distinctive organization—with a high degree of vertical integration, nearly complete reliance on contracts with independent growers who provide labor and housing capital, and grower compensation based on relative performance—helped fuel growth in the early period, and that growth provided good returns at low risk for growers. The cessation of growth places new financial pressures on contract growers and new stresses on the broiler industry.

Four attributes distinguish the broiler industry. First, it is *highly integrated*. Poultry firms own hatcheries, feed mills, processing plants, and trucks, and they contract with independent growers to raise birds for meat and for hatchery eggs. While this model is also followed by some producers in other industries (for example, some firms in hog production manage breeding, production, and processing), it is used by almost all broiler producers, while other industries feature a variety of organizations.

Second, almost all production is governed by *production contracts*, with compensation based on relative performance. Poultry firms provide growers with chicks, feed, veterinary services, and technical assistance, as well as catching and live-haul services. Grower pay is pegged to performance (flock mortality and feed efficiency) relative to other growers delivering flocks during the same week. Production contracts are used in other agricultural industries, but not as extensively as in broiler production, and performance incentives in other production contracts are rarely based on relative performance.

Third, other meat industries produce many retail products, but from similarly sized animals. In contrast, broilers range from 3.5 to 9 pounds when ready for processing. Since *growers specialize in specific weight ranges*, and since processing equipment must be adjusted for changes in bird size, poultry firms must tightly coordinate production and processing capacity and flows of chicks, feed, and birds. The advantages from tight coordination are an important factor driving reliance on contracts and vertical integration.

Finally, contract poultry *growers are relatively small and specialized* farms. While most U.S. agricultural production comes from large farms, most broiler production comes from small farms, with sales under \$350,000 (Hoppe et al., 2010). Moreover, those farms tend to rely heavily on income from broiler production, with little diversification into other livestock or crops.

The industry also figures prominently in several ongoing public issues, encompassing environmental pollution, health, competition, and international trade. The issues are complex, and a good understanding of the industry's organization and economics is necessary for effective policymaking.

For example, high and growing concentration in meatpacking has raised concerns over the exercise of market power in markets for grower services in poultry. Those concerns featured prominently in public workshops, held jointly by the U.S. Department of Agriculture and the U.S. Department of Justice during 2010, on “Agriculture and Antitrust Enforcement Issues in Our 21st Century Economy.”¹ Relatedly, relationships between broiler growers and poultry companies—and particularly the design of the production contracts that govern their transactions—were a primary focus of concern in recent rulemaking by USDA’s Grain Inspection, Packers and Stockyards Administration (U.S. Department of Agriculture, 2011).

The United States exports nearly 20 percent of broiler production, and the volume of exports has increased sevenfold since 1990. Disputes over tariffs and trade restrictions on broilers have arisen between the United States and several other countries. Some have been settled through bilateral negotiations, but several have led to formal dispute filings with the World Trade Organization (WTO). These include a case filed by the United States against China concerning the imposition of duties on imports from the United States and separate cases against Russia, India, and the European Union concerning restrictions and bans on the import of U.S. chicken products.

The broiler industry has also been a focus of environmental regulation and litigation under the Clean Water Act. The U.S. Environmental Protection Agency (EPA) specifies and enforces manure and litter management regulations under the Act. The regulations have been the subject of litigation by producer groups and have been adjusted in response to court decisions. Some States also impose and enforce further environmental regulations on poultry operations. This is a complex area of regulation, in which matters of industry organization, finances, and practices play an important role.

Some industry production practices are also the subject of debate regarding public health. Broilers have long been provided with antibiotic drugs in their feed and water to prevent disease and to promote more efficient conversion of feed to meat. With growing scientific and public concern over increased antimicrobial resistance in human and animal pathogens, there is growing pressure, and a regulatory initiative from the U.S. Food and Drug Administration, to reduce the use of antibiotic drugs, especially for growth promotion, in livestock and poultry production.

This report describes the industry’s distinctive organization, financial performance, competitive environment, and the major factors driving its continued productivity growth, with a focus on contract growers. The analyses rely primarily on data from a 2011 USDA survey and extend an earlier ERS report based on 2006 data (MacDonald, 2008).² The two surveys allow us to track recent changes in the industry and to assess some issues in greater detail.

Data

This report uses industry-level data from four USDA agencies: the Agricultural Marketing Service (AMS), the Animal and Plant Health Inspection Service (APHIS), the Economic Research Service (ERS), and the National Agricultural Statistics Service (NASS). However, the primary source is farm-level data on individual broiler grow-out operations drawn from the Agricultural Resource Management Survey (ARMS), which is jointly administered by NASS and ERS. The ARMS is USDA’s primary source of farm financial information; it links farm and field-level production prac-

¹See www.justice.gov/atr/public/workshops/ag2010/index.html.

²Earlier ERS analyses of the industry include Rogers (1979), Lasley (1983), and Perry et al. (1999).

tices to farm financial outcomes and to farm household attributes and finances. The 2011 ARMS, like the 2006 survey, included a questionnaire version aimed at broiler producers (see box, “Details of the Survey”).

Details of the Survey

The 2011 and 2006 broiler versions of the Agricultural Resource Management Survey (ARMS) focused on commercial producers of broilers grown for meat. Each excluded egg-laying, hatchery, and broiler breeder operations, as well as farms that raised broilers only for show or private consumption. The surveys sampled farms in States that together account for over 90 percent of U.S. broiler production.¹

Interviews for 2011 were conducted early in 2012. Of 2,061 sample operations, 1,498 usable survey responses were received.² Some respondents, while still in farming, did not raise broilers in 2011, leaving 1,436 growers for analysis (a 70-percent response rate). Each sample farm represents a set of other farms with a similar geographic location and size. Sampling probabilities vary with those factors, and broiler sample weights (the number of farms that each sample point represents) range from 2 to 150 farms. Population estimates are generated from sample observations, weighted to reflect their varying selection probabilities.

The 2011 ARMS estimates are quite close to those from other sources. The 17 States accounted for 95 percent of national production in 2007, the year of the census of agriculture that provided the basis for sample design. Total estimated production from the 2011 sample came to 8.144 billion birds, or nearly 95 percent of the 2011 NASS national estimate of 8.607 billion.

We compared ARMS-based estimates of production attributes (see below) to estimates from the National Chicken Council (NCC), based on data collected by Agristats, Inc. All four NCC and ARMS estimates are quite close to one another, and the NCC estimates are well within the estimated sampling errors of the ARMS sample. ARMS estimates closely match estimates from other sources, providing greater confidence in other estimates drawn from the ARMS sample.

Comparing ARMS and industry estimates, 2011

Item	National Chicken Council	ARMS
Average weight of bird	5.80 pounds	5.89 pounds
Mean time in grow-out	47 days	48 days
Average mortality rate	3.8 percent	3.6 percent
Average feed conversion rate	1.91 pounds of feed per pound of gain	1.89 pounds of feed per pound of gain

Note: The estimates in this table are averages across all birds, rather than averages across farms.

Sources: 2011 USDA Agricultural Resource Management Survey, Version 4; National Chicken Council, “U.S. Broiler Performance,” 2011 data, <http://www.nationalchickencouncil.org/about-the-industry/statistics/u-s-broiler-performance/>.

¹The States were Alabama, Arkansas, California, Delaware, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, and Virginia.

²Questionnaire copies can be found at www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices/questionnaires-manuals.aspx. ARMS reference years denote the calendar year during which production and financial outcomes occurred.

The Industry

Broiler production and processing is carried out within tightly integrated production complexes operated by firms called integrators. Twenty integrators together accounted for 96 percent of all broilers produced in the United States in 2012, and the top 3 accounted for 50 percent (table 1).

Under the system of production contracts that governs almost all production, integrators provide independent contract growers with chicks, feed, vaccine, and veterinary/technical assistance, as well as catching and live-haul services. Growers provide housing, labor, and utilities and grow the chicks to market weights. Growers, who have exclusive contracts with integrators, receive payment for the services that they provide, with premiums and discounts tied to the efficiency with which feed is converted to live-weight broiler production.

Chicks are delivered to grow-out farms from hatcheries owned by the integrator, which receive hatching eggs from broiler breeder farms, which also usually operate under production contracts with integrators (fig. 1). Integrators also contract with primary breeder companies, from which they purchase chicks to be raised on pullet farms and then moved to broiler breeder farms for hatchery

Table 1
Largest U.S. broiler integrators, 2012

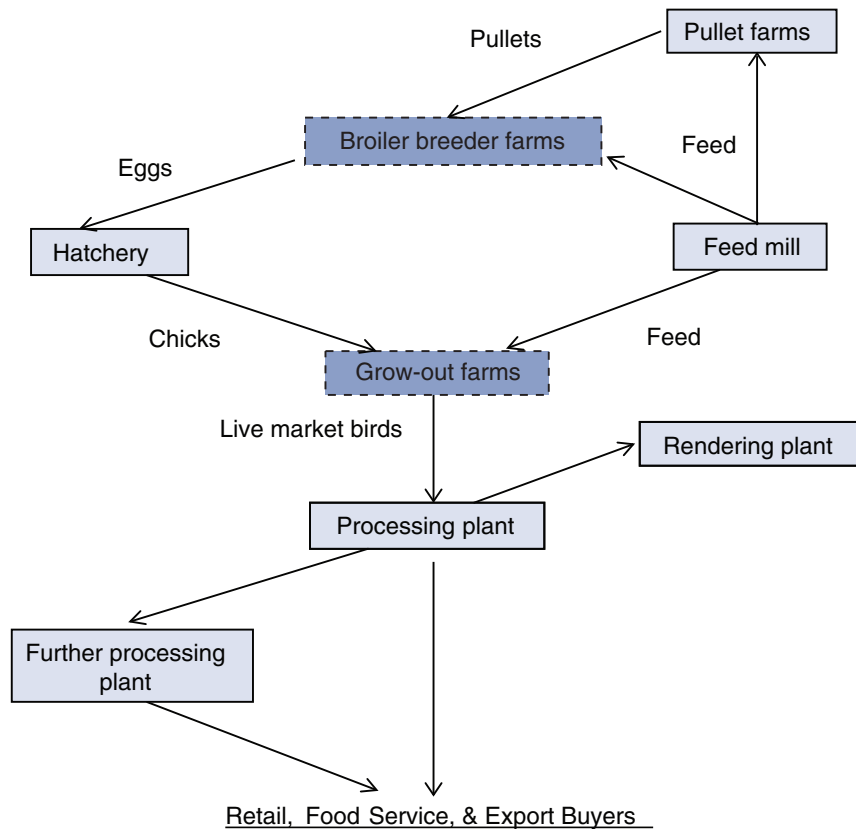
Rank	Firm	Slaughter Plants	Average weekly slaughter (million head)	Average bird size (lbs)
1	Tyson Foods	33	35.40	5.53
2	Pilgrim's Corporation	26	33.10	5.46
3	Perdue Farms, Inc.	12	12.01	5.67
4	Koch Foods, Inc.	8	12.00	5.10
5	Sanderson Farms	9	8.62	7.53
6	Foster Farms	5	5.84	6.07
7	Mountaire Farms	3	5.79	7.76
8	Wayne Farms	8	5.65	7.41
9	George's, Inc.	4	5.33	4.46
10	Peco Foods, Inc.	5	4.82	7.30
11	House of Raeford Farms	5	3.54	7.78
12	Simmons Foods	4	3.50	4.80
13	Keystone Foods, Inc.	3	3.49	6.97
14	Fieldale Farms Corp.	2	3.05	5.80
15	O.K. Industries	2	2.90	6.40
16	Case Foods	4	2.42	7.55
17	Marshall Durbin Companies	2	2.25	4.01
18	Amick Farms, Inc.	2	2.20	8.18
19	Claxton Poultry Farms	1	2.00	4.60
20	Mar-Jac Poultry< Inc	1	2.00	4.25
Largest 20 Integrators		139	155.9	5.82
All U.S. Production			162.1	5.85

Source: WATT Poultry USA, March, 2013. Companies ranked by average weekly slaughter. U.S. production figures from USDA National Agricultural Statistics Service, *Poultry Slaughter*.

Figure 1

Organization of a broiler complex

The integrator owns facilities in solid boxes and contracts with those in dashed boxes



Source: USDA, Economic Research Service.

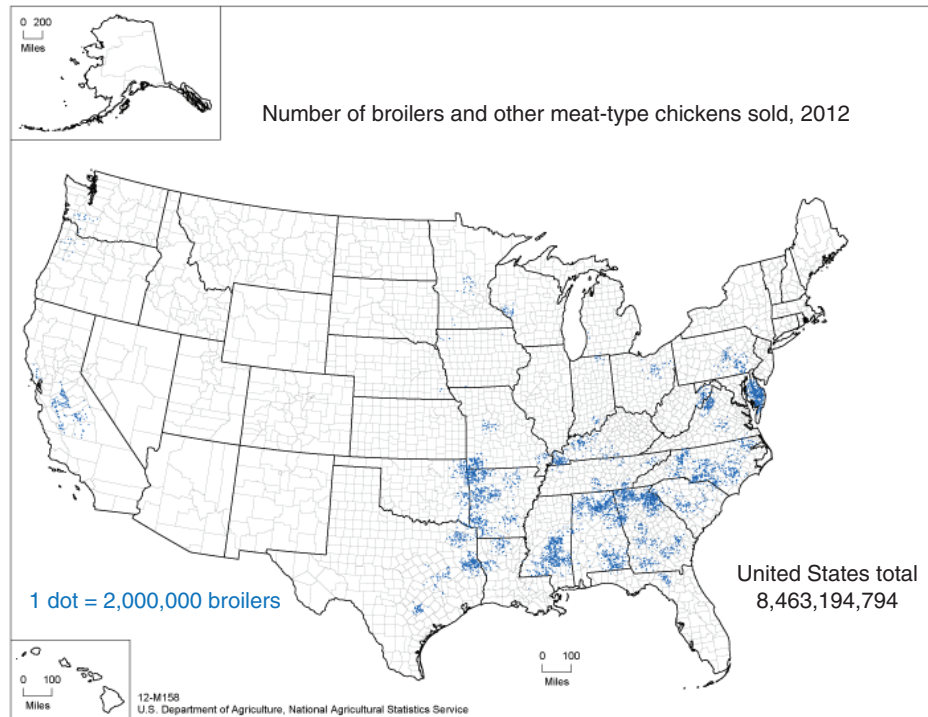
egg production. (Primary breeder companies are not necessarily co-located with production complexes and so are omitted from figure 1.)

Live market birds are shipped from grow-out farms to the integrator's slaughter plant after 5-9 weeks, depending on bird size. Plants slaughter about 1.1 million birds per week, on average, and a plant of that size would need to draw on 100-150 grow-out farms to supply its annual production. Slaughter plants produce whole chickens and cut-up parts and may ship products to other plants for further processing.

Integrators sell chicken products to customers in the foodservice and food retailing industries, often under annual contracts, and also export products abroad. In 2011, according to the National Chicken Council (an industry trade group), about 19 percent of U.S. broiler production went to exports, while 45 percent went to domestic retail grocery clients, 20 percent to purchasers in the U.S. fast food industry, and 16 percent to other domestic clients in the foodservice industry.

Integrators arrange for truck transportation to move feed and chicks to grow-out and broiler-breeder farms, eggs to hatcheries, live birds to processing plants, and chicken products to further processing plants. Because of the expense of truck transportation, farms, mills, hatcheries, and plants must locate near one another, and broiler production is geographically concentrated (fig. 2).

Figure 2
Location of U.S. broiler production



Source: Census of Agriculture, 2012.

Demand, Chicken Products, and Production Growth

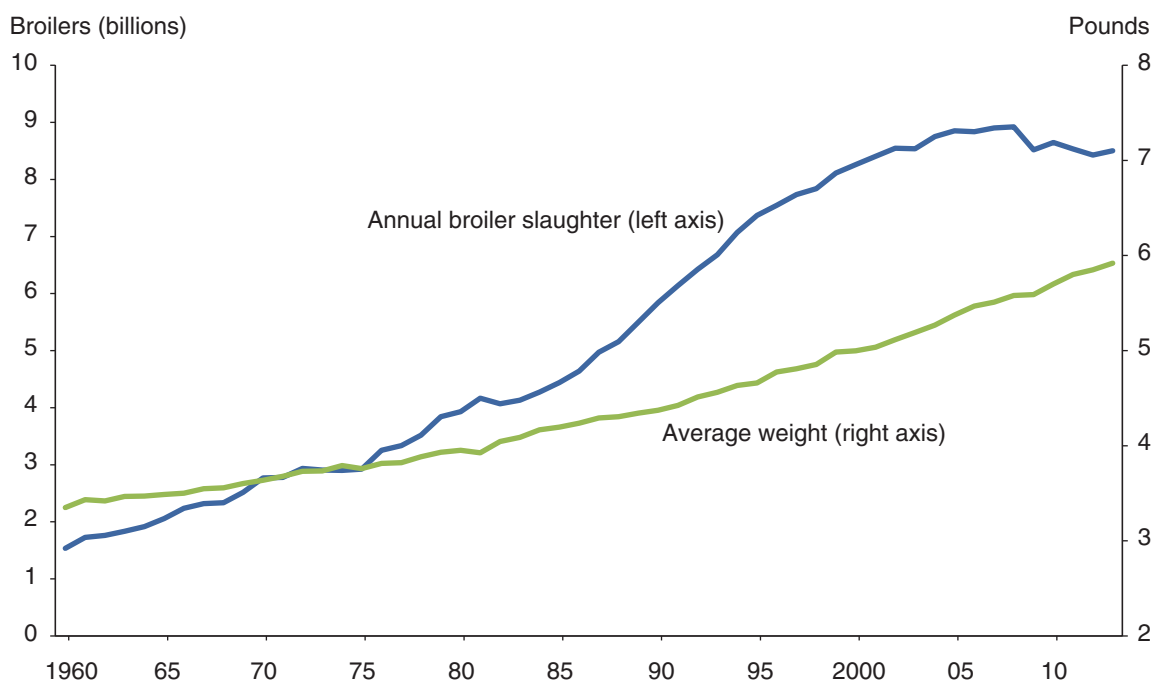
The organization and performance of the grow-out sector has been affected by developments in retail demand and by diversification in retail chicken products.

Between 1960 and 1995, annual broiler slaughter grew from 1.5 to 7.4 billion birds—4.6 percent per year, on average (fig. 3). With birds also getting larger—from an average of 3.35 pounds to 4.66—total live-weight production grew at an average rate of 5.6 percent per year. To meet that growth, the industry added production complexes and recruited new growers, while existing growers added new houses and expanded existing facilities. For growers, the risks of the major capital commitments required for houses were mitigated by the prospect of full-capacity utilization and by the active recruitment from integrators.

While average weights continued to grow steadily after 1995, growth in annual slaughter slowed sharply and then fell in 2009 and again in 2012. Total live-weight production reached 49.8 billion pounds in 2008, but did not exceed that figure until 2013. In all, live-weight production grew by just 1.3 percent per year between 2003 and 2013, one-fourth of the 1960-1995 growth rate. High production growth in earlier decades—and slowing growth later—reflected movements in demand for chicken meat.

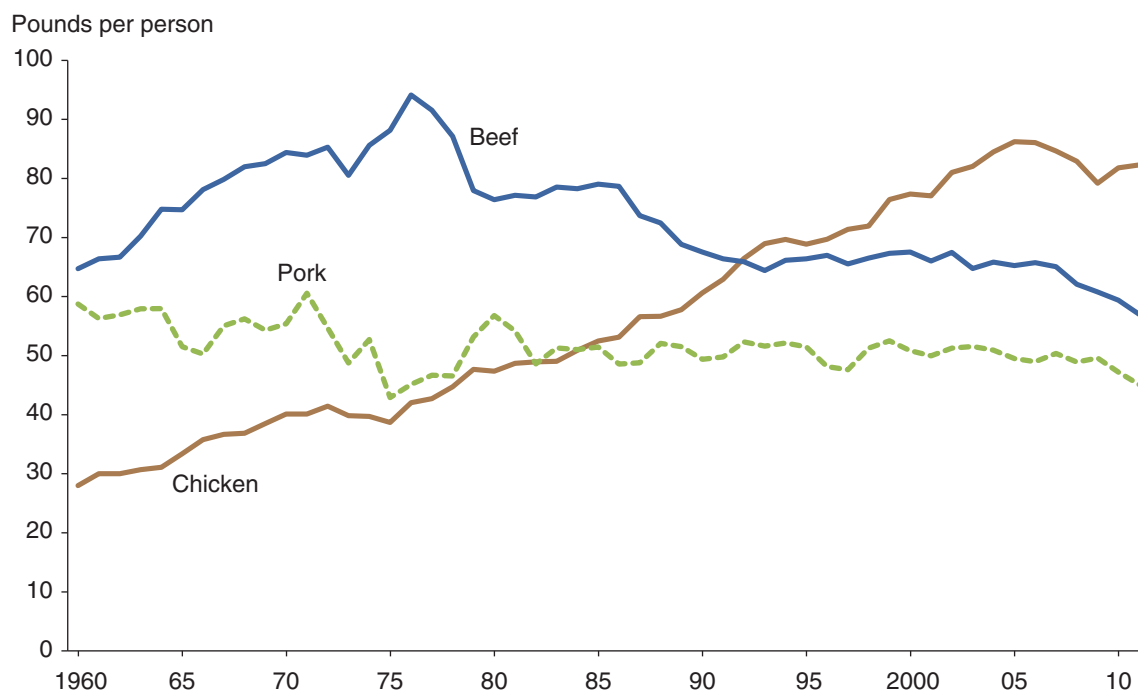
Between 1960 and 1990, annual per capita chicken consumption rose from 28 pounds to 61 pounds (fig. 4). Per capita consumption continued to grow, at a slower pace, from 1990 to 2005, but has not matched the 2005 peak since. Domestic consumption totals are driven by population growth as well as growth in per capita consumption, but that source of growth has also diminished: the U.S. population has grown by 0.7 percent per year since 2000, down from 1.3 percent per year in the 1960s.

Figure 3
Broiler production, 1960-2013



Source: USDA, National Agricultural Statistics Service, chickens slaughtered under federal inspection.

Figure 4
Trends in per capita meat consumption, 1960-2012



Source: USDA, ERS Food Availability (Per Capita) Data System, at www.ers.usda.gov/Data/FoodConsumption.

The third source of demand growth is exports, which accounted for just 3 percent of U.S. broiler production in the mid-1980s (fig. 5). Major expansions in foreign demand drove demand growth over the next decade, and exports accounted for 17 percent of production by 1996. Export volumes continued to grow (by 50 percent) between 1996 and 2008, when they peaked, and in 2013 exports accounted for 20 percent of U.S. broiler production.

Retail prices played an important role in early consumption and production growth. Inflation-adjusted poultry prices fell by 45 percent between 1960 and 1983 (fig. 6).³ Prices fell because real costs of production fell.⁴ Chicken consumption is sensitive to movements in its own price, and declines in real chicken prices clearly raised per capita consumption. However, prices alone cannot account for all demand growth: per capita chicken consumption rose by 75 percent in 1960-83, more than can be accounted for by the impact of falling real prices, and by another 75 percent in 1983-2005 as real prices remained steady (fig. 6).

Eales and Unnevehr (1988) found that the introduction of new products stimulated further growth in chicken consumption. In the early 1960s, over 80 percent of broiler production went to whole birds, and only 2 percent went to further processed products (fig. 7). Over the next three decades, production shifted from whole chickens to cut-up parts and processed products such as boneless chicken parts, breaded nuggets/tenders, and chicken sausages. By 2011, further processed products accounted for nearly half (46 percent) of production, while 42 percent was marketed as cut-up parts and 12 percent as whole birds.

Different products come from birds of different sizes, and higher average weights reflect a shift toward larger birds for processed products. Smaller broilers are usually marketed bone-in (whole or cut-up in parts) to the fast-food and foodservice sectors, while intermediate sizes are normally marketed to retail groceries in tray-pack or bagged forms. The largest birds can be sold whole as roasters but are also marketed deboned and processed into parts and value-added products.

Product attributes matter for growers, because farms specialize according to the size of the bird produced. The ARMS sorted production into four classes according to market weight, using USDA Agricultural Marketing Service classifications (fig. 8). The largest class—birds of 7.76 pounds or more—doubled its share of broilers (to 18 percent) and production (to 27 percent) between 2006 and 2011.

Recent economic events contributed to declines in per capita consumption. Real retail poultry prices rose in 2007, 2008, and 2009, by 5.5 percent in total, largely due to production declines occasioned by higher feed prices. In addition, the sharp recession that began in 2008 reduced real per capita disposable income by nearly 4 percent in 2009. Estimates of the sensitivity of poultry consumption to prices and incomes vary with the time period covered and the specification of the demand model, but the mean estimate suggests that the 2007-09 price increases should have reduced domestic per capita consumption in 2009 by 3.7 percent, compared to 2006. The 2009 income decline should have

³We measure retail price trends with the Consumer Price Index (CPI) for each item in figure 6, deflated by the CPI for all items. Thus, retail poultry prices fell, relative to the economy-wide average trend of consumer prices during 1960-1983.

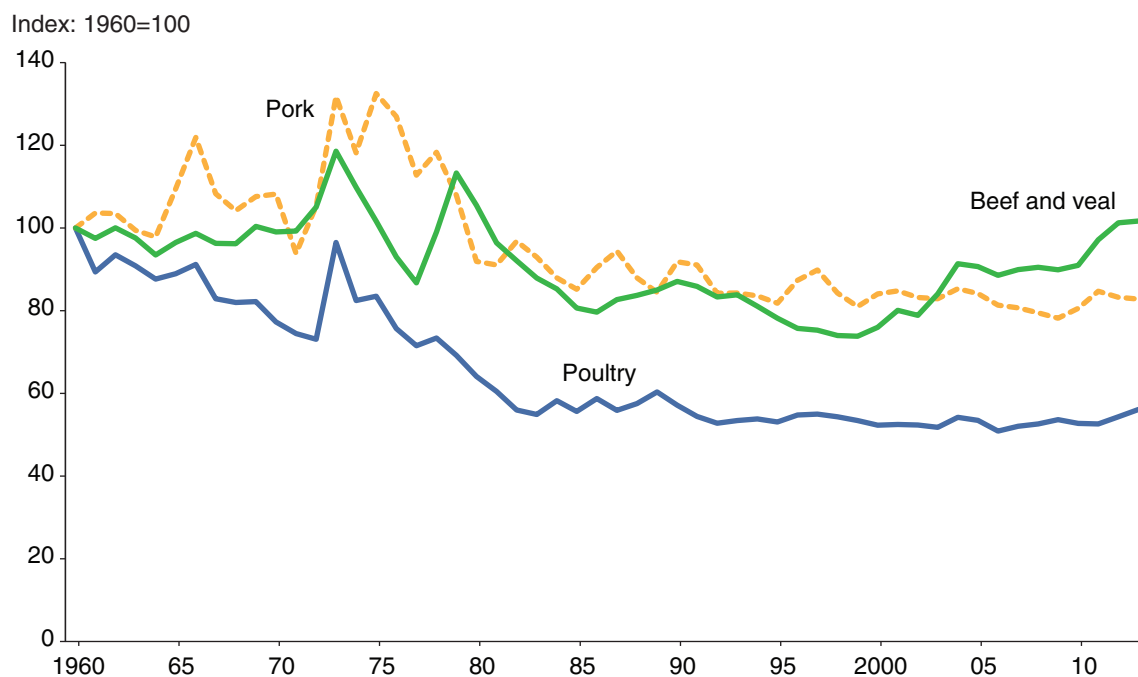
⁴Productivity improvements led to large reductions in per-broiler feed, labor, and housing requirements (Lasley, 1983), while expanded production allowed integrators to realize further cost savings through scale economies in larger plants (Ollinger et al., 2005).

Figure 5
U.S. broiler exports, as a share of production, 1960-2013



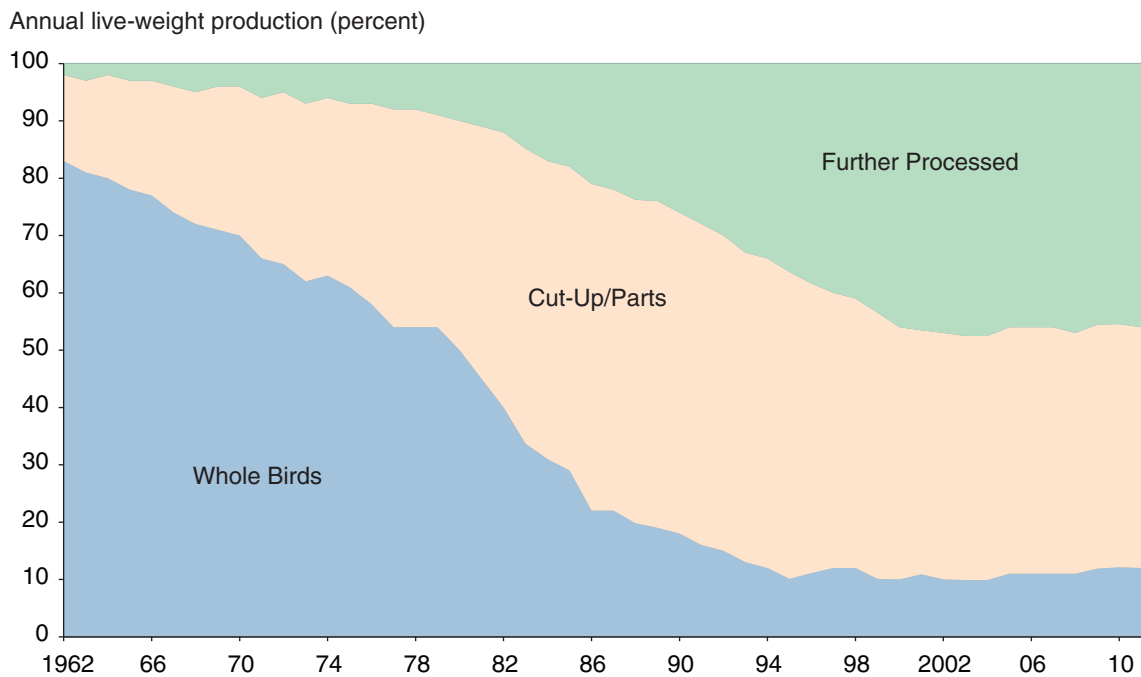
Source: USDA, ERS Food Availability (Per Capita) Data System, at www.ers.usda.gov/Data/FoodConsumption.

Figure 6
Real retail price trends for poultry, pork, and beef, 1960-2013



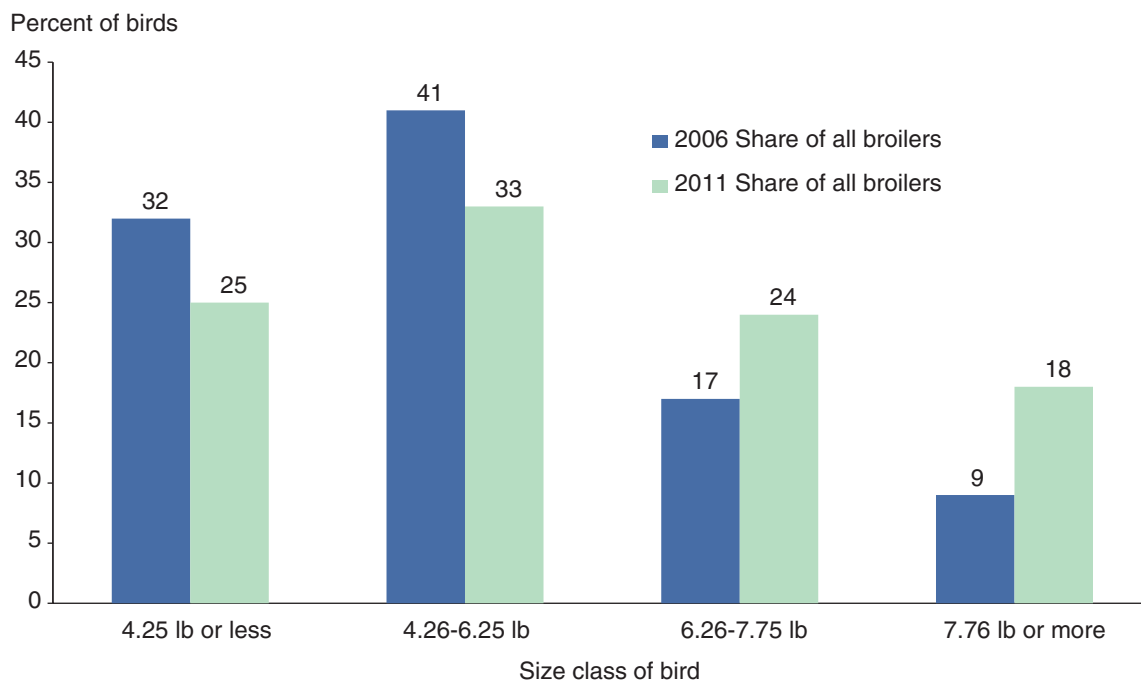
Source: Bureau of Labor Statistics, Consumer Price Indexes. Deflated by all-items Consumer Price Indexes.

Figure 7
Broiler processing product types, by production share



Source: National Chicken Council.

Figure 8
Broiler production shifted to larger birds



Source: 2011 Agricultural Resource Management Survey, Version 4.

reduced per capita consumption that year by another 1.2 percent.⁵ Mean real per capita incomes have recovered slowly following the 2007-09 recession, while medians have continued to decline. Real retail prices for chicken fell slightly in 2010-11 before rising nearly 7 percent in 2012-13. Neither development provided an impetus to further consumption growth.

Slackening demand growth has had an unmistakable impact on industry production. Total production of birds peaked in 2008 and then declined (fig. 3). Average weights continued to grow, but total 2013 live-weight production was only 1 percent greater than in 2008. Declines in demand can lead to nonrenewal of contracts, reduced chick placements, and longer wait times for new flocks, which create production risks for contract growers in the form of lower capacity utilization and reduced revenues (Etter, 2009; U.S. Department of Agriculture, 2009). With fixed interest expenses for housing loans, net cash incomes will also fall. Moreover, slowing demand growth leads integrators to open fewer new production complexes, thereby reducing competition for growers among integrators.

Processing Plants, Broiler Types, and Timing

The wide variation in broiler sizes presents challenges for processing plants, which run most efficiently at full capacity and when handling birds of uniform size. Some integrators and plants specialize in birds of a given size. However, other plants produce a range of products and must adjust their equipment periodically to handle different size classes of birds.

Figure 9 depicts the weekly volume of broiler slaughter in processing plants during 2011, defined as an index with average slaughter set to a base of 100. The solid black line reflects all birds, with sharp downward spikes during weeks with holidays, such as Thanksgiving, when plants are closed. Production stays within 5 percent of the weekly average in most weeks, despite modest declines starting around week 40 (early October 2011).

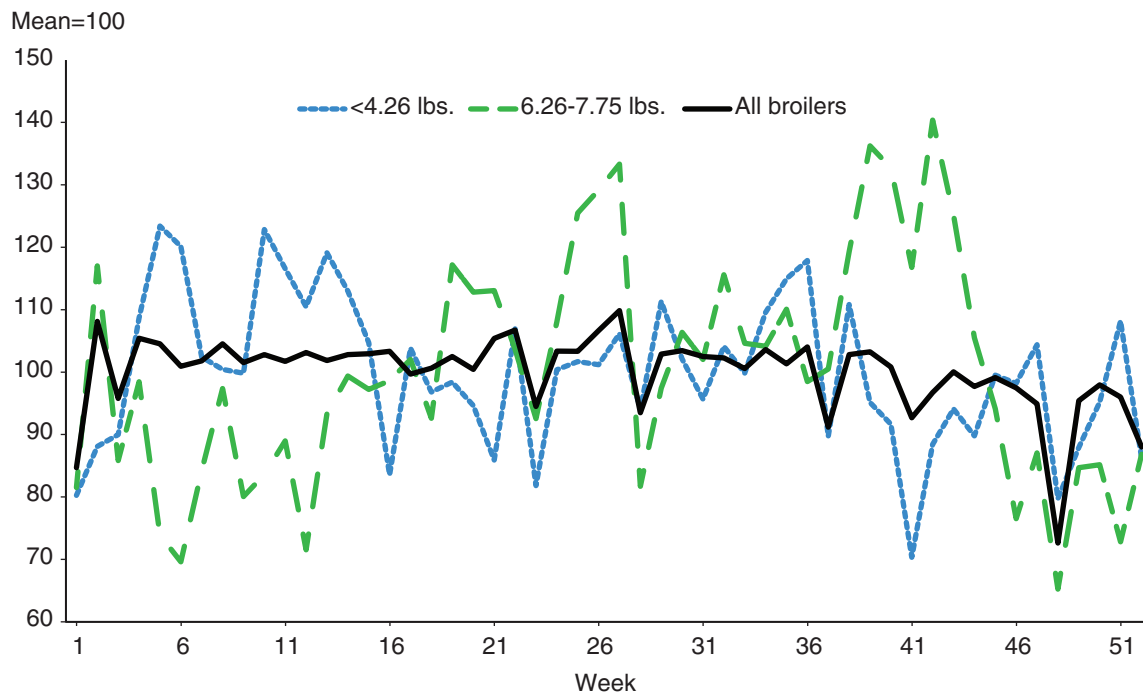
Figure 9 also displays two size classes—birds of less than 4.26 pounds and birds of 6.26-7.75 pounds.⁶ Week-to-week slaughter fluctuations for each class are much larger than for all birds, and they tend to offset one another. Early in the year, weekly slaughter of small birds reached 20 percent above its weekly mean, while the larger class fell 20-30 percent below its mean. During the rest of the year, production of the larger birds shows several surges, to 30 and 40 percent above weekly averages, accommodated by sharp declines in small bird slaughter.

This is an important feature of poultry production. Pork and beef slaughter plants produce many retail products from animals of nearly uniform size—carcasses from slaughter lines are cut into different products on processing lines. However, broiler and turkey plants produce many more retail products, often from birds of differing sizes. Since processing equipment must be adjusted for different sizes, and poultry plants run at least cost when processing birds of uniform size, integrators must precisely schedule grow-out capacities, chick placements, bird removals, and plant alignments to minimize operating costs while meeting buyer needs. That may be why broiler production is more tightly integrated than hog and beef production.

⁵A summary of estimates of price and income elasticities for chicken can be found at <http://www.ers.usda.gov/data-products/commodity-and-food-elasticities/demand-elasticities-from-literature.aspx>. Real income data are drawn from the 2014 Annual Report of the Council of Economic Advisors.

⁶The chart omits the other two size classes, for clarity. They show similarly sharp week-to-week fluctuations, and fluctuations in the four size classes largely offset one another to maintain stable total slaughter volumes.

Figure 9
Weekly 2011 broiler slaughter volumes



Source: USDA Agricultural Marketing Service, *Weekly Poultry Slaughter Report*.

Broiler Grow-out Farms

In 2011, 15,951 commercial operations raised broilers for meat in the 17 sample States (table 2). Almost all—97 percent—were contract growers. The number of broiler farms has fallen by about 9 percent since 2006, consistent with slowing total production growth and increasing production per farm.

An average contract grower produced 504,180 broilers in 2011, in just over 4 houses, and an average house produced about 120,000 birds annually (table 3). Live-weight production per farm grew by 12 percent between 2006 and 2011, to almost 3 million pounds, as the average number of houses, birds, and bird weight all increased.

Contract growers tend to operate small and rather specialized farms. The ERS farm typology defines small farms as those with annual gross cash farm income (sales) of less than \$350,000 (Hoppe and MacDonald, 2013). By that definition, 85 percent of contract growers, accounting for 73 percent of broiler production, are small farms. For agriculture as a whole, only 29 percent of the value of production occurs on small farms, so small farms have an unusually high presence in broiler production.

Average gross cash farm income from all sources was almost \$233,000 for contract broiler growers in 2011, and \$164,889—or 71 percent of the total—came from production contract fees. Few contract growers raise any other livestock, over one-third have no cropland, and nearly half have no commodity enterprises except broilers (table 3).⁷

Contract fees amounted to about 13 percent of the value of the broilers removed in 2011. The expenses borne by contract growers are a small share of total broiler production costs. Feed, chicks, and veterinary services are provided to growers by integrators, and are not part of grower expenses; in particular, feed accounts for most of the full cost of producing broilers.⁸

Table 2
Broiler removals in 2011, 17 major States, by type of operation

	Observations	Farms	Broilers Removed
Production contract	1,419	15,516	7,822,856,880
Processor-owned	4	206	185,331,592
Independent	6	100	18,266,677
Refused	7	129	34,102,086
Total	1,436	15,951	8,060,557,235

Notes: The table reports the number of sample observations in each category, and the number of broiler farms that are represented by those observations. Sample mean values of removals were imputed for 11 operations that did not report values. The row labeled “refused” covers survey respondents who did not provide a response for operation type.

Source: USDA Agricultural Resource Management Survey, 2011, version 4.

⁷Gross cash farm income in table 3 exceeds the sum of production contract fees and other commodity revenue. The difference reflects other farm income—from government payments, land leases, agro-tourism, income from custom services, etc.

⁸Integrators provide NASS field offices with average per-pound or per-bird expenses for their growers, which are then incorporated into ARMS databases as contractor expenses. Average feed costs were 29 cents per live-weight pound in 2011, while chick expenses were 5 cents, and veterinary services were 0.4 cent. These three items, plus the mean grower payment of 5.6 cents per pound, amount to 89 percent of the value of production of 44.8 cents per pound of broilers removed.

Table 3

Summary features of contract growers

Attribute of operation	2006	2011
<i>Mean values</i>		
Years producing broilers (operation)	18.5	19.3
Number of houses	4.1	4.3
Total birds removed	483,618	504,180
Total live-weight pounds removed	2,654,019	2,968,701
Value of broiler production	\$1,020,649	\$1,314,286
Gross cash farm income	\$177,280	\$232,536
Revenue from broiler contract	\$130,086	\$164,889
Other commodity revenue	\$36,133	\$48,352
Age of primary operator	55	55
<i>Percent of operations with:</i>		
No cropland	32	37
No other livestock sales	97	95
No commodity sales, other than broiler fees	41	47
Off-farm employment (operator household)	57	57
Male primary operator	92	92
Any female operator	53	51
White primary operator	95	92
Education of primary operator:		
Less than high school	14	11
High school, no more	49	49
More than high school	37	40

Source: USDA Agricultural Resource Management Survey, 2011 and 2006, version 4; sample restricted to contract growers reporting broiler removals.

Respondents to the ARMS may designate up to three operators of the farm who are responsible for day-to-day management decisions, and they also designate a single primary operator. Most primary operators are White and most are male (table 3); however, more than half of contract operations report that one of the operators is a woman, usually a spouse. Contract broiler operations tend to be small family operations, with spouses and sometimes children contributing labor and management to the farm. Most households contain at least one member who is employed off the farm.

Production has shifted to larger broiler enterprises over time. In 2011, half of all broilers came from farms that produced at least 628,600 broilers, and half came from farms that produced no more than that number. This measure of midpoint size is useful for those industries with many small producers and fewer very large producers. In the 2006 ARMS survey, the corresponding estimate was 605,000 birds; it was 520,000 in the 2002 Census of Agriculture, and 300,000 in the 1987 Census. Thus, the midpoint broiler enterprise more than doubled in size between 1987 and 2011.

Broiler production was often a part-time occupation for families in the past. Today, families with 1 or 2 broiler houses devote less than 40 hours a week to the broiler operation, and with the hours split between spouses, they can still treat broiler production as a part-time job for each (table 4). As the farm adds more broiler houses, the labor commitment increases and farms add more hired labor. However, commitments grow by less than output, so family labor hours, per 1,000 pounds of

Table 4

Labor commitments in broiler production

Mean Weekly hours				Labor inputs to production	
Number of houses	Primary operator	All operators	Hired labor	Unpaid hours from operators & family	Hired labor expense (dollars)
				<i>Per 1,000 pounds produced</i>	
1-2	28	37	4	2.12	1.48
3-4	33	42	9	1.06	2.20
5-6	38	49	20	0.76	3.01
7-8	40	50	28	0.56	3.73
9-10	38	51	48	0.43	5.38
>10	34	48	64	0.32	5.26

Note: Unpaid hours are reported because operators and their families cannot pay themselves salaries unless their farm is incorporated. Therefore, no explicit labor expense is recorded for the operator and family labor on those farms (expenses for hired labor are reported).

Source: 2011 Agricultural Resource Management Survey, version 4. Contract growers only.

production, fall sharply as farms expand from 1-2 houses toward 5-6 houses. This provides a strong incentive to expand for families that can obtain the capital and commit the hours required, and it is a major reason why production has shifted to larger operations with more full-time family labor commitments.

While production has shifted to larger farms—and there are some very large contract growers—the very large farms do not dominate production. Over two-thirds of growers had 1-4 houses in 2011, and those farms accounted for just under half of all production (table 5). Another 26 percent had 5-8 houses, with 37 percent of production. Five percent of growers, with 14 percent of production, had 9 or more houses.

Almost all contract growers—even those with more than 12 houses—remain family farms (table 6).⁹ Some are incorporated (family farms can incorporate) but most are not, even in the largest size classes. Larger operations are more likely to choose corporate or Limited Liability Corporation (LLC) status, usually for tax or liability purposes.

Grow-out operations are significant investments. Cunningham and Fairchild (2011) estimated a cost of \$924,000 for site preparation, construction, and equipment for four 25,000-square-foot houses in rural Georgia, independent of the cost of the operation's land. That is consistent with ARMS estimates; among specialized contract broiler operations with four houses in the 2011 ARMS, the median value of the operation's assets, *including* land, was \$1,043,700.

Most new broiler housing is debt-financed. Contract growers' total debt amounted to \$5.2 billion, or 22 percent of their total assets, in 2011. Debt loads, and exposure to liquidity risks should placements and revenues fall, are closely related to the age of the operation. Farms with less than 6 years of experience in broiler production carried debt equal to 51 percent of assets, on average, and one-quarter of them carried debt that was at least 77 percent of assets. At the other extreme, farms with

⁹We define family farms as those whose principal operator, and people related to the principal operator by blood or marriage, own more than 50 percent of the farm business.

Table 5

Size distribution of broiler operations, 2011

Item	Farms	Broilers removed	Pounds removed	Capacity (sq. ft.)
All farms	15,468	7,868 million	45,921 million	1,265 million
Houses on farm	<i>Percent of total</i>			
1-2	23.7	10.2	9.5	9.6
3-4	44.3	37.3	37.6	38.2
5-6	20.3	26.8	27.0	26.8
7-8	5.9	10.5	10.6	10.8
9-10	2.1	4.7	4.8	4.7
11-12	2.3	5.7	5.6	5.6
13-30	1.0	3.9	4.1	4.3
Refused	0.4	0.9	0.9	n.a.
All	100.0	100.0	100.0	100.0

Note: Contract growers only, with 2011 removals. The row labeled “refused” covers survey respondents who did not provide a response for housing features.

Source: 2011 Agricultural Resource Management Survey, version 4.

Table 6

Farm organization, by size of broiler operation

Number of houses	Share of gross cash income from broiler contract fees	<i>Percent of farms that are</i>		
		Family farms	Incorporated	LLCs, not incorporated
1-2	58	100	2	3
3-4	71	99	4	4
5-6	75	98	9	4
7-8	78	98	17	8
9-10	77	100	7	13
11-12	80	100	12	11
13-30	64	92	27	6
All Farms	71	99	6	4

Note: Contract growers only. LLCs are Limited Liability Corporations.

Source: 2011 Agricultural Resource Management Survey, version 4.

at least 20 years in broiler production carried debt equal to 13 percent of assets, on average, and 36 percent of them had no debt.¹⁰

Most contract grower debt—about 90 percent—is financed by commercial banks and the Farm Credit System. However, USDA’s Farm Service Agency (FSA) also plays a significant role in financing contract growers. Most of FSA’s involvement is through the guaranteed loan program, under which the agency provides guarantees to lenders, covering up to 95 percent of the principal and interest on qualifying loans provided to farmers. The guarantees enable lenders to serve groups who otherwise might be unable to obtain credit, especially beginning and socially disadvantaged

¹⁰The poultry and dairy sectors rely more heavily on debt than other farm sectors do, and ARMS data indicate that contract broiler growers accounted for 56 percent of all debt held by poultry producers in 2011. Ifft, Novini, and Patrick (2014) show that younger farmers are considerably more reliant on debt than older farmers, consistent with the findings above.

farms, and support a secondary market in farm debt, which can allow lenders to diversify their loan portfolios, reduce lending risks, and expand credit.

Over 2009-2013, the FSA guaranteed an annual average of \$210 million in loans made to broiler producers, about 8.1 percent of all agricultural loan guarantees made by FSA.¹¹ The volume of guaranteed loans could generate a significant risk exposure for FSA if growers were to default. To manage that exposure, the FSA sets guidelines for guaranteed loans. Some guidelines require certain integrator commitments in the production contract held by a borrower, and the requirements may influence contract design in the industry.

¹¹Personal communication with FSA economic analysis staff.

Productivity Growth and Technology

Improvements in breeding and in feed formulations have boosted the industry's productivity growth. These innovations are developed off the farm and implemented by integrators, not growers. But improvements in poultry housing and in on-farm production practices—paid for and implemented by growers, often under the direction of integrators—also play important roles in bird health and industry productivity. Such improvements have led to reduced bird mortality, increased output per hour of labor, improved feed conversion, and faster production cycles.

Feed Conversion, Labor Productivity, and Production Cycles

Improvements in feed conversion and production cycles underlie productivity growth in broiler production, contributing to lower costs and lower retail prices. Automation, along with improvements in breeding and feed formulations, allowed growers to increase live-weight broiler production per labor hour from 78 pounds in 1955 to 800 pounds by 1980 (Lasley, 1983), and to 1,427 pounds in 2006 and 1,573 pounds in 2011, in the two ARMS broiler surveys.

New technologies also improved feed conversion and shortened production cycles. In 1955, it took 73 days onsite to produce the average broiler, which weighed 3.1 pounds, and it took 2.85 pounds of feed to produce 1 pound of live-weight broiler output (Lasley, 1983). By 1980, it took 52 days to produce a 4-pound broiler, at a feed conversion rate of 2.08 (Lasley, 1983). In 2011, 4-pound broilers could be produced in 38 days, at a feed conversion rate of 1.74 (table 7). In short, the amount of feed, capital structures, and labor required per pound of broiler production has dropped greatly over the last 50-60 years. The productivity gains have been slowing, however. The improvements over 1980-2011, while impressive, were smaller in absolute and percentage terms than those in 1955-1980.

Feed conversion rates vary with the size of the bird. While 4-pound birds required 1.74 pounds of feed per pound of weight gain in 2011, the largest birds required 2.09 pounds (table 7). Across all farms, the average bird size was 6.1 pounds, and average feed conversion was 1.90 pounds of feed for every 1 pound gain in weight (across all birds, rather than farms, average weight was 5.9 pounds and average feed conversion was 1.91).¹²

On average, broilers today are removed for slaughter after 7 weeks in grow-out, but the cycle is longer for larger birds: the smallest birds are removed after 38 days, on average, while the largest take 61 days (table 7). Time onsite was shorter for every size class in 2011, compared to 2006, when average days onsite were 39, 49, 56, and 63 days for the four classes, in increasing order of size (table 7; MacDonald, 2008). Lower cycle times allow for faster turnover and more intensive use of housing capital.

After flocks are removed, farms wait 16-17 days, on average, for placement of a new flock. While the mean was 17 days, 25 percent of farms reported an average downtime of 14 days or less, and another

¹²ARMS estimates align with other sources. The American Society of Agricultural and Biological Engineers used a feed conversion estimate of 1.95 for 5.2-pound broilers in the 2005 revision of its standards on Manure Production and Characteristics. ERS estimated a ratio of 1.95 for a 5.5-pound bird, with 2006 ARMS data (MacDonald, 2008). Agristats, an industry consulting firm, reported an estimate of 1.93 for a 5.6-pound bird in 2008. The National Chicken Council, which relies on Agristats data, reported 1.91 for an average 5.8-pound bird in 2011. The temporal trend of the estimates—to larger birds at lower feed conversion rates—suggests continuing incremental improvements.

Table 7

Average production attributes, by weight class, 2011

Weight class	Days on site	Days between flocks	Flocks	Average weight	Feed conversion	Mortality (percent)
All farms	49.5	17.0	5.49	6.13	1.90	3.74
By weight class:						
<4.26 lbs.	38.2	15.7	6.95	3.90	1.74	3.79
4.26-6.25 lbs.	46.5	17.7	5.72	5.50	1.86	3.63
6.26-7.75 lbs.	52.3	17.2	5.36	6.80	1.92	3.84
>7.75 lbs.	61.0	17.0	4.72	8.34	2.09	3.76

Notes:

1) Sample restricted to farms that operated through the year. Estimates are means across all farms; means calculated across all birds would be slightly different.

2) Feed conversion is defined as pounds of feed consumed per pound of live-weight gain. Mortality is the percent of chicks placed on the operation that die before removal. Flocks is the number of different flock placements that could be made in 365 days, given days onsite and days between flocks.

Source: USDA Agricultural Resource Management Survey, 2011, version 4.

25 percent reported downtimes of 20 days or more.¹³ A 1-week difference in average downtime can mean an extra flock placed during the year, improving the farm's financial performance.

Housing and Technology

Better housing construction and innovations in equipment have led to better bird health and productivity growth. Over 30 percent of broiler houses have been built since 2000, and newer houses are decidedly larger (table 8). Whereas the average house in 2011 was 18,618 square feet (roughly 42 feet wide by 440 feet long), houses built in the 1980s were 15,000-16,000 square feet, and those built in recent years are nearly 25,000 square feet (50 feet by 500). The largest modern houses encompass nearly 40,000 square feet (66 by 600).

Newer houses also contain more modern technology. The ARMS gathered information on five technologies associated with climate controls and ventilation that can contribute to better bird health, more effective biosecurity, reduced mortality, and improved feed conversion.

Side curtains, made of vinyl or fabric, can be raised or lowered as outside temperatures change, to help control conditions inside houses. They are still effective in certain regions, but have been supplanted in most newer houses with fully enclosed walls as growers incorporate newer environment-control technologies. *Evaporative cooling* systems act to cool temperatures in chicken houses by evaporating water. Such systems can include cooling pads (paper filters that are placed over air inlets and moistened), fogging nozzles (placed at the air inlet and/or throughout the house), or both. The systems are combined with *tunnel ventilation*, which uses exhaust fans, placed at one end of the house, to pull air through inlets located on the opposite end of the house to create an air velocity and wind chill for cooling purposes. Some vent boxes are manually operated, but others—*static pressure-controlled vent boxes*—are actuated by static pressure and accomplish vent size adjustments automatically. Finally, manually operated thermostats are giving way to *integrated electronic controllers* to maintain a consistent and uniform environment.

¹³That's the inter-quartile range (25th to 75th percentile); the inter-decile range (10th to 90th percentile) was 12 to 24 days.

Table 8
Broiler housing and technology, by vintage

Year house was built	Share of all houses	Mean size	Side curtains	Evaporative cooling	Tunnel ventilation	Integrated electronic controls	Static pressure-controlled vent boxes
	<i>Percent</i>	<i>Sq. Ft.</i>	<i>Percent of houses with technology</i>				
Pre-1970	1.3	11,930	77	52	56	37	43
1970-74	1.5	13,922	65	63	70	44	59
1975-79	4.6	14,950	65	58	63	53	65
1980-84	4.2	15,695	55	77	83	66	79
1985-89	15.5	16,019	48	82	86	77	83
1990-94	19.2	18,027	54	87	90	82	88
1995-99	19.7	18,797	59	88	92	87	89
2000-04	14.2	20,383	39	96	97	96	96
2005-09	13.9	22,786	22	97	99	98	98
2010-11	2.9	24,887	13	98	100	100	99
Refused	3.0	16,018	60	67	77	70	72
All	100.0	18,618	48	86	90	84	87

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only. The row labeled "refused" covers survey respondents who did not provide a response for housing attributes. There were 66,680 houses in total.

Newer houses are less likely to feature side curtains, and more likely to have solid side wall construction. Recently built or rebuilt houses are more likely to be equipped with each of the other technologies (table 8), and as older houses are retired and replaced with newer construction, the technologies have spread rapidly through the industry. In the 2006 ARMS, 75 percent of houses were equipped with evaporative cooling and 76 percent with tunnel ventilation, while in the 2011 survey 86 percent had evaporative cooling and 90 percent used tunnel ventilation. In contrast, 48 percent of houses were equipped with side curtains in 2011, down from 70 percent in 2006.

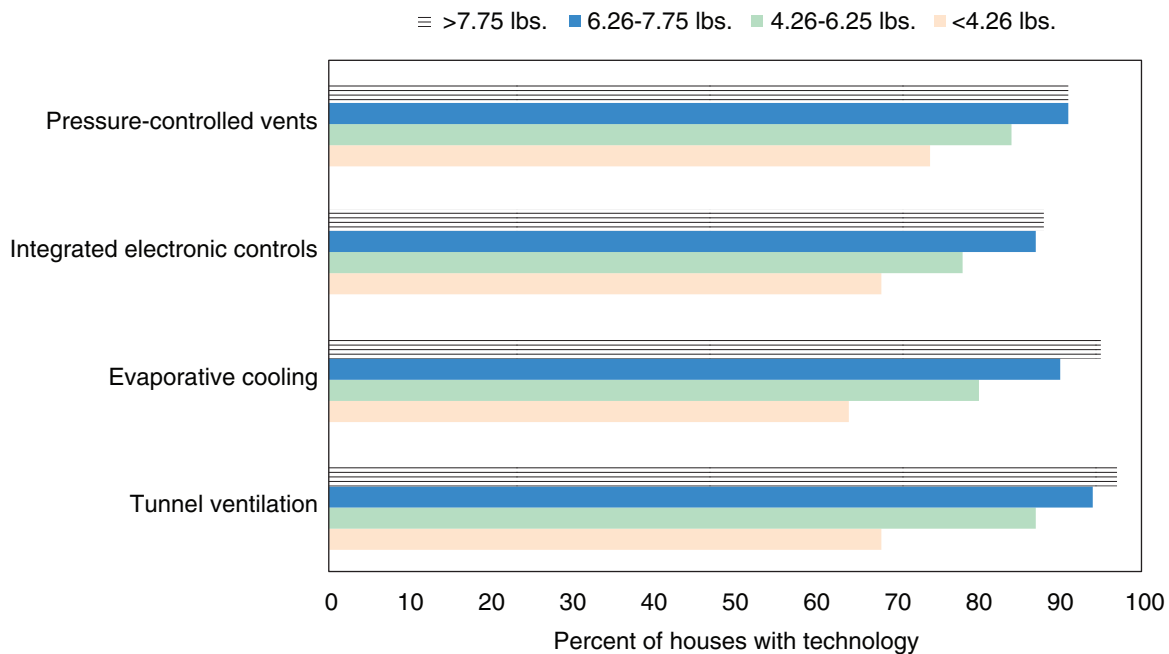
The 2006 survey did not ask about electronic controls or vent boxes, so we cannot estimate their spread since then. However, those technologies are used in almost all houses built since 2000, along with evaporative cooling and tunnel ventilation. Older houses can be retrofitted with modern equipment, and many have been (table 8).

Technologies are linked to the size of bird being produced. Operations producing the smallest birds (less than 4.26 pounds) are considerably less likely to have the four common cooling and ventilation technologies, and use increases steadily as operations shift to larger birds (fig. 10). The technologies also reduce the amount of labor time needed per house, thereby allowing growers to manage larger operations with the same amount of time or to work more off the farm.

Production Practices

Specific on-farm production practices can contribute to flock (and human) health and improved productivity. The 2011 survey asked about 18 different practices (see the Glossary for definitions of

Figure 10
Use of technologies, by size of bird



Source: 2011 Agricultural Resource Management Survey, Version 4.

each). Respondents were allowed to respond “don’t know” to these questions, and that is a common response when integrators, and not farmers, take the relevant actions, as with testing for pathogens.

Growers are far more knowledgeable about biosecurity practices on their operations. Almost all farms report raising flocks on an all-in all-out basis (table 9)—10 percentage points higher than in 2006. All-in all-out production reduces the chances that pathogens in one flock will infect the next, as long as houses are sanitized between flocks. Over 95 percent of growers report having rodent control programs and bird-proofing of houses (against wild birds, which can carry bird diseases), and nearly 90 percent report that houses are constructed so that pets and wildlife have no access. Over 80 percent report following specific animal welfare rules provided by their integrator—an increase of 12 percentage points from 2006.

Other practices are less universal. For example, over 40 percent of growers change into protective clothing upon entering a house, but nearly 60 percent do not. Nearly half follow a HACCP (Hazard Analysis and Critical Control Point) program for identifying and controlling health and safety hazards on the operation (many report that they don’t know; in this case not knowing is tantamount to “no”).

Antibiotic drugs have long been fed to animals on a routine basis to prevent disease and to improve feed conversion. The practice has come under fire amid growing concerns about antimicrobial resistance among human pathogens. Nearly half of contract operations (48 percent) report that broilers were only provided with antibiotic drugs when they were sick (table 9). That is, they were not routinely provided in feed or water, in subtherapeutic doses, to promote growth. The estimate is 6 percentage points higher than that from the 2006 survey and is consistent with other evidence indicating a long-term shift away from the use of antibiotics for growth promotion in broiler production.

Table 9

Production practices on contract broiler operations

Production practice	Percent answering		
	Yes	Don't Know	No
Testing procedures			
Flocks are tested for Avian Influenza	56	40	4
Flocks are tested for Salmonella	42	54	4
Flocks are tested for Campylobacter	20	76	4
Breeder flocks are tested for Salmonella	30	67	3
Biosecurity procedures			
Operation follows a HACCP Program	49	38	13
Flocks are raised on an all-in, all-out basis	95	3	2
Houses cleaned out and sanitized after each flock removal	21	2	77
Removal vehicles are cleaned and disinfected before loading	32	54	14
Protective clothing put on before entering houses	42	2	56
Operation has rodent control program	96	1	3
Houses are bird-proofed against wild birds	97	1	2
No pet or wildlife access to houses	88	2	10
Water is chemically treated to control salmonella (after feed is withdrawn)	28	8	64
Feeding processes			
Certified organic operation	2	4	94
Birds are only provided with antibiotics when they are sick	48	32	20
Broilers receive prebiotic or probiotic supplements in feed	15	70	15
Feed contains animal, bird or fish by products	10	68	22
Other practices			
Operation follows specified animal welfare requirements	83	13	4

HACCP = Hazard Analysis and Critical Control Point.

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only.

Chapman and Johnson (2002) used data on diets provided on grow-out operations and found that 33 percent did not include antibiotics in 2000, compared to 2 percent in 1995. In 2003, the McDonald's Corporation announced that it would require all direct suppliers to end the use of antibiotics for growth promotion. Other retailers followed, and by early 2006 several media reports indicated that four major integrators had phased out such antibiotic uses (Weise, 2006). In the 2006 ARMS broiler version, 42 percent of respondents said antibiotic drugs were not being routinely provided in feed or water (MacDonald and Wang, 2011). By 2012, 26 major U.S. supermarket chains, owned by 12 large retail companies, offered chicken products branded as "antibiotic-free" or "raised without antibiotics" (*Consumer Reports*, 2012).

The ARMS survey is not an ideal instrument for measuring antibiotics use. Some respondents may not know about use, since integrators make feed formulations (32 percent responded with "don't know"). Moreover, there is not complete agreement on the specific drugs that qualify as antibiotics. However, the combined information from a variety of imperfect sources supports the inference that many operations do not feed antibiotics for growth promotion, and that the share that do not is growing.

How Growers Manage Poultry Litter

Poultry bedding material—such as wood shavings, sawdust, or straw—is used to line dirt broiler house floors. When collected from houses, poultry litter consists mostly of poultry manure, along with the original bedding, feathers, and spilled feed. The manure contains nutrients—including nitrogen, phosphorus, potassium, and calcium—that have value and can be used to fertilize cropland.

Excessive applications of nutrients, however, can create environmental risks to water and air resources. Nutrients not taken up by plants can contaminate groundwater and can run off into surface water where, in sufficient concentration, they can kill plant and marine life. Some nitrogen can volatilize as ammonia, which can contribute to haze, to long-distance nutrient depositions in surface areas, and to the spread of particulate matter that compromises human health. Poor storage of litter, leading to seepage of nutrients, exacerbates the risks.

Because broiler production is geographically concentrated, the environmental risks are also geographically concentrated, and the industry has been the focus of litigation, political initiatives, and regulation in some parts of the country. For example, major broiler production complexes are located on the Delmarva Peninsula adjacent to the Chesapeake Bay and in river basins that flow into the Bay. The industry is one focus of legislative and regulatory initiatives aimed at improving water quality in the Bay and its tributaries.

In managing litter, growers have several choices to make. They can spread litter on farm fields or remove it from the farm to be spread elsewhere or applied to other uses. If they spread litter on their own fields, they need to decide on application rates and crops. They also need to decide how to store litter prior to disposal. Each of these decisions may be affected by regulations, as well as the availability of local cropland for litter application.

Nearly 40 percent of contract broiler growers have no cropland (table 3), and many others do not have enough to absorb all of the nutrients from poultry production. Consequently, two-thirds of the litter from broiler grow-out operations is removed from the farm, usually to other farms (table 10). Half of the litter that is removed is sold instead of being given away for free or with a payment to the recipient.

A higher percentage of litter was removed from operations in 2011 than in 2006, and a higher percentage—a 14-percentage-point increase—was removed through sale (table 10). These developments are consistent with changes in prices for synthetic fertilizers; producer price indexes for fertilizers and fertilizer materials were about 60 percent higher in 2011 compared to 2006.¹⁴ With synthetic fertilizers costing more, farmers were more willing to use poultry litter instead and to pay for it.

Prices received for poultry litter ranged widely, with 10 percent of sellers earning at least \$4.70 in litter sales for every 1,000 pounds of live-weight broiler production, and 10 percent earning no more than 45 cents for every 1,000 pounds of production. The mean was \$2.42; with mean production contract revenue of \$55.60 per 1,000 pounds of production, litter sales could therefore add about 4.4 percent to revenues, on average. Prices reflect local conditions in markets for litter; prices for

¹⁴See Producer Price Indexes for synthetic ammonia, urea, superphosphates, and mixed fertilizers produced by the Bureau of Labor Statistics at www.bls.gov/ppi/#data.

Table 10

Methods of managing litter, 2006 and 2011

Methods of litter management	Percent of Farms		Percent of Litter	
	2006	2011	2006	2011
Methods of litter disposal:				
Applied to fields on the operation	60.2	51.7	39.0	31.7
Removed from the operation	70.8	71.8	60.7	66.6
Other	2.5	2.8	0.3	1.7
			100.0	100.0
Methods of litter removal:				
Sold by the operation	33.4	47.4	36.3	50.0
Hauled off operation for a fee	4.5	4.4	4.2	3.2
Exchanged for clean-out and hauling	33.9	35.3	33.8	31.1
Exchanged for other services	5.8	7.7	5.2	5.0
Given away free of charge	21.9	13.5	20.5	10.7
			100.0	100.0

Source: USDA Agricultural Resource Management Survey, 2006 and 2011, version 4. Contract growers only.

synthetic fertilizers matter, but so does the amount of litter production in an area relative to the acreage of cropland and the mix of crops planted on that land. Litter prices are relatively low in Delaware, Maryland, and North Carolina, where manure production is high relative to available cropland, while growers in Kentucky and Oklahoma receive higher prices for litter.

Litter management practices are affected by regulations. In 2011, 66 percent of contract growers reported having a comprehensive nutrient management plan (CNMP), compared to 59 percent in 2006. A CNMP identifies a set of management and conservation actions necessary to meet clearly defined nutrient management goals aimed at reducing excess nutrients in soil and water. The plans have become integral parts of regulatory permitting processes for animal feeding operations of all sizes; they are required by Federal law for some operations, but lenders, integrators, or State regulators may require them for operations that don't fall under Federal regulation.

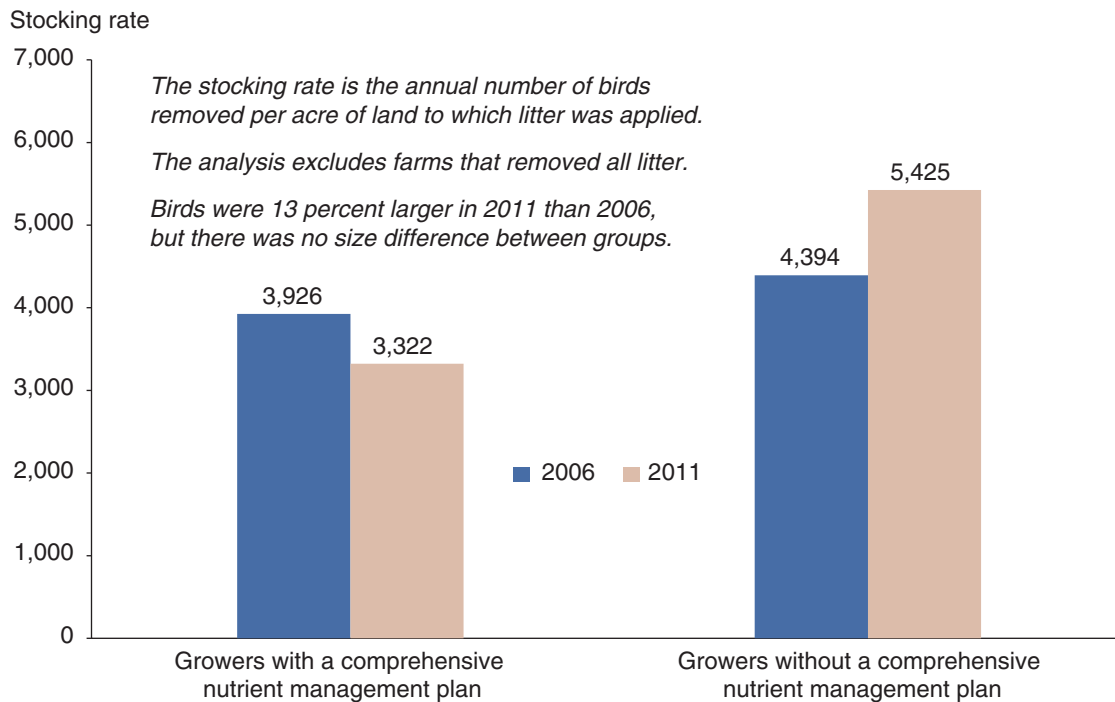
The use of CNMPs varies sharply across States. Almost all (95 percent) growers in sample States in the Chesapeake Bay region (Delaware, Maryland, Pennsylvania, and Virginia) had CNMPs in 2011, compared to 61 percent of operations in other States.

Operations with CNMPs followed different practices than those without. In particular, operations with CNMPs applied litter to their fields less intensively (fig. 11). We calculated an application rate for broiler litter spread on fields.¹⁵ During a year, operations with CNMPs applied the litter from 3,322 birds, on average, to each acre receiving litter, while operations without CNMPs applied the litter from 5,425 birds, more than half again as many.¹⁶ The gap between types of operations

¹⁵The application rate measured here is the number of birds removed from the operation in a year, times the share of poultry litter applied to fields on the operation, divided by the number of acres to which litter was applied. To account for differences in bird size across operations, we could replace birds removed with live-weight pounds removed, but that adjustment was not relevant for figure 11, since the groups each had the same average size of bird.

¹⁶Regions mattered. Application rates in the four Chesapeake Bay States averaged 2,132 birds per acre, while application rates for operations with CNMPs in other States averaged 3,525 birds per acre, still well below rates on operations without CNMPs.

Figure 11
Stocking rates for litter application



Source: 2011 Agricultural Resource Management Survey, Version 4.

widened considerably between 2006 and 2011, as operations with CNMPs reduced litter application rates, while operations without CNMPs substantially increased rates of litter application.

Operations with CNMPs may reduce application rates by spreading litter over more acres or by removing more litter from the farm. Litter removed from the farm is usually transferred to a nearby cropping operation. If the cropping operation's applications are not regulated (and those without live-stock are not), then CNMPs may not necessarily reduce regionwide applications of excess nutrients.

Government agencies seek to influence litter-management practices and reduce the environmental risks from litter and manure in other ways. Through the Environmental Quality Incentives Program (EQIP), the Federal Government provides financial support for conservation practices on working farms, and 60 percent of the money is directed to livestock operations. In 2011, 7 percent of contract broiler operations, representing 9 percent of production, received EQIP funds. That's down from 2006, when 12 percent of contract growers received EQIP funds.

Other public agencies have sought to add value to litter by encouraging its use in electricity generation or by investing in projects to pelletize litter, thereby reducing costs of transportation. However, such uses are so far quite limited. We estimate that just over 100 contract broiler growers (0.7 percent of the total) shipped litter for use in electricity generation in 2011, and about 200 growers had their litter pelletized for long-distance hauling.

Contracts, Grower Compensation, and Competition

The mean fee received by contract growers amounted to 5.77 cents per live-weight pound in 2011, with a wide range around that mean.¹⁷ The 10th and 90th percentile values were each 21 percent away from the mean (table 11).¹⁸ Contract payments increased since 2006, when the mean was 5 cents per pound. Some of the increase reflects a change in contract design: integrators paid growers' fuel expenses in some regions in 2006—with lower average contract fees as a result—but there are few instances of integrators paying fuel expenses in the 2011 data.

Some variation in contract fees reflects different types of production processes (MacDonald and Key, 2012). For example, growers who raise larger birds receive lower fees, per pound, than growers who raise smaller birds. Growers who raise birds without growth-promoting antibiotics receive higher base fees—likely because they incur higher sanitation expenses and produce at lower levels of capacity utilization. Growers who bear the expense of more inputs (like energy) receive higher base pay.

Some of the variation may also reflect differences in competitive environments. Contract growers make substantial long-lived investments in housing and cannot easily shift to another activity once they have entered the industry. Markets are also highly local, and most growers have no more than a few integrators in their area. Grower contracts can be quite complex and difficult to understand. For these reasons, integrators in more highly concentrated markets may pay growers less.¹⁹ The wide variation in contract fees also reflects the design of contracts: growers receive premiums and discounts from the base fee, based on their performance compared to other growers, and these drive wide variations in payments.

How Production Contracts Work

Most broiler contracts set a base fee (per pound of live-weight production delivered to the processing plant), combined with premiums or discounts reflecting performance. In turn, performance is

Table 11

Prices received in broiler production contracts, 2006 and 2001

Year	Mean	Median	P10	P90
<i>Cents per live-weight pound</i>				
2011	5.77	5.55	4.32	7.02
2006	5.00	5.00	3.81	6.19

Note: P10 refers to the 10th percentile, where 10 percent of growers receive that price or less, while P90 refers to the 90th percentile, where 10 percent of growers receive a higher price.

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only.

¹⁷Larger growers receive slightly lower payments per pound. Thus while the mean payment across growers was 5.77 cents, the median was 5.55 cents when weighted by production (table 11).

¹⁸Some growers (34 percent) added to broiler revenues through the sale of used poultry litter; those growers sold 80 percent of their litter and increased broiler enterprise revenues by about 4 percent, on average.

¹⁹There is less concern over markets for chicken products. While chicken processing is moderately concentrated—the largest 4 firms account for 57 percent of U.S. live-weight production—14 other firms operate at least 2 plants (table 1), and markets are national and global, rather than local, so U.S. firms compete with other processors for global sales. The products of any single seller are not highly differentiated from those of other sellers, and retailers and importers who buy chicken meat are sophisticated purchasers who buy in large volumes and can easily shift their purchases among sellers.

measured by mortality and feed conversion in the grower's flock, compared to the average of other flocks delivered that week (see box, "Payment Determination in Broiler Production Contracts").²⁰ Such arrangements are called relative-performance contracts.

The contracts are designed to meet several goals (Knoeber, 1989). They insulate growers against common price and production risks arising from weather, widespread disease, or price fluctuations for feed or broilers. Such events can affect mortality, feed costs, and feed conversion rates for all growers. But since they affect all growers in common, they do not affect base fees, nor do they affect relative pay formulas, so they don't affect grower compensation. Knoeber and Thurman (1995) estimated that relative-performance contracts shift almost all feed and product price risks, and most of the commonly held production risk, from growers to integrators.

The design also provides incentives for growers to expend effort, which should reduce overall broiler production costs and improve productivity.²¹ Because of their substantial financial commitment in broiler housing, growers are motivated to perform well enough to retain the contract and protect their investment. In addition, the relative-performance compensation formula suggests that greater effort leads to greater reward.

The contracts may also support greater industry productivity growth and faster spread of innovations over time. If the contract design rewards the best growers, it also provides incentives for the best growers to expand and assume greater shares of the industry's production. Such compositional shifts reduce industry costs and raise productivity.

The contracts do not remove all grower risks, and they introduce several new risks. Specific contract designs also vary and affect grower risks and incentives. Several details of relative performance contracts matter:

- 1) "League-composition" risks (Levy and Vukina, 2004). If an average grow-out farm delivers a flock of 90,000 birds, an average slaughter plant (1.1 million birds per week) will take birds from 12 growers in a week—a small group. If a cohort of suppliers happens to have one or two exceptional growers, the group's mean performance will be higher, and other growers' likely compensation, for any absolute level of performance, will be lower. This is a risk created by the contract design.
- 2) While the contracts shift common price and production risks to integrators, growers still face price risks for the inputs they purchase themselves, such as fuel, electricity, or water.
- 3) Contracts can introduce production risks for growers if they do not receive as many chick placements as expected. Since a substantial share of their costs are fixed (capital costs), variations in production can have substantial impacts on net income.

Integrators can adjust contract designs to manage risks and incentives. Premiums and discounts are adjusted for 100 percent of grower differences in feed conversion, while the integrator adjusts base

²⁰In the 2011 ARMS, 97 percent of broilers were grown under contract, 94 percent of contracts included payment incentives tied to grower performance, and 93 percent of those contracts tied the incentives to relative performance—that is, performance compared to other growers.

²¹Low-cost production depends greatly on the care and effort of the grower. Effective growers check and maintain equipment so that feed and water are easily accessible and available to birds, they manage temperatures and humidity in houses to maintain bird comfort and health, and they manage production practices and limit intrusions in houses to reduce bird stress.

Payment Determination in Broiler Production Contracts

Most contract broiler producers receive a base payment for a flock, and premiums or deductions that are based on their performance compared to other growers. Performance is measured by the efficiency with which growers turn the chicks, feed, and medications provided by the company into chickens delivered back to the processing plant. Growers receive documentation of their performance, specifying the calculation of compensation, from poultry companies. The calculation shown here is based on one from a particular company, with the numbers changed. Specific contract designs may vary across companies.

Box 2 table 1

Settlement Statistics

Chicks placed	88,000
Birds arrived—Head count	84,656
Birds arrived—Pounds	334,391

Table 1 lists the number of chicks placed on the site, the number of birds that arrived at the processing plant, and the total weight of the flock (trucks are weighed at the plant, with the tare weight subtracted). Mortality matters for performance pay and can be inferred from the difference between chicks placed and birds arrived. A quick glance indicates that this grower produces relatively small birds (3.95 pounds, on average), with a flock mortality of 3.8 percent, from 4 houses, if the houses are of a capacity to hold 22,000 birds.

Box 2 table 2

Performance Calculation

	Grower's Settlement Cost		Average Settlement Cost	
	<i>Dollars</i>	<i>\$/lb</i>	<i>Dollars</i>	<i>\$/lb</i>
Chicks	\$17,054	0.0510	\$253,709	0.0502
Feed	\$97,408	0.2913	\$1,446,444	0.2862
Medication	\$18	0.0000	\$252	0.0000
Total	\$114,480	0.3424	\$1,700,405	0.3364
Flock pounds	334,391		5,053,963	

Table 2 shows how the grower's relative performance is calculated. The company calculates the total expense of the chicks, feed, and medication provided to the grower and then divides by the total weight of the birds arriving at the plant (334,391 pounds) to get the "grower's settlement cost" per live-weight pound delivered (34.24 cents). It then compares that cost to the average settlement cost across all flocks delivered in that week (33.64 cents)—the total expenses associated with the chicks, feed, and medication delivered to all growers, divided by the total weight of all birds delivered that week (5,053,963 pounds). A higher settlement cost for a grower may reflect higher mortality or less weight added (and delivered) for the feed provided.

Box 2 table 3

Contract Payment

Base pay:	334,391 lbs. @	\$0.0555 per lb.	\$18,558.70
Performance +/- adjusted:	"	-\$0.0060 per lb.	-\$2,006.35
Energy allowance:	"	+\$0.0020 per lb.	\$668.78
Gross payment:	"	\$0.0515 per lb.	\$17,221.13

continued—

The grower receives a base pay of 5.55 cents per live-weight pound delivered and a payment incentive (“performance adjusted”) based on performance compared to other growers. The incentive payment of -0.0060 cents per pound equals the difference between the grower’s settlement cost and the average settlement cost in table 2, so in this case the grower’s fee is fully adjusted for settlement cost differences. Some contract designs adjust for less than the full difference.

Note that this contract also includes an energy allowance. Contracts include energy allowances to reflect seasonal changes in energy use. This contract effectively shifts base pay by the amount of the allowance.

Incentive pay in broiler production contracts depends on flock mortality, feed conversion, and performance by other growers in the comparison group. Higher mortality reduces the total weight delivered to the plant, while lower feed conversion implies more live-weight pounds delivered for any given amount of chicks and feed (slightly heavier birds).

fees to take account of variations in energy prices and use (see box, “Payment Determination in Broiler Production Contracts”). Contracts can be designed to flatten the impact of relative performance differences, with premiums or discounts that adjust by 50 percent (for example) of differences in settlement costs. Contracts can also be designed to leave the grower fully exposed to fuel price differences or to have the integrator bear those risks.

Markets for Contract Growers

Since eggs, chicks, feed, and broilers are all shipped by truck among the points within a broiler production complex, cost and live-bird mortality rates are minimized when the area covered by a complex is not large. In the 2011 ARMS, the mean distance from a grower to the integrator’s processing plant was 34 miles, and 90 percent of all birds were produced on farms within 60 miles of the plant. Effectively, integrators seek to contract with growers within a limited geographic area near their feed mills, hatcheries, and processing plants. Complexes may overlap, so several integrators in an area may compete with one another for growers, but local markets for growers nonetheless are quite concentrated, in that a single grower can contract with no more than a few integrators.

In 2011, 21.7 percent of growers, accounting for 24.5 percent of broiler production, reported that there was only a single integrator in their area, and another 30.2 percent, accounting for nearly a third of production, reported two integrators in their area (table 12).²² The data suggest a slight increase in concentration since 2006, with a higher proportion of growers facing two or fewer integrators (MacDonald and Key, 2012).

Even with more than one integrator in a grower’s area, the grower may not have options if other integrators are not recruiting additional growers. When asked whether they could change to another integrator if they stopped raising broilers for the current integrator, nearly half of those respondents with two integrators in their area, and over a third of those with three integrators, asserted that they could not shift to another integrator (table 12).²³ By any measure, local markets for growers are highly concentrated.

²²The questionnaire asked the respondent for the number of integrators in his or her area, so area is subjectively defined by the responding grower. The physical distance over which a grower could contract with an integrator will vary with topography and the nature of the road network around them, so growers ought to be best placed to identify their own feasible contracting area.

²³Note that 7 percent of those facing a single integrator assert that they could change, presumably through longer distance transportation to an integrator outside the area.

Table 12

Broiler production, by number of integrators

Integrators in Grower's Area	Farms	Birds	Production	Can change to another integrator
Number	<i>Percent of total</i>		<i>Percent of farms</i>	
1	21.7	23.4	24.5	7
2	30.2	31.9	31.7	52
3	20.4	20.4	19.7	62
4	16.1	14.9	14.8	77
>4	7.8	6.7	6.6	71
Refused	3.8	2.7	2.7	na
	100.0	100.0	100.0	

Note: Respondents were asked for the number of integrators in their area. They were then asked if they could change to another integrator if they stopped raising broilers for their current integrator. Row labeled "refused" refers to survey respondents who did not respond to the question on number of integrators.

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only.

However, an integrator's market power may be limited even when there is little or no direct competition from other poultry companies. Integrators who are expanding, or developing a new complex, must attract new growers or induce existing ones to expand. All integrators must also attract new growers to replace those who retire.

The need to attract new growers may limit integrators' ability to exercise market power over other growers. One way to exercise that market power would be to reduce the payments made to growers. But if that reduction keeps new growers away, and if foregoing new growers means operating processing plants at less than full capacity, then reducing contract fees may not prove profitable for integrators. On the other hand, integrators have had less reason to attract new growers in recent years, as aggregate production growth has slowed.

Research using the 2006 ARMS broiler survey indicates that integrators in highly concentrated local markets can exercise some local monopsony power. Specifically, contract growers in markets with a single integrator (two or three integrators) received fees that were about 8 percent (4 percent) lower, on average, than growers in markets with four or more integrators (MacDonald and Key, 2012). With average fees of 5 cents per pound in the 2006 data, fees in markets with a single integrator would be 0.4 cent per pound lower than in markets with 4 or more integrators, and 0.2 cent lower than in markets with 2 or 3 integrators. The findings were robust to a range of different controls and measures of fees.

The issue of local market power arose in a recent antitrust case involving two integrators in Virginia's Shenandoah Valley. In May 2011, Tyson Foods sold its broiler complex there, including a processing plant, to George's Foods. The transaction would have left two integrators in the Valley—George's and JBS/Pilgrim's. The U.S. Department of Justice filed a civil antitrust suit, arguing that the two remaining integrators could exercise expanded market power, in the absence of a third rival, by reducing contract fees. In a settlement, the Justice Department approved the transaction on the condition that George's undertake a series of capital improvements to the processing plant, which would lead to a significant increase in its processing capacity. With greater processing capacity, George's would have both the incentive and the ability to increase production, and to thereby recruit

more growers. In turn, the need to attract more growers would limit the incumbent integrators' ability and incentive to exercise monopsony power by reducing fees and production.

Contract Durations and Commitments

Broiler production contracts come in a variety of durations. Some are long term, with a specified duration of 5 years or more. Some carry specific intermediate terms, such as 3 years, but many are short-term contracts that cover only a single flock. Those growers often continue to produce for the same integrator for many years, but they do run a risk of cancellation at any time. In recent years, the risks of short-term contracts became apparent; as industry production declined after 2008, some contracts were not renewed, and lenders and growers began to complain about increased times between placements and reduced placements.

USDA's Farm Service Agency altered its guidelines for loan guarantees in recognition of the increased risks. In a guidance issued in April 2009, the agency required that production contracts offered in support of new loan applications should feature durations of at least 3 years and minimum annual flock commitments (USDA, 2009).

Integrators may have additional reasons to offer different contract commitments to different growers. Contracts specify the same base pay to all growers in a complex, and so integrators cannot target better fees to new growers. However, they can target other contract attributes, such as duration and placement commitments, to better attract new growers without offering higher compensation to existing growers.

Contract durations have a strong relationship with local integrator concentration and with grower experience (table 13). At one extreme, contract durations among new growers in markets with a single integrator average 84 months; at the other extreme, durations average less than a year for growers with 20 or more years of experience in markets with at least four integrators. For a given level of concentration, durations decline with grower experience, and for any level of experience, durations decline with increases in the number of integrators.

Two other measures of duration—the proportion of contracts that are short term (less than 12 months) and the proportion that are long term (5 years or more)—reinforce the notion that longer term contracts are much more likely to be offered to newer operations in the most concentrated markets (table 13).

New growers, of course, can decide not to enter broiler production at all. Moreover, they can recognize that monopsony markets are risky for them; once they commence production, their alternatives will be greatly reduced. They can also recognize the slowdown in total production, and recognize the increased risks of reduced chick placements that flow from the slowdown. In that case, integrators may have to offer new growers more inducements to enter production (and their lenders may require further commitments from integrators). Longer term contracts are one such inducement.

Broiler production contracts frequently do not specify any quantity commitment by the integrator. Longer durations, without a quantity commitment, seemingly provide no obvious assurance to growers at all. However, contracts cover a range of durations, and in 2011 durations were more closely tied to competitive features of markets, like integrator concentration and grower experience, than they were in 2006. Longer durations may provide a commitment that matters to growers, integrators, and lenders, even if there's no associated quantity commitment.

Table 13

Contract length, by number of integrators and years producing broilers

Number of integrators	Years producing broilers (operation)			
	0-5	6-10	11-19	>19
<i>Mean contract duration (months)</i>				
1	84	52	47	40
2	51	36	39	26
3	44	30	29	26
>3	29	33	21	11
<i>Contract is less than 12 months (Percent of farms)</i>				
1	27	36	54	64
2	59	64	61	71
3	50	70	66	70
>3	62	63	78	89
<i>Contract exceeds 59 months (Percent of farms)</i>				
1	63	48	42	26
2	36	24	25	12
3	28	22	17	18
>3	13	19	12	4

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only.

Quantity commitments also now appear in production contracts, at least in part due to FSA requirements. Over half of growers now state that their contracts specify the number of birds to be placed onsite with a flock, although this contract commitment does not appear to be linked to newer houses (table 14). However, 40 percent of contracts specify the number of flocks to be placed in a year, and growers with newer houses are clearly more likely to receive this commitment. FSA requires this contractual commitment for new loans initiated after 2008; a grower may get a new loan to finance the purchase or renovation of an older house, but many cover new houses.

Integrators offer other types of contract commitments, and some appear to be targeted to growers investing in newer houses (table 14). The 2011 questionnaire asked growers several questions related to contract terms. For example, 37 percent of contracts adjust base pay during the year to account for seasonal changes in energy use (and therefore in grower expenses). One quarter of contracts offer some payments tied to facilities, rather than to production. Nearly one-fifth specify payments to be made to the grower in the event of a catastrophe stemming from weather or disease. In each of these instances, growers with newer houses are more likely to have these terms in their contracts.

Growers make large capital investments when entering the business, and they may also make further substantial investments for expansion, remodeling, and equipment replacement. Some of the further investment may be required by the integrator as a condition of contract renewal—an implied feature of a contract. The 2011 ARMS gathered information on recent capital investments (2009, 2010, and 2011) in the broiler enterprise. Fifty percent of contract growers reported making a capital investment in those years, and most of those (29 percent of growers) were required to do so by their

integrator (table 15). While many were for relatively modest sums (less than \$10,000), the average expenditure among those with capital expenditures was substantial, and average expenditures were larger when required by the integrator, with a larger gap for older facilities undergoing remodeling or equipment replacement.

In summary, contract fees vary widely, partly due to differences in products and production processes, and partly due to differences in competitive environments. But contracts are also designed to generate wide differences in fees, reflecting differences in relative performance, and these all affect the financial prospects for contract growers.

Table 14

Features in broiler production contracts

	All farms	By mean age of houses (years)			
		<6	6-10	11-20	>20
Percent of farms with contract feature					
Seasonal base pay adjustments for energy price use	37	48	38	35	37
Some payments tied to facilities, not production	25	46	25	27	18
Contract specifies payment in event of catastrophe	18	31	19	14	18
Contract specifies the number of birds per flock	54	45	50	59	53
Contract specifies the number of flocks per year	39	53	47	45	29

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only.

Table 15

Grower capital expenditures in 2009-11

	By mean age (years) of housing				
	All farms	<6	6-10	11-20	>20
Percent of farms					
Any capital expenditures	50	47	43	56	46
At least \$10,000 in capital expenditures	39	40	34	46	32
Expenditures required by integrator	29	24	24	31	30
Dollars per farm with any expenditures (mean)					
Expenditures, if required by integrator	142,110	577,474	206,842	118,654	66,100
Expenditures, not required	113,341	555,136	122,818	73,828	38,261

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only.

Farm Finances

What sorts of incomes do contract poultry growers earn? Are they locked into a relationship that guarantees them a low income? Or does contract production provide growers with a reasonable return on their labor and financial investment and a way to make them better off? In poultry as in most agricultural enterprises, there is a wide range of financial outcomes, so we need to also ask which producers seem to be earning good financial returns and which producers are not.

This is also a complicated question: poultry provides part of the income for the farm business (usually a large part), and the farm business provides part of the income received by the farm household. Moreover, the farm business may also provide financial benefits to the farm household that are not captured in farm income. Therefore, we must first evaluate the finances of the broiler enterprise, then consider the whole farm business, and finally evaluate household incomes for operators of broiler enterprises.

Some farm- and enterprise-level financial calculations can be challenging. Estimates of expenses or revenues per unit of production can vary widely, with values for some operations that are extreme enough to sway estimates of average values for the group. In part, that is because actual expenses and revenues can vary widely, but it can also reflect constraints imposed by ARMS, which collected data on expenses incurred, revenues received, and birds removed during 2011. Expenses associated with 2011 production, but incurred in other years, will not be captured. Correspondingly, expenses incurred in 2011 for production completed in other years will be recorded. Each case can generate extreme and unlikely values for expenses per pound of production. The same issue arises when calculating average revenue measures, such as payments per pound of production. The revenue and expense flows for farms that operated only part of the year will look different than those at operations open all year. Transcription errors in either an output or an expense category can yield extreme values for per-unit expenses and revenues. Finally, some respondents may find detailed expense questions to be intrusive and may refuse the specific question, which will reduce sample sizes for the item in question. In each analysis below, adjustments are made to handle these problems and are noted in each section.

Broiler Enterprise Cash Expenses and Returns

ARMS financial data can be used to generate estimates of average cash operating expenses, by category, for the broiler enterprise. In this case, the goal is to estimate average expenses for typical farms that operated all year. For that reason, we take several steps to handle outlier data points. We focus only on farms that were in operation all year and not shut down for reconstruction. We record average expenses for respondents who report expenses, ignoring those reporting zero expenses (who likely incurred expenses in an earlier year). Finally, we limit the impact of extreme values in each category of unit expense by setting all values greater than the 95th percentile of values to the 95th percentile, and by setting all values lower than the 5th percentile to the 5th percentile value (a procedure called “winsorizing”). We then calculate and report mean and median values.

Fuel and electric expenses, at \$13.66 per 1,000 pounds of production, were the largest category of cash operating expenses in 2011 (table 16). Maintenance and repair of buildings and equipment

Table 16

Cash expenses for broiler grow-out production, 2011

Expense category	Mean ¹	Median
<i>\$ per 1,000 lbs. removed</i>		
Fuel	8.24	8.68
Electric	5.42	5.00
Bedding	2.20	1.74
Building and equipment maintenance	4.58	2.71
Supplies	1.67	0.54
Property taxes & insurance	1.55	1.13
Six expense categories combined	23.66	21.75 ²

¹Mean estimates are winsorized means for positive reported values of expense categories, after all values in the top and lower 5 percent values are set to the 95th and 5th percentile values. Medians are for positive reported expenses only.

²Median for six expense categories is not the sum of the individual medians, but the median for the six expenses combined (that is, means are additive, but medians are not).

Source: ARMS 2011 version 4, contract growers only.

added, on average, \$4.58.²⁴ When bedding purchase, supplies, and property taxes/insurance are added, the sum is \$23.66 per 1,000 pounds produced in 2011.²⁵ Median values for expenses were lower, with the overall median about 8 percent lower than the overall mean.

The estimates correspond well to estimates from sample budgets constructed in extension publications. Cunningham and Fairchild (2011) estimated cash operating expenses of \$20.84 for a new 4-unit production facility in rural Georgia, 4 percent lower than the ERS median and 12 percent lower than the mean. However, their estimate is for a new facility; if our estimate of maintenance for all operations (\$4.58) is replaced with an estimate derived for newer facilities (\$2.41), the ERS estimate for operating expenses falls to \$21.49. In addition, the Georgia report assumes a mortality rate of 3 percent; if we instead assume mean nationwide mortality (3.7 percent), and hence slightly lower live-weight production, the Georgia mean would rise to \$21.00, 2.3 percent below the ERS estimate, adjusted for facility age, of \$21.49.²⁶ Doye et al. (2012) also produce a sample budget for broiler growers in Oklahoma, based on relatively large birds (6.5 pounds) in a new facility. They report expenses for a more detailed set of categories than ERS, but the sum of expenses for the six categories reported here comes to \$20.78 per 1,000 pounds produced, 3.3 percent less than the ERS estimate noted above.

Recall that growers receive, on average, contract fees of 5.77 cents per pound, or \$57.70 per 1,000 pounds, and those who sell litter raise revenues a further 4 percent, on average. Using the ERS estimates, the average operating margin (revenues minus operating expenses) is \$34.04 per 1,000

²⁴This expense varied with the average age of houses, from \$2.41 in houses that were less than 6 years old to \$4.95 in houses that were over 20 years old.

²⁵The estimate in table 16 is for total bedding expenses, whether borne by the grower or integrator. We estimate that integrators provide bedding on 29 percent of operations, while growers and integrators share expenses on half of operations.

²⁶Hired labor expenses have been left out of the ERS estimates, while Cunningham and Fairchild estimates assumed no hired labor. The use of hired labor varies with the size of the operation (table 4) and can add over \$5 per 1,000 pounds to operating expenses.

pounds produced (\$57.70 in revenue minus \$23.66 in operating expenses). However, operating expenses omit two key enterprise costs—the costs of capital for the enterprise and the costs of the labor provided by the family.

Broiler grow-out is a capital-intensive business, usually financed with debt, so operators also bear substantial interest expenses. Nearly 80 percent of growers reported interest payments in 2011, and their mean expense was \$8.18 per 1,000 pounds removed (table 17). Average interest expense varies with the age of the operation, from \$6.12 among operations that have been in business for more than 20 years, to \$12.81, on average, among operations in business for less than 6 years (table 17). A farm with average revenues and cash expenses therefore generated net 2011 revenue of \$25.86 per 1,000 pounds of live-weight production (\$57.70 in gross revenue, minus \$23.66 in operating expenses and \$8.18 in interest expense).

That return of \$25.86 must be weighed against the additional expense of any hired labor used by the farm, as well as the labor provided by the farm family. Operators of small grow-out operations with one to two houses, incur hired labor expenses of \$1.48 and devote 2.12 hours of family labor for every 1,000 pounds of live-weight production (table 4). Given net revenue—before labor costs—of 25.86, the estimates indicate that those operators are likely to earn about \$11.50 an hour. Average returns to the family are closer to \$20-\$30 an hour for larger operations. Those returns include both a return to unpaid labor and to the capital provided by the operator family.

Actual returns can range widely around these average estimates. Farms with below-average performance will generate lower revenues, and lower net returns once operating and interest expenses have been accounted for. Farms that receive fewer bird placements will realize higher interest and operating expenses, per 1,000 pounds produced, and lower returns. Conversely, farms with above-average performance or more placements will show higher returns, and the differences can be large.

Farm Finances: Farm Incomes for Contract Growers

The broiler enterprise is usually part of a farm business, which can also produce income from other agricultural production or farm-related activities. In table 18, we present aggregated farm income statements developed from the 2011 ARMS for contract growers in four size classes in order to track revenue and expense sources and to develop measures of farm financial performance. The focus in this case is on average performance for typical growers, so several types of atypical farms are excluded from the analysis. Specifically, farms that (1) were closed down for part of 2011, (2) produced other poultry as well as broilers for meat, (3) were owned by multiple

Table 17

Interest expenses for grow-out production, by years in operation

Item	By years in operation				
	All farms	Under 6	6-10	11-20	Over 20
Farms with interest expense (%)	78	90	92	77	66
For those with interest expense:	\$ per 1,000 lbs. removed				
Mean	8.18	12.81	9.67	7.26	6.12
90th percentile	16.70	23.90	16.85	15.39	14.70

Source: ARMS 2011 version 4, contract growers only.

households, or (4) reported debt in excess of assets were excluded. The analysis retains 84 percent of the original sample.

The smallest size class, operations with one to two houses, includes about 24 percent of growers, while the next smallest (three to four houses) includes 44 percent of growers (see table 5). The third class (five to six houses) covers 20 percent of growers, while the largest (seven or more houses) covers a wide range of sizes and 12 percent of growers. Two measures of financial performance are generated: net cash farm income, which is the difference between gross cash income and cash expenses; and net farm income, which adds certain noncash elements to income and to expenses.

The income statement starts with an accounting of gross cash farm income. Fees from production contracts account for a large share of revenue in each size class (table 18). Other sources of gross income include cash income from sales of crops and livestock, Government payments, and other cash farm income.²⁷ There are no Government programs specifically covering poultry, but farms may receive payments associated with other activities on the farm (see box, “Government Programs and Contract Growers”).

Gross farm income is the sum of gross cash and noncash income, where the latter includes net changes in the value of inventories and accounts receivable as well as the imputed rental value of the farm dwelling (for those farms with a dwelling that is part of the farm business).²⁸ Those imputed rental values provide a value to the household that is excluded from farm business and household income estimates, which are based on cash revenues and expenses.

Net cash farm income is the difference between gross cash income and cash operating expenses, while net farm income is the difference between gross farm income and all operating expenses (cash and noncash). Depreciation accounts for the bulk of noncash operating expenses on broiler enterprises. Net income represents the return to both the capital and the unpaid labor provided by the grower. Mean values of net farm income range from \$38,434 among small farms to \$107,727 for very large growers (table 18).

Over 20 percent of the smallest farms failed to cover cash expenses in 2011, and that share fell sharply in larger size classes. Nearly a third of smaller farms, and nearly a fifth of larger farms, had negative net farm income in 2011. That may in part be due to the snapshot nature of these accounts: farms that incurred expenses in 2011 for production to be carried out in 2012, or that realized income in 2010 or 2012 instead of 2011, may have negative net income in 2011 even if they are financially sound. However, placements also fell in the latter part of 2011, and that may have led to declines in grower revenues as well.

Mean rates of return on equity require some explanation since we must calculate a return to farm operator labor as part of the estimation of the return on invested equity. Farms that have incorporated can pay a salary to their owner-operators, and that salary is included as a cash expense. Most contract growers are not incorporated (see table 6), and they cannot report a salary expense for

²⁷Other cash farm income can arise from activities produced jointly with farm commodities, such as renting out land, machinery, or buildings; providing custom services; or litter sales.

²⁸The dwelling is part of the farm business in 70 percent of contract grower operations, ranging from 80 percent of 1- to 2-house operations to 58 percent of those with more than 6 houses. Dwellings that are owned by the farm business are financed jointly with the farm business and share common farm expenses (for utilities, maintenance, and interest, for example).

Table 18

Income statement, contract broiler farms, by size of broiler enterprise

Item	Number of houses			
	1-2	3-4	5-6	>6
<i>Farm characteristics</i>				
Share of farms (%)	24	44	20	12
Average house age (years)	22	18	16	16
Average primary operator age	58	55	54	54
<i>Gross farm income</i>				
Fees from broiler production contracts	66,926	141,725	220,328	356,309
<i>plus</i> Crop and livestock cash income	33,495	38,321	41,920	57,467
<i>plus</i> Government payments	1,944	2,803	4,007	9,569
<i>plus</i> Other cash farm income ¹	12,083	10,308	15,658	25,945
<i>equals</i> Gross cash farm income	114,448	193,157	281,913	449,290
<i>minus</i> Cash operating expenses	76,367	117,944	171,540	277,958
<i>equals</i> Net cash farm income	38,081	75,213	110,373	171,332
Gross cash farm income	114,448	193,157	281,913	449,290
<i>plus</i> Net change in inventories ²	14,854	3,354	7,259	2,738
<i>plus</i> Other noncash income ³	11,011	8,674	8,280	8,087
<i>equals</i> Gross farm income	140,313	205,185	297,452	460,115
<i>Net farm income</i>				
<i>minus</i> Noncash operating expenses ⁴	25,512	35,977	50,216	74,428
<i>minus</i> Cash operating expenses	76,367	117,944	171,540	277,958
<i>equals</i> Net farm income	38,434	51,264	75,696	107,729
Farms with negative net cash income ⁵ (%)	21.5	9.8	9.6	6.9
Farms with negative net farm income (%)	31.3	21.1	18.4	17.1
Mean hourly return to operator labor (\$) ⁶	18.34	20.21	20.48	23.57
Mean return on labor & equity (%) ⁶	5.7	7.9	7.8	8.2
Mean return on equity (%) ⁶	-2.1	0.9	1.5	2.7

¹Includes income from other contracts, net Commodity Credit Corporation loans, land rentals, energy leases, custom services, etc.

²Includes changes in accounts receivable.

³Includes value of farm production consumed on farm, and imputed rental value of farm dwelling.

⁴Includes depreciation expense charged to farm assets and noncash benefits to farm employees.

⁵Net cash farm income is gross cash income, minus cash operating expenses.

⁶This is a winsorized mean, adjusted to reduce the influence of extreme values. Value less than the 5th percentile, or greater than the 95th percentile, have been replaced with 5th and 95th percentile values.

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Sample consists of contract growers, operating throughout year, with positive net worth, for whom all business income flowed to primary operator household.

Government Agricultural Programs and Contract Broiler Growers

Federal farm commodity programs do not provide direct financial support to broiler growers. However, they may receive financial support for other activities carried out on the farm. One quarter of contract broiler growers received payments under Government farm programs in 2011, and the payments amounted to just over 4 percent of farm gross cash farm income, on average, for those farms that received payments. Among specific program areas, commodity programs provide support for producers of certain field crops through direct payments tied to historic land use and yields. Few broiler growers (8 percent) received commodity payments, since nearly half have no cropland, and many of those who do receive payments plant hay and grasses, which receive no commodity program support.

Some growers participate in conservation programs, including land retirement and working lands programs. The major working lands program is the USDA Environmental Quality Incentives Program (EQIP), where payments can cover a share of the expenses incurred by the grower for onfarm conservation projects such as stream protection or litter storage. Other Government programs, which account for the largest share of farms and money, include disaster and emergency assistance payments as well as continuing payments from a 10-year tobacco buyout program initiated at the phase-out of tobacco programs in 2005. Some broiler growers were eligible for each.

About 4 percent of poultry growers received indemnity payments from federally subsidized crop or livestock insurance programs in 2011. No Federal insurance programs cover poultry. Poultry growers receiving indemnity payments received them for other commodities produced on the farm, principally field crops.

Box 3 table 1

Receipt of Government farm program payments by contract growers, 2011

Type of program	Share of farms receiving 2011 payment	Program participants only	
		Mean 2011 payment	Share of 2011 grower revenue
	<i>Percent</i>	<i>Dollars</i>	<i>Percent</i>
Any Government farm program	25.5	14,342	4.2
Land retirement programs	3.6	2,447	0.8
Working land programs	7.8	12,431	3.6
Commodity programs	8.4	6,353	1.3
Other Government farm programs	11.3	18,173	5.5
Federal crop or livestock insurance	3.8	22,224	5.8

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Contract growers only.

owner-operators. Nonetheless, there is an opportunity cost to their time, and we must impute a cost to their labor if we are to estimate a return to capital.

In its farm financial accounts, ERS imputes a value for the unpaid farm labor and management provided by operators and spouses. The labor component is priced at the hired labor wage rate for the State in which the farm is located, plus an addition for Social Security payments, which ranges from \$11 to \$12 an hour. ERS then adds an imputed value for the management services provided by the

operator, valued at 5 percent of gross income of the farm, less certain purchased inputs. The mean hourly return to operator management and labor then consists of the imputed value for those farms that are not incorporated, and the reported salaries for those farms that are incorporated. The mean hourly return ranges from \$18.34 an hour for the smallest farms to \$23.57 for the largest (table 18).

The rate of return on equity is defined as net farm income, minus the imputed value of unpaid operator labor and management, divided by net worth. We also report a return on labor and equity (net farm income, plus salaries paid in incorporated farms, divided by net worth).²⁹

The average returns on equity are negative for operations with one to two houses and rise with size to reach 2.7 percent among operations with six or more houses (table 18). These are well below rates of return on equity reported for manufacturing, mining, and trade corporations in the Quarterly Financial Reports of the U.S. Census Bureau.³⁰ They are also below average rates of return on equity for large and midsize U.S. farms. The mean rate of return for farms with at least \$1 million in sales (gross cash farm income) was 11.1 percent in 2011, while that on farms with \$350,000-\$999,999 was 5.3 percent. Average returns were, however, comparable to those estimated for farms with \$50,000-\$350,000 in sales, which came to -0.7 percent in 2011.³¹

Production is shifting to larger operations in contract broiler production and in all of farming, a shift that is consistent with greater profitability among larger operations. Moreover, 2011 may have been a relatively poor financial year for contract growers, with falling production in the latter part of the year, and returns may be higher in other years. However, persistent low returns will make it difficult to attract capital investment to the broiler industry.

Our estimated rates of return on equity are relatively low. However, farm businesses yield incomes to households through the labor as well as the capital that they provide, and our methods of estimating returns to investment necessarily involve some arbitrary allocation of returns between operator labor and operator capital. Moreover, households also receive income from off-farm sources.

Household Incomes

Farm household income is the sum of farm income and income from off-farm sources. The bulk of the farm income component is straightforward: it consists of net cash farm income minus depreciation expenses, or farm business income to the household.³² But there are three other elements which, while irrelevant for most households, add to farm income for others and hence give positive average amounts across farms. They are the net income from operating other farm businesses, income flowing to the farm household from renting out land, and farm wages paid to the household—from

²⁹As in the enterprise estimates, rate of return estimates were winsorized, with values above the 95th percentile or below the 5th percentile set to those values. Estimates of ratios can generate extreme values (for example, for farms with very low estimated equity) that are large enough to sway means.

³⁰The 2011 Quarterly Financial Reports show average rates of return on equity of over 20 percent, pre-tax, and 16-17 percent post-tax (<http://www.census.gov/econ/qfr/>).

³¹These were estimated using ARMS 2011 data for all farms with positive net worth, and winsoring extreme values to the 95th and 5th percentiles, as in table 18.

³²Recall that this sample is limited to farms in which all of farm business income flows to the primary operator's household. As a noncash expense, depreciation does not reduce the cash flow to the household, but it does shelter that cash flow from taxes.

their own farm business if incorporated or from others if members of the household are hired on as labor at other farms.

Note the wide range of farm business income to the household. Farm households with one to two broiler houses earned just over \$12,000, on average, from the farm business, while farms with at least seven broiler houses earned an average business income of \$98,544 (table 19). On average, farm households in each size class had substantial off-farm income from unearned sources as well as wages from off-farm jobs.³³

So far, the analyses of finances for broiler enterprises, whole farms, and farm households have focused on average returns for typical grower operations. But we also want to compare contract grower households to all farm households and to all U.S. households. In those comparisons, we are interested in the range of incomes as well as average incomes, and we want to compare inclusive groups. For that reason, we do not impose the exclusions (percentiles) used in the earlier analyses, but instead focus on all contract growers.

Total farm household income combines income from farming with off-farm income. Across all contract growers, mean 2011 household income was \$86,883, while the median—where half of households earned more and half less—was \$68,445 (table 20). These substantially exceeded the mean and median for all U.S. households (a mean of \$72,812 and a median of \$50,504) and the median for all U.S. farm households (while falling just below the all-farm mean).

Table 19

Accounting for household income for contract broiler producers

Item	Number of houses			
	1-2	3-4	5-6	>6
<i>Farm business income to the household</i>				
Net cash farm income	38,081	75,213	110,373	171,332
<i>minus</i> Depreciation expense	25,364	39,699	49,621	72,788
<i>equals</i> Farm business income to the HH ¹	12,717	35,514	60,752	98,544
<i>From farm business to household income</i>				
<i>plus</i> HH income from land rents	173	169	490	366
<i>plus</i> Income from another farm business	1,944	422	630	890
<i>plus</i> Farm wages to the HH	2,484	3,011	3,466	9,969
<i>equals</i> Farm income to the HH	17,318	39,116	65,338	109,779
<i>plus</i> Off-farm income to the HH	54,505	40,295	40,791	51,701
<i>equals</i> Total farm household income	71,823	79,411	106,129	161,480

¹The sample for this table is restricted to farms with a 100% ownership share by the household (93 percent of the full sample, and 87 percent of very large farms). As a result, Farm Business Income and Farm Business Income to the (Primary Operator's) Household are identical.
HH = household.

Source: USDA Agricultural Resource Management Survey, 2011, version 4. Sample consists of contract growers, operating throughout year, with positive net worth, for whom all business income flowed to primary operator household.

³³Income accounting makes a distinction between earned income from salaries and wages and “unearned” income from all other sources, such as income from pensions, Social Security, gifts and transfers, or interest and dividends.

Table 20

Household income comparisons, 2011

Household category	Annual 2011 Household Income (\$)			
	Mean	Median	20th Percentile	80th Percentile
All U.S. households	72,812	50,504	20,262	101,582
All U.S. farm households	87,288	57,050	24,201	114,417
All contract growers	86,883	68,445	18,782	143,294
By number of houses				
1-2 houses	61,174	45,199	7,865	106,706
3-4 houses	77,998	65,050	18,782	127,187
5-6 houses	98,392	85,159	27,069	158,326
7 or more houses	157,343	119,363	42,302	269,112

Sources: USDA Agricultural Resource Management Survey, 2011, version 4, and U.S. Census Bureau, Current Population Reports P-60, *Income Poverty and Health Insurance Coverage in the United States: 2011*.

There is a wide spread of incomes around the averages, and the spread as measured here is wider for contract growers than for other groups (table 20). For all U.S. households, the 20th percentile of income was \$20,262 in 2011, while the 80th percentile was \$101,582.³⁴ The corresponding range for all farm households was \$24,201 (P20) to \$114,417 (P80), while that for contract poultry growers was considerably wider, from \$18,782 (P20) to \$143,294 (P80).

Average household incomes (mean and median) increase with the size of the broiler operation. Median incomes in the smallest size class (1-2 houses) fell about 10 percent below the U.S. median in 2011, but medians in the other classes—which cover more than three-quarters of all growers—were well above the U.S. median. The range *within* each size class is quite wide: for example, 20 percent of households in the largest class had 2011 household incomes of \$42,302 or less, below the median for the U.S. population, while 20 percent had incomes of at least \$269,112.

The estimates of total household income omit one important noncash benefit that accrues to most farm households. Most nonfarm households pay for their housing, through rents or mortgage payments, out of the cash income received by the household. However, most farm households (and nearly 80 percent of contract growers) do not—they pay for housing through the farm business, as part of operating expenses. In essence, the farm business provides shelter for most farm households, in addition to the cash income provided. For that reason, measures of household income understate the financial well-being of most farm households, in comparison to most nonfarm households.

Contract broiler growers are not a low-income group when compared to other farm households or to all U.S. households. Median incomes for three of the four size classes of growers exceed those for the two comparison groups, even if we ignore the additional housing benefit that most receive. Contract grower households do show a wider dispersion of household incomes than other groups. This is striking. The U.S. household population includes people from across the country, with a wide range of ages, education levels, occupations, and experience, so a wide range of incomes is not unexpected. In contrast, broiler growers are a much more homogeneous group—a single occupation performed by people with a much narrower range of ages, education levels, and locations. The wide range of financial performance indicates that there are considerable financial risks in the industry.

³⁴Twenty percent of household incomes are at or below the 20th percentile (P20), while 80 percent are at or above; 80 percent of household are at or below the 80th percentile (P80), while 20 percent are at or above; and 50 percent of households are at or below the median, with 50 percent at or above.

Conclusions

Contract broiler growers earn household incomes that exceed the averages for all U.S. households, even without accounting for the value of the family housing providing through most farm businesses. The industry's productivity continues to grow through continued improvements in feed conversion and grow-out time to maturity.

The industry also continues to adapt quickly to changes in consumer demand and to regulatory requirements. The rapid shift to larger birds accommodates increased foreign and domestic demand for processed chicken and chicken parts. The industry's litter management practices have changed in response to regulations on nutrient application and management (e.g., storage requirements) and to changes in prices for commercial fertilizer (a substitute for litter nutrients). A reduction in the feeding of antibiotics for growth promotion is evident, as retail and foodservice clients look to market products as raised without antibiotics. Finally, the industry is expanding the use of practices associated with improved biosecurity and bird health.

Poultry production is financially risky: while average incomes exceed those for comparison groups, there is a very wide range of financial performance among contract growers, and many earn very low returns from broiler production and low household incomes. Moreover, even among large and relatively efficient contract growers, average rates of return on invested capital are quite low compared to economy-wide averages and to midsize and large U.S. farms.

With the low rates of return, can the industry continue to attract the capital investments in improved housing that underlie improved productivity, bird health, sanitation, and biosecurity? Those investments are made by growers, and low returns may discourage them from continuing to invest.

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Glossary

All-in all-out production. A production system in which all chicks are placed on the operation at the same time, and all broilers are removed for slaughter at the same time.

Animal welfare requirements in broiler production. The amount of space per bird is one of the more common requirements. Others may include noise levels, ammonia levels, or other hazards that broilers may be exposed to.

Broiler. A chicken bred and raised specifically for meat. Most broiler breeds have fast growth rates and reach slaughter weight at a young age—5 to 9 weeks.

Certified organic broiler operation. A certified organic operation must have been certified by a USDA-accredited State or private agency. Organic poultry must be fed certified organic feed, which in turn must be produced without the use of most synthetic chemicals; must be raised without antibiotics or animal byproducts; and must have year-round access to the outdoors.

Comprehensive Nutrient Management Plan. A CNMP identifies a set of management and conservation actions necessary to meet clearly defined nutrient management goals, aimed at reducing excess nutrients in soil and water. The plans have become integral parts of regulatory permitting processes for animal feeding operations of all sizes.

Evaporative cooling. Systems that cool temperatures in chicken houses by evaporating water. Such systems can include cooling pads (paper filters that are placed over air inlets and moistened), fogging nozzles (placed at the air inlet and/or throughout the house), or both.

Farm business income. Net cash income, minus depreciation expense.

Feed conversion ratio. The mass of the food eaten divided by the body mass gain, all over a specified period. In broilers, it is usually reported as the amount of feed consumed divided by the market weight of the broiler.

Feed without animal byproducts. Operations that do not provide antibiotics in feed or water often provide broilers with feeds that are entirely from vegetable sources—that is, they do not contain animal byproducts (including fish or poultry). The use of such feeds may affect production costs, financial performance, and productivity outcomes.

Gross cash farm income. Cash revenue received by the farm during a given year, including cash sales of crops and livestock, production contract fees, Government payments, net Commodity Credit Corporation proceeds, and other farm income (including lease and rental income, income from custom services and machine hire, income from agro-tourism and processed products sold from the farm, etc.).

Gross farm income. Gross cash farm income, plus noncash income such as changes in inventories, changes in accounts receivable, the value of farm commodities consumed on the farm, and the imputed rental value of dwellings that are part of the farm business.

Hazard Analysis and Critical Control Points. HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards

in production and handling. USDA regulations require meat and poultry processing plants to use HACCP systems, and some integrators require contract growers to have on-farm HACCP plans.

Integrated electronic controls. Some broiler houses have manually operated thermostats to control temperatures in the house. Others use integrated electronic controllers to maintain consistent temperatures.

Litter. Poultry litter consists of poultry manure mixed with feathers, spilled feed, and bedding material such as wood shavings, sawdust, or straw spread on broiler house floors.

Net cash farm income. Gross cash farm income, minus cash operating expenses.

Net farm income. Gross farm income, minus cash and noncash operating expenses. Noncash expenses include depreciation as well as meals, housing, and other non-cash items provided to paid labor.

Prebiotics/probiotics. Prebiotics are non-digestible food ingredients that stimulate the growth of certain bacteria and may be conducive to animal health. Probiotics are micro-organisms that may stimulate the growth of bacteria and may provide benefits to animal health. Operations, especially those that do not provide antibiotics in feed or water, sometimes provide prebiotics or probiotics as nutritional supplements in feed.

Production contracts. An agreement under which a contract grower raises a commodity, usually livestock, for a contractor that owns the commodity. Contractors often provide feed, while growers provide labor, housing, and utilities.

Raised without antibiotics. Antibiotic drugs, used to treat disease in animals, are sometimes provided routinely in feed or water to prevent disease and to improve feed conversion. Because of concerns over the impact of widespread antibiotic use on the development of antimicrobial resistance, some retailers now require their suppliers to raise birds without using antibiotic drugs for growth promotion, and they market products with that label.

Relative performance contracts. Most broiler production contracts base grower compensation on a combination of a fixed base payment and premiums or discounts reflecting the grower's performance compared to the average performance among growers who delivered flocks during the same week.

Side curtains. Some poultry houses have vinyl or fabric sidewall curtains that can be raised or lowered to calibrate temperatures and ventilation inside houses.

Static pressure-controlled vent boxes. Air is pulled through cracks and vents that are built into houses. Some vent boxes are manually operated, but others are actuated by static pressure and accomplish vent size adjustments automatically.

Tunnel ventilation. Tunnel ventilation systems use exhaust fans, placed at one end of the house, to pull air through the house for cooling purposes. The fans draw air through openings and then through the house.