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Session 2:
Reshaping Global Agricultural Production

Reshaping Agricultural Production: Geography, Farm Structure, and Finances

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This session announces an enormous topic, *Reshaping Global Agricultural Production*. We are not going to try to cover all that the session title implies, but will focus on a few topics that we can be informative about. Much of what we have to say will draw on USDA data and analyses.

First, we discuss likely changes in the location of global production in the next decade, drawing on USDA annual baseline projections. The USDA projections are far from certain, but they are a good reflection of the consensus views of some well-informed people, and the global macroeconomic assumptions underlying the projections provide a good starting point for thinking about alternative futures in a reasonably disciplined way.

Second, we summarize the major ongoing changes in U.S farm structure, as well as the reasons for those changes and their likely impacts. Those changes are obscured in aggregate farm statistics and may not be widely known, so we spend some time on them. We use farm-level data from the Census of Agriculture, as well as annual farm-level data drawn from the Agricultural Resource Management Survey (ARMS), USDA's primary source of data on farm finances, farm production practices, and farm household well-being.[2]

Third, we touch on changing farm structure in some other countries. The U.S. looms large in most discussions of farm structure, partly because of the size of the U.S. agricultural sector but also because of the deep reservoir of U.S. farm data. Recent efforts to develop databases on farm structure in other countries have softened that judgment, and we draw on those data in this analysis.

Finally, changes in U.S farm structure are tied to changes in how farms access capital for the enterprise, and how farms arrange for the sale of their output. We discuss the impacts of the financial crisis and swings in farm prices on farm financial arrangements and farm structure.

[1] The views expressed herein are those of the authors, and do not represent the views of the U.S. Department of Agriculture.
[2] ARMS is a large annual survey directed to over 30,000 farms, with 21-22,000 useable responses in each year. The sample is designed to be representative of all U.S. agriculture, and a major strength of the survey is that it links production, production practices, and marketing decisions to farm financial measures.

The Big Picture: USDA Baseline Projections

USDA produces annual baseline projections, ten years ahead, for global agricultural production and trade.[3] This is a useful starting place for thinking about some key drivers of structural change, and their impacts on the geographic organization of production.

Baseline projections are a conditional, long-run, scenario: a Departmental consensus about what would be expected to happen under a continuation of current policies, normal weather, and specific assumptions about international and U.S. macroeconomic conditions and agricultural productivity growth. For our purposes, the key assumptions include:

- A rebound of global economic growth to an annual average of 3.3 percent, and a resumption of high growth rates in China and India.
- Real increases in crude oil prices, with refiner acquisition costs projected to be $100 per barrel by the end of the period.
- No change in biofuels policies, and continued growth in the ethanol industry.
- Corn, wheat, and soybean prices remain historically high, with farm-gate prices of $3.65, $4.75, and $9.20 per bushel, respectively, at the 2019 projection.
- The U.S. dollar is projected to depreciate through the projection period, and thus will continue to positively impact U.S. exports.

Economic growth in China and India will drive significant increases in their meat consumption, and those dietary changes will have major impacts on global agricultural production and trade. Figures 1-4 illustrate several structural impacts likely to arise from expanded global meat consumption, and the associated expansion in animal feed production. While Indian and Chinese meat imports increase, expanded consumption is largely fueled by domestic production, with Chinese pork production projected to grow 19 percent between 2009 and 2019, compared to 7 and 3 percent in the U.S. and the EU, respectively (Figure 1). Similarly, growing poultry consumption will be met largely by domestic production (Figure 2), with major 2009-2019 increases projected in China (48 percent) India (130 percent), and Brazil (23 percent).

While USDA projects increased Chinese soybean production, most of the derived demand for soybeans will be met through imports. In turn, USDA projects a major expansion of soybean production in Argentina and Brazil, accomplished largely through expanded acreage, with projected 2118/19 acreage nearly a third greater than the 97.6 million acres in the two countries in 2008/09 (Figure 3) . While Chinese corn imports are expected to grow, domestic production is projected to account for most of the increase in corn use in China. In turn, the U.S. and the EU are projected to expand corn production, but the USDA projection does not envision major structural changes (Figure 4).

[3] We rely on the baseline projections for 2010-2019, issued in February, 2010, at http://www.ers.usda.gov/Publications/OCE101/OCE101.pdf

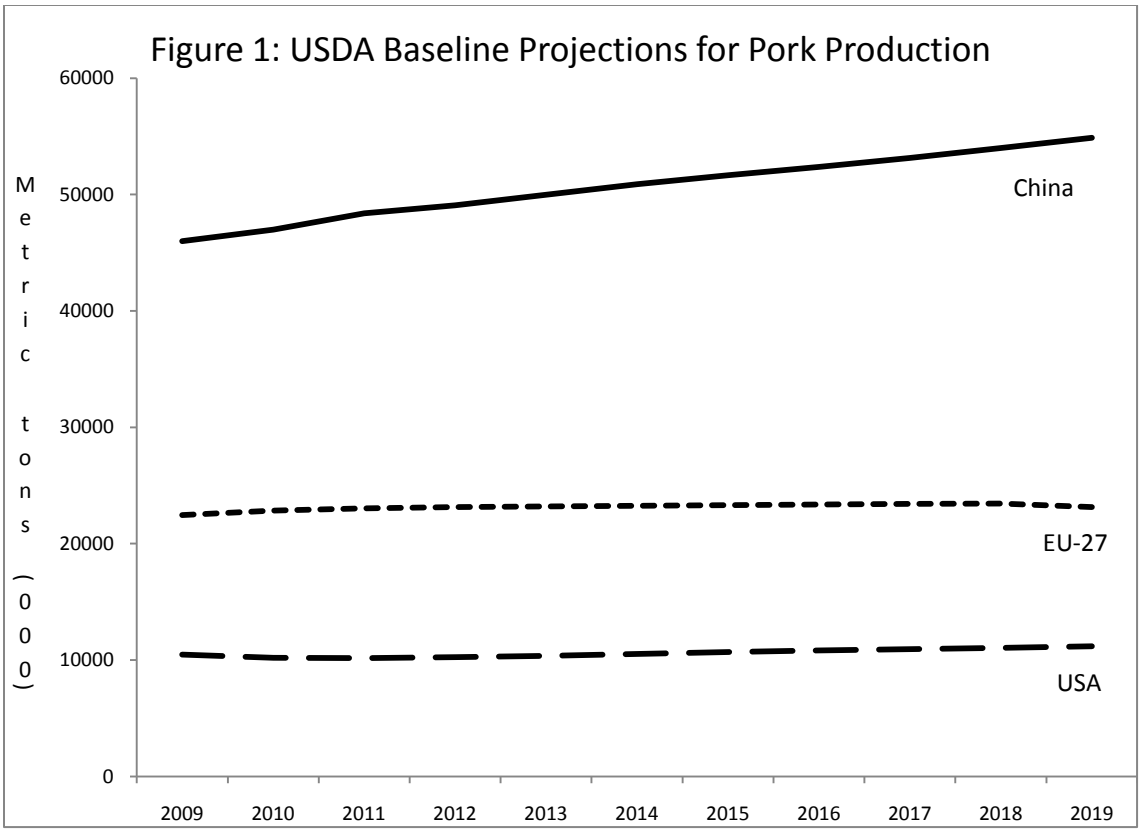


Figure 1: USDA Baseline Projections for Pork Production
Metric tons (000)
60000
50000
40000
30000
20000
10000
0
China
EU-27
USA
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

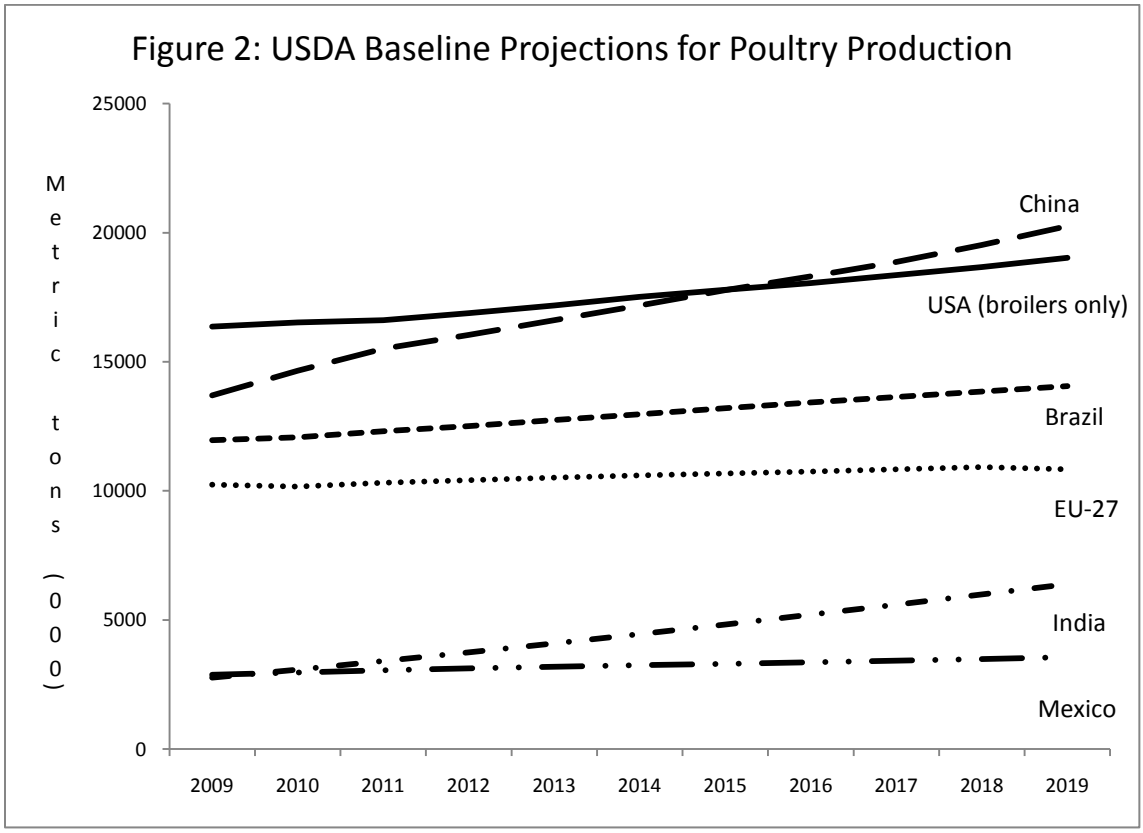


Figure 2: USDA Baseline Projections for Poultry Production
Metric tons (000)
25000
20000
15000
10000
5000
0
China
USA (broilers only)
Brazil
EU-27
India
Mexico
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

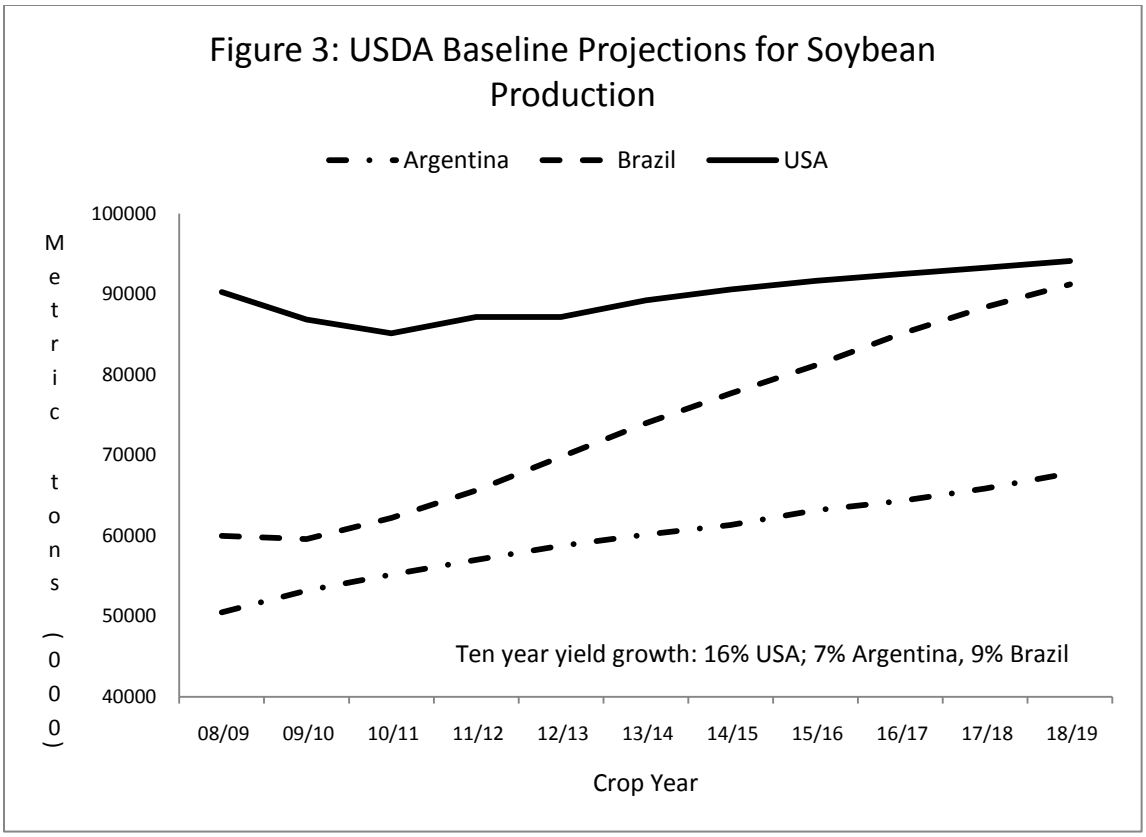


Figure 3: USDA Baseline Projections for Soybean Production
Argentina
Brazil
USA
Metric tons (000)
100000
90000
80000
70000
60000
50000
40000
Ten year yield growth: 16% USA; 7% Argentina, 9% Brazil
08/09
09/10
10/11
11/12
12/13
13/14
14/15
15/16
16/17
17/18
18/19
Crop Year

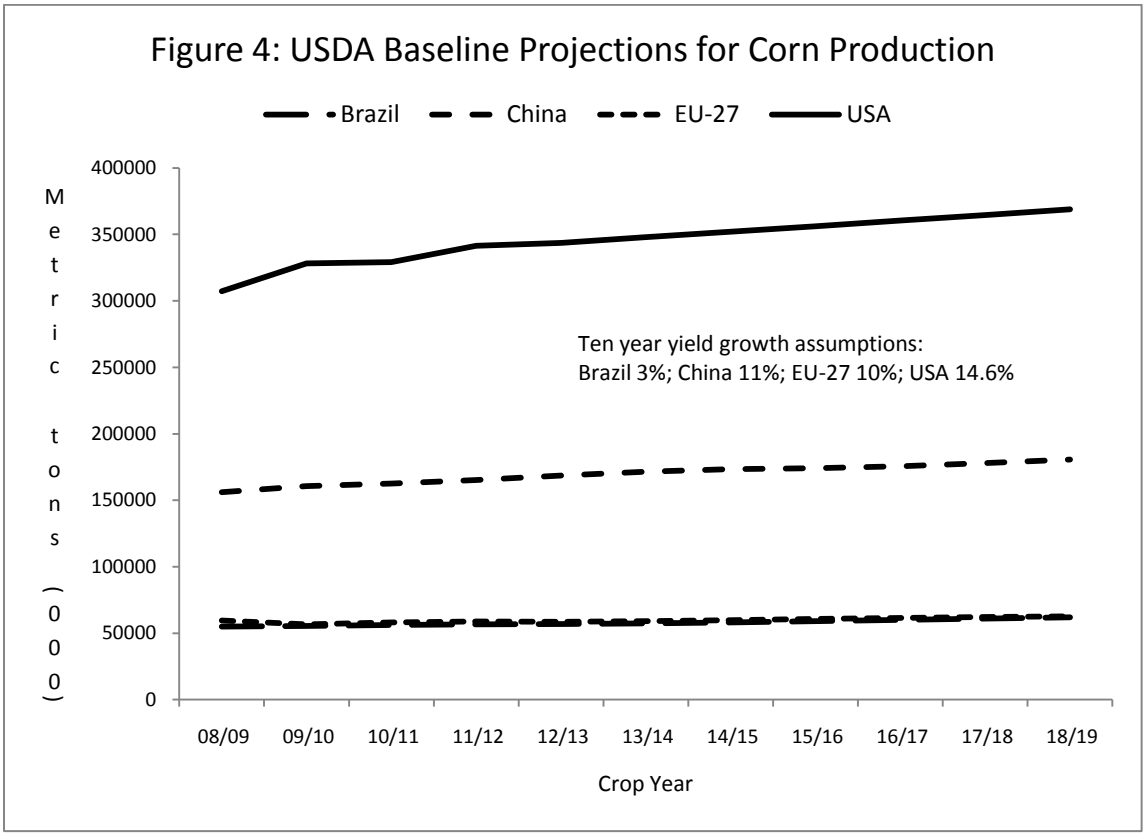


Figure 4: USDA Baseline Projections for Corn Production
Brazil
China
EU-27
USA
Metric tons (000)
400000
350000
300000
250000
200000
150000
100000
50000
0
Ten year yield growth assumptions:
Brazil 3%; China 11%; EU-27 10%; USA 14.6%
08/09
09/10
10/11
11/12
12/13
13/14
14/15
15/16
16/17
17/18
18/19
Crop Year

The USDA projections point clearly to two major changes in the geography of global agricultural production in the next decade: major expansions of domestic poultry production in developing countries and of soybean production in South America. The USDA projections also point to sharp increases in U.S. production, exports, and imports of horticultural products (fruits, vegetables, and tree nuts). USDA projects a 10 percent increase in US acreage, with most of the increase in fruits and tree nuts, and a 30 percent increase in import volume. This sector has seen important shifts in recent years, with U.S. and European supermarket chains organizing global procurement networks relying on a tight degree of vertical coordination. The projections suggest that we will see a greater shift in this direction.

Structural Change at Ground Level: Farm Organization in the U.S.

In the U.S., structural change at the farm level encompasses three closely interrelated features: larger farms; more complex farm business organizations; and more formal contracting in place of cash market relationships.

Production is steadily moving to larger farms in most livestock and crop commodities. But the magnitude of the shift can be obscured in aggregated statistical summaries by another feature of U.S. farm structure--the growing number of very small farms. We outline the aggregate shift with Census of Agriculture data (Table 1). There, a farm is defined as a place that produces, or normally would produce, $1,000 in farm commodities. In 2007, 60 percent of the 2.2 million U.S. farms had sales below $10,000, and just over half of those were below $1,000 (Table 1).[4] In contrast, the 55,500 farms (2.5 percent of the total) with sales of at least $1 million accounted for 59 percent of U.S. production.

Table 1: Changes in U.S. Farm Structure, 1982-2007

	Farms		Market Value of Sales (millions of 2007 $)	
	1982	2007	1982	2007
Total	2,240,976	2,204,793	189,151	297,220
Sales Class	-Distribution of farms and sales, by sales class-			
Less than $10,000	42.6	59.8	1.8	0.9
$10,000-$249,999	50.8	30.7	40.8	14.2
$250,000-$999,999	5.9	7.0	30.0	25.7
$1,000,000 or more	0.7	2.5	27.4	59.2
All	100.0	100.0	100.0	100.0

Source: USDA National Agricultural Statistics Service, Census of Agriculture

Notes: Values for sales in 1982 are adjusted to 2007 dollars using the Producer Price Index for Farm products.

[4] Places that do not have $1,000 in sales can meet the threshold because they have assets, such as inventories of animals or holdings of cropland, which would normally produce at least $1,000 in sales if the farm sold crops or animals (USDA/NASS, 2009; O'Donoghue, et al., 2009).

Table 1 also shows how farm sizes changed between 1982 and 2007. We measure farm size by agricultural sales, and adjust all 1982 sales figures for price changes, to compare distributions in constant–dollar values. The aggregate number of U.S. farms, 2.24 million in 1982, fell slightly to 2.20 million in 2007. But that seeming stability masked major changes. The number of small commercial farms (sales of $10,000-$250,000) fell by over 40 percent, but the number of farms with less than $10,000 in 2007 sales increased sharply, as did the number with sales of $1 million or more, whose numbers grew by 243 percent (Table 1).[5]

This hollowing-out of the middle shows up in production numbers as well. Farms with at least $1 million in sales (2007 dollars) increased their share of production by 30 percentage points between 1982 and 2007, while the share held by small commercial farms fell by 27 percentage points.[6]

Enterprise data--for specific commodities on farms--also show major shifts to larger farms. We can use physical measures of production, such as bushels, harvested acreage, or animals, to measure size in enterprise statistics without the need for adjustments for price changes. However, because production is so highly skewed, simple mean comparisons of enterprise size are not very informative. To understand the issue, consider Table 2, with measures of average enterprise size for dairy and tomatoes.

Table 2: Comparing Measures of Average Size for Two Commodity Enterprises

	1987	1997	2007
Dairy			
Mean herd size (cows)	61	78	133
Weighted median	80	140	570
Tomatoes			
Mean harvested acres	26	29	17
Weighted median	400	589	820

Source: USDA National Agricultural Statistics Service, Census of Agriculture

Mean dairy herd size—the number of milk cows divided by the number of farms with cows—was 61 cows in 1987, and it grew to 133 by 2007, as small dairies exited. For contrast, we identify an average size from the point of view of production: the median of the distribution of cows by herd size. At this weighted median, half of all milk cows are in smaller herds and half are in larger herds. The weighted median wasn't much higher than the simple mean in 1987 (80,

[5] Some of the increase in very small farms reflected inflation. The USDA farm definition is not adjusted for inflation, and it therefore took fewer animals or acres to qualify as a farm in 2007 than in 1982. But the increase also reflects USDA methodological changes designed to more effectively locate and identify such farms, and as well as an actual increase in rural residences (USDA/NASS, 2009, p. 31).

[6] Almost all of the growth in large farm sales is accounted for by more farms, rather than increases in the size of large farms--real sales per farm increased very little.

versus 61). But the weighted median increased more than six-fold, to 570, in the next 20 years. By 2007, most cows and most production occurred on farms that were far larger than 133 head, and the weighted median provides us with a useful way to track structural change in production.

Tomatoes provide a striking example. Mean size fell from 26 acres in 1987 to 17 in 2007. Most production occurs on much larger farms: the acre-weighted median, 400 acres in 1987, grew to 820 by 2007. The different trends mirror larger patterns in agriculture: production shifts to larger operations combined with major increases in the number of very small farms. The 1987 Census recorded 15,500 farms with tomato production, and half (7,700) had less than an acre. In 2007, 17,500 farms (out of 25,800 in total), had less than 1 acre. Some of that increase may have been real, but it may also have followed from Census efforts to track more very small farms.[7]

Weighted medians for 20 selected commodities are reported in Table 3, which clearly shows major shifts of production to substantially larger enterprises.[8] The dairy and hog industries, with dramatic recent structural upheavals, show changes that can only be described as massive. But the midpoint (weighted-median) size also doubled over 20 years in fed cattle, broiler, and cow-calf enterprises. The first two underwent major changes in organization decades ago, and have not seen the sort of upheavals evident in hogs and dairy. But the data still show important ongoing shifts of production to larger enterprises.

Table 3: U.S. Production Shifted to Much Larger Enterprises

Selected Commodities	1987	1997	2007
	Herd size (cow-weighted median)		
Dairy	80	140	570
Other livestock	Annual sales (animal-weighted median)		
Broilers	300,000	480,000	681,600
Hogs	1,200	11,000	30,000
Fattened Cattle	17,532	38,000	35,000
Cattle, <500 lbs	50	65	128
Selected Crops	Harvested acres (acre-weighted median)		
Corn	200	350	600
Soybeans	243	380	490
Wheat	404	693	910
Cotton	450	800	1,090
Rice	295	494	700

[7] Farms with less than an acre of tomatoes—two thirds of all farms with tomatoes in 2007-- accounted for 1 percent of total tomato acreage in that year.

[8] These are drawn from a larger list of about 80 commodities drawn from Census data, and the patterns shown here mirror those in the larger list.

Table 3: U.S. Production Shifted to Much Larger Enterprises (continued)

Selected Commodities	1987	1997	2007
Selected Crops	Harvested acres (acre-weighted median)		
Asparagus	160	200	240
Lettuce	949	1,461	1,815
Peppers, Bell	88	180	300
Potatoes	350	556	990
Sweet Corn	100	173	250
Tomatoes	400	589	820
Apples	83	122	146
Almonds	203	292	450
Oranges	450	769	1,113
Peaches	92	100	120

Source: ERS calculations, from Census of Agriculture data

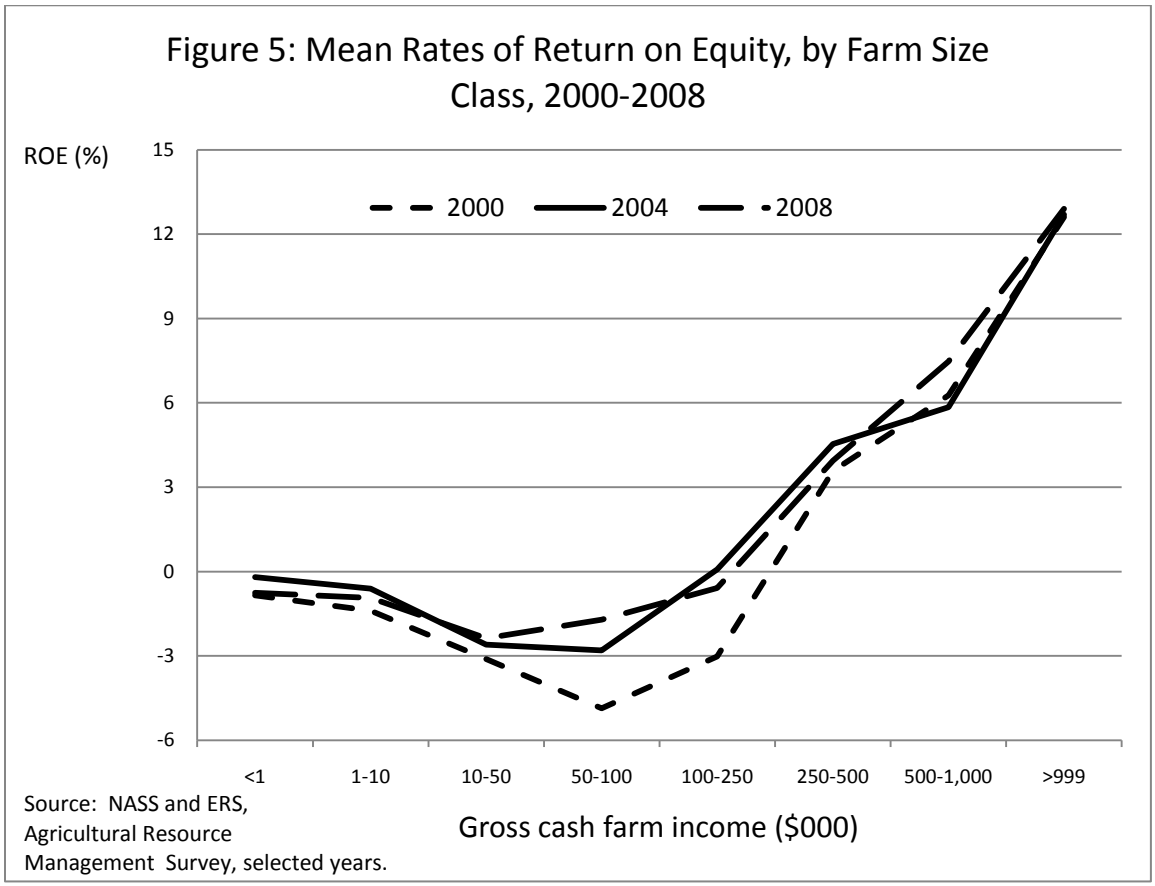
Note: The "cow-weighted median" is the herd size at which half of all milking cows are on farms with at least that many cows and half are on farms with no more. For other livestock, we use sales instead of inventories: half of all sales or removals came from farms that sold at least that many head, and half came from farms that sold no more than that number. For crops, we use harvested acreage: half of all harvested acreage of a commodity was in farms that harvested at least the median value, and half was on farms that harvested no more than the median.

Structural change in the livestock sector is well-known. But production shifted rapidly to larger crop operations as well. The midpoint corn enterprise tripled in size, from 200 acres to 600 acres, between 1987 and 2007. Some of this increase probably reflects the sharp increase in total corn acreage in 2007, and thus a shift away from soybeans, wheat, and cotton. But weighted medians increased by at least 100 percent in each of the other field crops as well. Moreover, fruit, nut, and vegetable commodities show similar patterns—increases in each 10-year time span shown and large overall increases over time. Particularly striking are the shifts in almonds, oranges, bell peppers, potatoes, and sweet corn, where midpoint sizes more than doubled in each case.

What's Driving the Movement of Production to Larger Farms?

Financial performance plays an important role in driving structural change, and farm size and financial performance are strongly related. Farms with at least $1 million in sales earned average rates of return on equity in excess of 12 percent in 2008, the most recent year for which we have complete data, substantially higher than farms in the next largest sales classes, while on

average small farms with less than $250,000 in sales recorded losses (Figure 5). This pattern has remained quite stable over time, and the continued strong size-profits relationship suggests that production is likely to continue to shift to larger farm operations.



Why are farm size and financial performance related? One possibility is scale economies in production that yield lower production costs for larger operations. But the evidence for scale economies is actually rather mixed--strong for livestock production, but much weaker for crops.

Allen and Lueck (2002) argue that technological innovations in livestock production, particularly in poultry, cattle feeding, and hogs, allowed farm operations to escape some biological and seasonal constraints and gravitate toward large-scale, factory-style, routinized production processes. Analyses with ARMS data support their argument: we find substantial scale economies in hog and dairy production, and those economies have been important drivers of the major structural changes in those sectors (Key and McBride, 2007; Mosheim and Lovell, 2009; MacDonald and McBride, 2009). Other ARMS-based research finds that there are continuing modest scale economies in broiler production (MacDonald and Wang, 2010), consistent with the steady shift toward larger enterprises.

But we just don't see the same strong evidence in field crop production. ERS develops commodity cost of production estimates for major field crops, based on ARMS enterprise surveys, and has published analyses of the data in the "Characteristics and Production Costs…" series (http://www.ers.usda.gov/publications/sb974/). The analyses find small cost advantages to size in one case (corn) and no apparent size advantages, once production exceeds 100 acres, in others. These findings are also consistent with prior analyses. Kislev and Peterson (1982), in assessing the large increases in mean acreage per farm that occurred between 1930 and 1970, argued that scale economies were not apparent in contemporary empirical analyses of field crop production, while Allen and Lueck (2002) argued that field crop operations had not mastered the constraints imposed by nature to the same degree that livestock operations have.

However, crop enterprises are growing much larger (Table 3). If scale economies don't account for the shift, what does? ARMS data provide one hint, again drawing on the commodity cost of production data. In 1996, farmers devoted an average of 2.7 hours of labor for each planted corn acre (Foreman, 2001). In the 2001 survey, that labor commitment fell to an average of 1.8 hours (Foreman, 2006), a striking decline in such a short period.

Labor commitments, per acre, are not strongly related to enterprise size—there is little evidence of scale economies in these analyses--but they fell across all sizes of operations between years. The driving forces appear to be the combined shifts toward conservation tillage and genetically modified (GM) seeds; each innovation reduced the number of passes of machinery in fields, and therefore the labor hours needed for field operations.[9] Beyond the short period covered by the comparison, the use of conservation tillage and GM seeds continued to spread, and innovations in machinery reduced the time needed to cover a field of a given size. Farmers could use the saved time for off-farm work, or for leisure, or for expanded farm operations. Today, we see many small field crop operations, whose operators combine off-farm work with the operation of several hundred acres. But full-time farmers can manage much larger operations than they could in the past, and many now do so.

The technological innovations may have affected farm size not by expanding the range of scale economies, but by expanding the range of production that is subject to constant returns.

This shift is consistent with a model of farm size developed by Kislev and Peterson (1982), in which relative factor prices and technological change, combined with a fixed quantity of family labor, could account for growing farm size without reference to scale economies. In this case, the shifts described above could be viewed as technological change that augments family labor hours, and that allows an operator and family to effectively operate more crop acreage.

Key and Roberts (2007) investigate another possible element in farm consolidation: the impact of government payments. They analyzed changes in the weighted median farm size in

[9] Fernandez-Cornejo and McBride (2002) found that GM seed adoption saved farm operators' labor and management time through three channels: adoption reduced the time needed for field operations, allowed farmers more flexible time windows for applying chemicals, and reduced the time needed to spend on planning and decision-making for pest and weed control strategies.

counties and zip codes—at this weighted median, half of a county's farmland was on larger farms, and half was on smaller (obviously, this is most relevant for crop operations). Key and Roberts established that the weighted medians grew substantially over time in most locations, and that rates of growth were closely associated with the incidence of government payments. Specifically, counties with higher levels of government payments per acre had faster growth in this measure of farm size. The association was large and robust, and it also held when measured at the zip code level. Acreage shifted to larger farms in most counties, but the shift was much more pronounced in counties with high levels of government payments per acre.

The authors argued that the association was causal and that the likely avenue of causation was that government payments supported the provision of liquidity and credit: farmers with higher payments could attract more credit for farm expansion. While this explanation helps to explain why farm consolidation might occur more rapidly in some counties, it doesn't really explain why larger operations realize higher returns. Moreover, a weakness of this explanation is that it applies to crops supported by commodity programs, and consolidation appears to cover a much wider range of commodities (Table 3).

We also need to consider factors that may be related both to payments and to changes in farm size. For example, locations with high values of payments per acre also tend to have cropland that is relatively flat and contiguous, which is best suited for the intensive application of large and fast machinery. Thus the innovations most effective in freeing farmers' time for expanded production may have been best suited for these locations.

Structural change is one driver of aggregate productivity growth. According to the most recent USDA estimates, total factor productivity (TFP) in U.S. agriculture grew at an annual rate of 1.74 percent between 1999 and 2008, a rate that compares quite favorably with the rest of the U.S. economy.[10] Where scale economies are important, structural change toward larger enterprises directly increases productivity. For example, Key, McBride, and Mosheim (2008) find that TFP in hog finishing grew by 6.3 percent annually between 1992 and 2004, and that half of that was due to the exploitation of scale economies. Scale economies appear to be less important in crops. Yet many of the innovations that have allowed for increased farm sizes also contribute to productivity growth, through intensified use of labor, capital, and materials, and structural change was the avenue by which those innovations spread through the sector.

International Comparisons of Farm Structure

International comparisons of structure are hard to do. National statistical systems have different farm definitions: some countries include many very small farms in their statistics, while

[10] The data can be found at http://www.ers.usda.gov/Data/AgProductivity/ . For the entire 1948-2008 period, annual TFP growth in agricultural was 1.52 percent (compounded, that amounts to 147 percent more output, for a given level of inputs, over the period). Annual TFP growth amounted to 2.32 percent between 1979 and 1989, and 1.53 percent between 1989 and 1999. For comparisons to the rest of the economy, see Jorgenson, Ho, and Stiroh (2005), chapter 7.

others have much higher production or sales thresholds. As a result, measured mean farm size may differ widely even if the commercial farm sectors of each country are quite similar. Comparisons of dollar sales figures require close attention to currency values, which may fluctuate sharply for reasons having little to do with agricultural production, while comparisons of things like acreage may flounder because of differences in land quality and commodity mix.

We can, however, draw on recently released data from the Brazilian Agricultural Census to compare structural *change* in the U.S. and Brazil. The Brazilian Institute of Geography and Statistics (IBGE) recently reported on a 2006 Agricultural Census, following up on an earlier Census in 1996. We report farm structure data in Table 4, using the same framework as that used in Table 1 for the U.S. Size classes are defined in Brazilian currency—the real, which through 2006 traded at about 2.16 real to the U.S. dollar. Sales in 1996 are adjusted for inflation and reported in 2006 $R.

There were 4.9 million Brazilian farms in 2006, 6 percent more than in 1996, and the real value of sales grew by about 25 percent in the decade. Three structural features stand out (Table 4). First, Brazilian farm structure is highly skewed, as in the U.S. Farms with less than $R10,000 in sales accounted for 63 percent of all farms but just 7 percent of total sales in 2006. Second, what we might think of as small commercial farms—the 1.77 million farms with $R10,000 to $R249,999 in sales—accounted for 59 percent of Brazilian farm sales in 2006. Third, production is shifting, rapidly, to much larger operations. Farms with at least $R250,000 in sales accounted for more than a third of total sales in 2006, up from 11.9 percent ten years earlier.

Table 4: Changes in Brazilian Farm Structure, 1996-2006

	Farms		Market Value of Sales (millions of 2006 R$)	
	1996	2006	1996	2006
Total	4,624,617	4,900,876	44,544	55,982
Sales Class	-Distribution of farms and sales, by sales class (%)-			
Less than $R10,000	74.3	63.5	11.9	7.2
$R10,000-$249,999	25.7	36.1	76.2	59.1
$R250,000-$999,999	0.07	0.4	11.9	22.9
$R1,000,000 or more	0.0	0.02	0.0	10.8
All	100.0	100.0	100.0	100.0

Source: Calculations, by Costanza Valdes, USDA/ERS, based on data from Brazilian Institute of Geography and Statistics (IBGE), Agricultural Census.

Notes: Values for sales in 1996 are adjusted to 2006 dollars.

We have more limited comparative data for three other countries. Recently, under the auspices of the Farm Accountancy Data Network (FADN) and the Organization for Economic Cooperation and Development (OECD), analysts in several countries have begun to develop comparable measures of farm structure. At this time, we cannot make temporal comparisons of

structural change, and are limited to a single year comparison. But the findings so far suggest that farm structure is comparably skewed, with output concentrated in a small share of farms.

The analysts start by defining a comparable cross-country farming universe as the set of farms accounting for 90 percent of agricultural production. Because the U.S. has a very expansive farm definition, the threshold screens out all U.S. farms with less than $71,000 in gross farm income (77 percent of U.S. farms), leaving the 494,680 largest farms that accounted for 90 percent of U.S. production. Call these "commercial farms," for purposes of this discussion.

The analysts sorted each country's commercial farms into four quartiles based on size, as measured by gross farm income, and developed summary statistics for each quartile and for commercial farms as a group (Table 5). Focus on farms in the largest quartile, which in the U.S. included 123,670 farms (one fourth of all commercial farms). Farms in the largest quartile accounted for 61 percent of U.S. gross farm income, and mean gross income among those farms was $1.46 million. Since mean GFI among all U.S. commercial farms was $543,806, the mean farm size in the largest quartile was 2.68 times the mean farm size among all commercial farms; it was 8.2 times the mean farm size ($178,000) in the smallest quartile.

Table 5: Farm Structure in Four OECD Countries

Country	Largest 25 percent of farms (Q4)		
	Q4 share of receipts	Relative farm size	
		Q4/all	Q4/Q1
Canada	68	2.6	11.7
Germany	63	2.5	12.9
Netherlands	59	2.3	9.3
United States	61	2.4	8.2

Notes: to facilitate comparisons across national statistical systems, analysis is limited to largest farms accounting for 90 percent of farm production. Within that group, farms are sorted into four quartiles according to size, with Q4 containing the largest 25% of farms

What's interesting about the international comparisons is that these simple measures are quite similar across the countries who have reported so far (Table 5). For example, the largest quartile's share of gross farm income ranges from 59 percent (Netherlands) to 68 percent (Canada), and the ratio of mean farm sales in the largest quartile to that of the sample mean ranges from 2.3 to 2.6.

Organizing Large Commercial Farms

Large commercial farms in the U.S. are tightly held businesses. Most are still family farms.[11] Most non-family farms are owned and operated by a small number of unrelated people, organized into partnerships or small corporations (Hoppe, Korb, and Banker, 2008). This feature distinguishes agriculture from other U.S. industries.

Tightly held businesses can respond nimbly to changing markets, weather, and technologies, and operators have powerful incentives to operate efficiently. While such farms can be large enough to take advantage of the economies of scale that do exist in agriculture, accessing capital for growth can be a challenge, and the shifts in farm and enterprise size noted above, combined with asset price increases, have substantially increased the total capital investment required in commercial farm operations.

With Corn Belt cropland selling for $4,000 an acre, a farmer aiming to produce 600 acres of corn and 500 of soybeans, close to the weighted medians in Table 2, would face a fixed capital requirement of nearly $5 million for land, equipment, and structures. A dairy farmer with a herd of 1,000 milk cows, large enough to realize most economies of scale, and who also produces some feed on-farm, will likely need to assemble about $7 million worth of livestock, land, buildings, and equipment.[12] The farm-level investments required for a poultry or hog enterprise can require capital investments of $500,000 for small-scale entry (two houses), and considerably more for a producers who wish to build 6, 8, or more houses. Those who also intend to produce crops (for which the manure will provide fertilizer) also need to assemble the land and equipment for a cropping enterprise.

Several features of agricultural production ease access to capital. Farmers rent cropland, and share equipment with others by renting, or by either purchasing or providing custom services. In 2008 ARMS data, farms that produced between 800 and 1500 acres of corn and soybeans rented half of their cropland, on average, and 64 percent shared equipment through rental or custom service purchase or provision. Dairy farmers with herds of 500-1500 head rented nearly half of their land, and over 90 percent shared equipment through at least one of the three channels noted above.

U.S farmers also use production and marketing contracts to manage risk and capital needs. By obtaining a production contract with an integrator, hog and poultry growers can obtain loans from banks for the construction of the houses. They can also apply their own resources to other farm enterprises. Larger farms are considerably more likely to use contracts than smaller farms, and recent ERS analyses show that farms with production contracts were able to grow more rapidly than those that did not, suggesting that contracts provided a channel for accessing capital (Hoppe, Korb, and banker, 2008; Key, 2010).

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[11] Defined by ERS as farms on which the primary operator, and people related to the operator by blood or marriage, own more than half of the business.

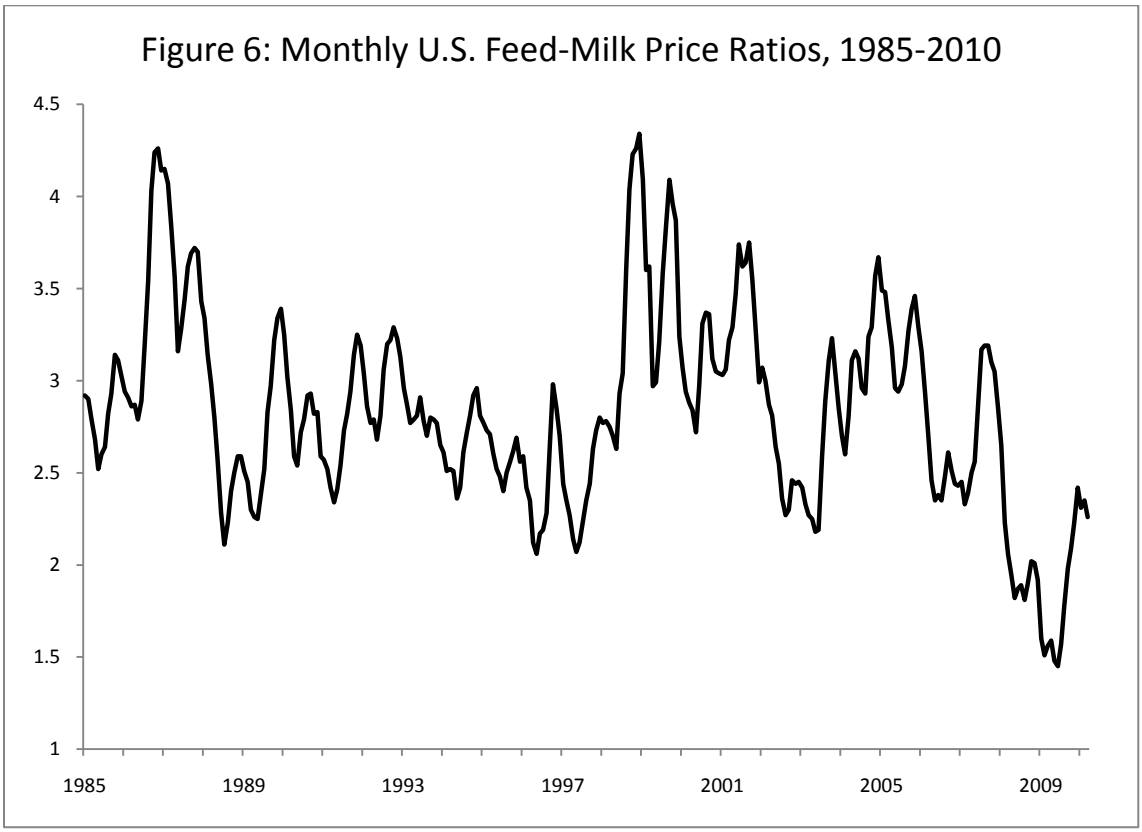
[12] These estimates are drawn from asset values reported in the 2008 Agricultural Resource Management Survey, as are the data on accessing capital.

The Financial Crisis, Commodity Prices, and Livestock Operations

ERS estimates that net farm income fell by 20 percent in 2009, and forecasts a modest recovery—up 11.8 percent--in 2010 (http://www.ers.usda.gov/Briefing/FarmIncome/). Prices for livestock animals and products fell in 2009 while crop prices declined from 2007-08 peaks. The severe recession cut demand for some protein foods and off-farm income for many households. Moreover, the broader financial crisis affected some major agricultural lenders, and limited some lending, while farmland prices began to fall in 2008-09, after strong gains for many years.

Evidence through 2009 shows little sign of liquidity problems in the sector: on the whole, debt loads remain low relative to asset values, and servicing requirements look manageable. However, financial performance varied sharply across commodities. ERS reports that net cash income for all farm businesses fell by 10.6 percent, on average, in 2009, but it fell by 82 percent for dairy farms and 52 percent for hog farms (Harris, et al, 2009). Dairy and hogs are the sectors with the most dramatic recent organizational and structural change, and they are more heavily leveraged than other agricultural sectors. Financial pressures there could have an outsize impact on organizational forms, contracting, and structural change in the future.

The 2008-09 price movements are at the heart of their current travails. With milk prices falling rapidly from a 2007 peak, and feed prices falling off slowly, the ratio of milk to feed prices fell from 3.19 in the summer of 2007 to 1.45 by June of 2009 (Figure 6). Feed price ratios also fell sharply for hogs, as demand declines led to sharp hog price declines in late 2008.



Growers with hog production contracts are largely insulated from price movements, but independent growers and integrators faced the full brunt of adverse hog and feed price shocks. Five large integrators in North Carolina, including the 22nd and 25th largest in the country, filed for bankruptcy during 2009, and their contract growers (over 100 each in the case of the largest failures) were then left without hogs, or fee revenue, for their houses.[13] Most contract hog producers, particularly in the Midwest, operate diversified farming operations and therefore could generate earnings from crop production. But integrators tend to be specialized businesses.

Dairy farms accounted for 8.5 percent of all farm cash receipts in 2009--but held 12.2 percent of farm debt and 20 percent of non-real estate debt. With the sharp decline in cash incomes, some faced severe liquidity problems. Vreba-Hoff, a company that develops large-scale dairies, ran into financing problems, leaving clients with unfinished farms and bankruptcies (Etter, 2010). One of the company's primary lenders halted a program to finance large dairies, and instituted foreclosure proceedings against 8 farms sponsored by Vreba-Hoff.

The poultry industry faces an aging stock of housing as production growth rates declined after 2000 and then went negative in 2009 (MacDonald, 2008). Housing is one important channel by which innovations are spread in the industry, and the industry may need to adjust production contracts to encourage more replacement investment. Faced with growing capital requirements, more operations may seek wider equity participation in different farm assets.

Conclusions: Structural Challenges for the Future

Start with several well-known points. First, continued economic growth in China and India, with associated dietary changes, will have major impacts on production and trade of feed grains, oilseeds, and livestock products. Second, we are likely to see significant expansions of soybean and poultry production in South America, particularly in Brazil. Third, the growing global network of production and trade in horticultural products is likely to continue. Each development will lead to expanded opportunities for agribusiness firms in the financing, production, or marketing of agricultural products.

The projections that underlie the above points make several strong assumptions. In particular, note the current USDA baseline projections for yield growth, cited in figures 3 and 4. U.S. projections match historic growth rates, but those for other major producers are quite modest. Most of the expansion in Brazil and Argentina is driven by projected acreage expansions. The USDA projections call for Brazilian soybean yields to expand by 9 percent over the next decade, consistent with yield growth during 1995-2006, but well below growth rate prior to 1995. Yield growth projections for Brazilian corn are well below historic patterns. Higher than projected South American yield growth will affect world prices and production projections. There have been substantial expansions of public R&D support in developing countries,

[13] Similar challenges faced broiler growers. Production in 2009 fell 4.5 percent, after average annual growth of 4 percent for the previous half-century. Since growers are insulated from price risks, growers who received birds were unaffected by the downturn, but some were left with significant production and therefore fee revenue shortfalls.

particularly in Brazil, and these investments could lead to improved yield growth, along with downward pressure on world prices, in the decade ahead.

There is a second major uncertainty to the USDA projections—macroeconomic policy in China, and in Asian countries generally (Wolf, 2008). They are currently running large current account surpluses, offset at the global level by deficits in the US and, to a lesser extent, the UK. In China alone, it appears that savings (household and government) accounts for 60 percent of GDP. At the margin, investments from those savings, in US securities, appear to have very low returns. Analysts disagree about the continued sustainability of the current pattern of global imbalances, but the effect of the policies is to allow the US and UK to consume substantially more than they produce, while limiting consumption in Asian countries. A modest relaxation of Chinese policy, leading to greater consumption by Chinese households out of national income, could lead to substantially greater dietary changes than are currently forecast, with attendant consequences for global meat and feed grain production and prices.

If we are to sustainably meet projected long-term increases in feed and energy demand for crops, we will need continued long-term growth in productivity—through yield gains, livestock feed conversion, and post-harvest retention. There is currently a lively debate in the U.S. on agricultural productivity. Some argue that growth has slowed, the result of slackening public R&D expenditures in the last two decades, and that these trends bode ill for future productivity growth (Alston, Beddow, and Pardey, 2009). Should U.S. productivity growth slacken, yields are likely to fall below those assumed in the projections, with significant impacts on commodity prices and land use. But there's no consensus on this point. While year to year fluctuations in measured productivity growth make for noisy data , USDA productivity indexes do not show a slowdown through 2008 (http://www.ers.usda.gov/Data/AgProductivity/) . This issue will be of growing public and academic interest.

The financial crisis and recession followed upon years of powerful structural change in U.S. farming, in which production shifted to larger farms, and capital requirements for those farms expanded. Farmers accessed capital through savings, debt, and a variety of contractual relationships. That structural change likely fueled some of the continuing growth in U.S. agricultural productivity.

The feed and livestock price fluctuations of 2006-2009 were driven by sharp changes in energy prices, sudden shifts in international demand occasioned by income and exchange rate fluctuations, and weather-related supply disruptions. There is little reason to believe that these factors will abate in the future. At the same time, economies of scale in livestock operations appear to be real and substantial, while large-scale crop operations offer substantial cost advantages from the opportunity to use fixed resources (principally, operator labor) intensively. Each requires substantial capital investments to realize. In short, there are still strong economic reasons to organize large family farms, and for production to continue to shift to them. But a key question is how to organize and finance those operations.

Producer and government groups will likely seek some important changes in farm policy during upcoming farm bill debates, as they seek ways to adjust to the particular price and liquidity risks apparent in the current environment. They will be doing so in a difficult funding environment as the federal government faces the challenge of unwinding large budget deficits, and with a growing number of stakeholder groups seeking support.

But we are also likely to see widespread interest in, and experimentation with, different ways of writing contracts and accessing capital. Some livestock contract parameters, in both marketing and production contracts, may no longer work effectively in a world of higher and fluctuating feed and energy prices. Contract terms may need to be adjusted if contractors are to continue attracting growers, and we are likely to see continued experimentation with alternative strategies for assigning expenses and designing compensation among contractual parties.

Regarding access to capital, we are increasingly cognizant, in our farm surveys, of alternative housing finance options used by poultry and hog growers: some integrators finance housing investments by growers, some own the houses on a grower's land, and some work with third parties who own the houses and receive rental payments from growers or integrators. As the capital needed to take advantage of scale economics in livestock production continues to grow, we may see more such examples of shared equity stakes throughout agriculture. More broadly, we are also seeing more complicated ownership and management structures for large family farms, with non-operator equity and resource providers, the sharing of assets and services among farms, and complex contractual relationships with input suppliers and with processors. Recent events will likely spur greater interest in such structures.

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Industry Panelist

Transcript

Wesley Batista, President and CEO
JBS Swift, USA

I would like to thank the Federal Reserve Bank of Kansas City for inviting JBS to be here. I really appreciate the opportunity to share our views with you and to discuss our sector. Thinking back about JBS and what JBS is and what we do, JBS started 57 years ago. JBS primarily was a beef company, which started in Brazil.

Over these past several years, we became a meat company. Today we operate in beef, poultry, and pork segments and also in the lamb business. We operate in Brazil, Argentina, Uruguay, and Paraguay. We have operations here in the United States, as well as Mexico, Italy, Russia, and Australia. Today we have many investments in United States. In these last 20 years, we invested over $5 billion in the United States. Our operation today here includes beef, chicken, and pork, and also lamb. We have over 70,000 employees in the United States. Worldwide, JBS has 125,000 employees.

We have been expanding our business in countries that are, in our view, the countries that already lead meat production globally and will continue to be the leaders of meat production. That is South America and North America, so we have been investing in these countries and in these regions, believing we will continue to see growing production for meat in these areas.

And, in other countries also, we have already seen meat production growing. What we are seeing and what we think is happening in the meat sector is when we see consumption growth globally and GDP growth increasing globally also. In our view, in the 1950s, 1960s, 1970s, and 1980s the growth was in North America, Europe, and Japan.

In these last 20 years, we are seeing a big change and in our view this is a fundamental change for all of our business. We are seeing very strong growth in the emergent markets, like China, India, Brazil, and Russia. Brazil – we are from Brazil, a country with 200 million people – has a growth forecast for this year of 5 to 6 percent. China is close to doubling its growth for consecutive years.

In all these countries, this kind of growth is changing the dynamic of all of our business. Feeding people in these countries will increase when they increase their income power and they will improve their diet. This is the first thing to happen. So it is directly related to food consumption.

It is different in the United States, in our view, in our sector for beef, pork, poultry, or lamb. In our view, U.S. GDP can grow 5 percent and we will not see a big meat consumption increase, because people already have a strong and very high per capita consumption in countries like here. The same thing goes in Europe. And we are seeing this when we look at the last 10 years. In Europe meat consumption is flat, but in the United States meat consumption is up 5 percent. In Africa it is up 70 percent. In Asia and the Middle East, it is up over 40 percent. In South America, it is up 37 percent. So we are seeing a very, very strong growth in meat and we believe we will see food consumption increase overall. I used to say about countries like Japan, the United States, or Europe, if the country is growing and if the economy is going well, people buy more cars, more homes, and more durable goods. But specifically, the basic demand for food doesn't change a lot.

This is a fundamental change that we are seeing in our sector and we think we'll see this in these coming years. Even China perhaps will not grow 10 percent in the next five years. Maybe China needs to change, but China will continue to grow. In Brazil, we will continue to grow. All these countries will continue to grow at an important level.

When we see supply, we need to remember that as an example in our sector – cattle – the business cycle in cattle is very long. If demand is very, very strong, for this year or for 2011 or even for 2012, we'll not see beef production increasing. Because to increase beef production is to retain cows, to grow the size of the herd for three or four years or longer to start to produce more beef.

Poultry and pork cycles are shorter, so we can see more of an increase and we think we will see them and we will need to increase production in poultry and in hogs to support the increase in worldwide demand. We are very optimistic about our sector. We are very optimistic about the livestock sector. We think farmers will make money. Of course, we saw some tough years, but we think farmers will make money. Hog, cattle, and poultry producers will make money, because demand will be strong. So we are optimistic.

In our sector also we are seeing strong demand. Every day, the United States will play a very, very important role in our sector. We believe we will see exports from the United States growing over time. As an example, we have been seeing a lot of comments from Russia, that Russia has a plan to be self-sufficient in hog and poultry production. We think we'll see Russia definitely increase their production, but it will not be enough to offset their growth. The United States will continue to increase their presence in the beef sector to supply and to support global growth.

Thank you. I am glad to be here. Are there any questions?

Industry Panelist

Agricultural Innovation in the 21st Century: The Optimistic Science

James C. Borel, Executive Vice President
DuPont

Good afternoon. I would like to thank members of the Federal Reserve Bank of Kansas City and the organizers of this panel on "Reshaping Global Agricultural Production." I appreciate the chance to be here today.

As you all know, economics is often called the "dismal science." Perhaps the most famous example came when the Reverend Thomas Malthus said that the human race would face horrifying starvation as the growth of population inevitably exceeded the growth of our food supply.

He was wrong. Instead we have produced more food, for more people, and we have done it with less. Agricultural productivity has increased by almost any measure you care to use. And it was enabled by science – science that led to the creation of hybrid corn, for example, by Henry Wallace, the founder of DuPont's Pioneer Hi-Bred business. Or the science that Norman Borlaug deployed to power the Green Revolution that saved an estimated one billion lives. Or the science of modern farm equipment that enabled farmers to till more acres in less time and with less labor. And all of this science originated from creative individuals or groups and was put to use by innovative farmers that recognized that progress requires change and adopting new approaches. As we look back from the time of Malthus to today, the progress the world experienced demonstrated agriculture's ability to grow more than many (but fortunately not all) had thought was even possible.

So, I think of what we do in agriculture as the optimistic science. The science in which my company invests over half of our $1.4 billion annual R&D budget to increasing global food production. That includes developing better seeds that produce higher yields, discovering better products for controlling crop pests and providing food ingredients that benefit consumers.

<u>It's the science of growing food.</u>

Today, the science of growing food combines advances in conventional breeding with innovations unleashed through the advent of biotechnology and advanced processes that build

more robust seeds. And, like all science, the science of growing food depends not just on the advance of knowledge; it depends on the efforts of people.

My purpose today is to explain the reasons that we should embrace an optimistic vision of science in agriculture. And then shape our efforts – private and public, local and international – to make it so. Through global collaboration and innovation, we can increase the future productivity of agriculture even more than past history would suggest. We can meet the world's demand for more food – and we can do it while improving consumer benefits and raising the standards of environmental stewardship. And, with that, we can avoid catastrophic hunger and all that it brings, including civil unrest. We can empower farmers to be productive in all parts of the world. In short, we can set the stage for the next agricultural revolution.

We know the need is great. In the year 2011, our global population will exceed seven billion people. And it won't stop then. By 2050, the globe will be home to nine billion people.[1]

Two centuries ago, Malthus was wrong, but he wasn't asking the wrong question. The question today is how we will feed nine billion people. The answer is clear: Only by nearly doubling food production – and ensuring that the food is available to the people who need it.

Success in this endeavor will require new and sustained levels of "innovation" and "collaboration" by and among all of us in the global food system. With collaborative ingenuity, I'm confident we will build the solutions that will surpass current agricultural trendlines.

But there is, of course, a big "if" – actually a series of "ifs." We can meet the global challenges of food only if we embrace contributions from all sources, if we empower collaboration, if we ensure that farmers can choose the seeds and other products that work best for them, and if we enhance the ability of farmers in all parts of the world to be as productive as possible.

In the next few minutes, I would like to share my thoughts on how this can be done. Starting, first and foremost, with the people who farm our land.

I. Farmers are the original innovators

I grew up on a farm in Iowa. To grow up in a farming community is to understand the character of farmers. Sometimes I hear farmers described as risk-averse. That wasn't what I saw in the people around me. Careful or cautious, perhaps, but not risk-averse.

You can't be risk-averse and borrow a lot of money to put the crop in the ground in the spring on the belief that you'll make it back, and a profit, when the harvest comes. Successful farmers combine equal parts of effort and experimentation – they innovate.

[1] United Nations, World Population Prospects: The 2008 Revision

That's why farmers need the practical freedom to be creative, to choose the seeds that will work the best for them, in their soil, with their growing conditions. Whether it's a farmer in central Iowa with 1,000 acres of corn, or a small farmer in the Philippines with half a hectare.

And the success of even one farmer starts a virtuous cycle of innovation. A cycle that is not, and Dr. MacDonald's paper is very insightful on this point, dependent on the size of a farm. Better seed improves productivity on farms of all sizes. That's a great advantage because it means that innovation in seed can be useful to all farmers, everywhere.

But first, we need to get the economics right.

II. Economic trends in agriculture favor innovation

No one understands the nature of supply and demand better than a farmer. Produce more than the market wants, and prices go down. Produce less and prices go up. Produce too little and total revenue declines. Innovation that boosts productivity might, therefore, be seen as bad for prices.

I don't believe that is true because demand is on the rise. Not only is the global population growing, the composition of global demand is changing. Most of our population growth occurs in less economically developed places. In 2005, for instance, we added about 81 million people to the globe and about 79.5 million were in the developing world. Urban places are growing especially quickly.[2] And the rising income in countries like India and China drives demand for more protein in the diet, which in turn demands more grain. In addition, the need for energy, and energy security, is increasing, and agriculture can be an important source of renewable energy. These are all fundamental drivers of demand and there is no reason to believe that they will slacken.

Greater agricultural production will not, therefore, automatically result in lower prices. In fact, we need to drive production increases to avoid price spikes like we saw in 2008. Think about corn prices in the United States over the past century. From an average of 65 cents per bushel in the opening years of the 20th Century, we have reached a plateau, from 2007-09, with an average price of about $3.95/bushel.

I believe that we have reached a new plateau of pricing and that the long term trends of growth in population and per-capita income will continue to support agricultural demand.

[2] Population Reference Bureau, 2005 World Population Data Sheet; United Nations Food and Agriculture Organization, The Importance of Food Quality and Safety for Developing Countries

The result favors innovation. Increased demand and the current level of pricing will act as a strong driver of improved agricultural productivity.

And greater productivity is on the horizon. For example, the National Corn Growers Association holds annual yield contests. Already the top yielding hybrids deliver more than 300 bushels/acre[3], compared to the record average yield today of about 165 bushels. Perhaps more importantly, we are working toward doubling the rate of genetic gain before the end of this decade using new breeding and biotechnology tools. What's true for corn is also true for soybeans – another of the mainstays of production agriculture. In other words, current projections and estimates based on historical data do not account for our changing world dynamics and the corresponding increase in demand or the impact of emerging technologies. The economics, in other words, support innovation.

III. Agriculture may be the Biggest Innovation Challenge of the 21st century

Agriculture may just be the biggest innovation challenge of the 21st century. But consider the magnitude of the challenge. To double agricultural output by 2050 is daunting. But that is not all. Today, about one billion people – roughly 14 percent of everyone in the world – live in hunger.[4]

In a world of global trade and agricultural exports, it may come as a surprise to know that 85 percent of all food never crosses an international border.[5] That means that the bulk of food to feed the hungry needs to come from the place where the hungry live.

This does not detract, in any way, from the importance of international trade. U.S. agricultural exports are strong and they must remain strong to meet global needs. But they are not enough.

Indeed, the geography of agriculture is too-often overlooked. We speak of the looming food "gap" between production and population. We don't speak enough of the potential "mismatch" between the location of production and the location of people. Food only feeds those who have access to it and the income to afford it. The potential for an agricultural "mismatch" can only be cured by encouraging all productivity, by ensuring that food flows freely across the globe to places where it is needed and that economic growth supports both local production and the purchase of imports. That will call for changes in trade policy, food aid policy, international development policy and many others.

[3] National Corn Growers Association 2009 Yield Corn Contest
[4] United Nations Food and Agriculture Organization
[5] United Nations Food and Agriculture Organization

In other words, the innovation challenge can be summed up in two principles: First, we must produce more, everywhere, in increasingly sustainable ways. Second, it must be available – truly available – to those who need it.

How can that be achieved?

On the science side, today, seed companies use a sophisticated toolkit, combining advances in genetics to continuously breed better germplasm for diverse conditions; technological advances in biotechnology to incorporate new plant traits; and advanced processes to build the robustness of crops. The results include:

- Greater Yield: Biotechnology tools used to accelerate plant breeding progress is beginning to accelerate the rate of genetic gain. Additional biotech traits, especially in certain combinations, can boost yield. For example, combining our Optimum®GAT® trait in soybeans with the traditional glyphosate resistant trait provides a six percent increase in yield over today's commercial varieties with Roundup Ready® alone. That would be worth more than $2 billion of increased productivity annually for U.S. soybean growers.
- Benefits to Consumers: This week, we received USDA deregulation for a new trait called Plenish™ high oleic soybeans, which offer benefits to consumers and the food industry and industrial sector, in turn providing increased value to soybean farmers. Plenish™ offers a soybased solution to the trans fat challenge with approximately 75 percent oleic content (the highest of any soy product under commercial development), 20 percent less saturated fat than commodity soy oil and 75 percent less than widely used palm oil.
- Environmental Sustainability: We are using our improved genetics and biotech expertise to develop drought tolerance, nitrogen use efficiency and new forms of insect and disease resistance.
- Combating New Threats: Combining different biotech traits in a single seed can allow farmers greater flexibility in the use of herbicides – an important way to combat the rise of weeds resistant to Roundup® herbicide, or "superweeds," as the popular press refers to them.

But I believe we must look beyond even these achievements. Because innovation requires collaboration – the ability to harness our collective ingenuity and resources. A single plant, a single farmer, even a single computer, makes for very small advances. A field of plants, a community of farmers, a network of computers creates new forms of value and boosts economic productivity and growth.

So what does collaboration look like in agriculture? It begins, of course, with incentives – chief among them are intellectual-property rights and open, competitive markets. The right incentives not only encourage single companies to invent, they encourage companies to share the benefits of their inventions with each other. Intellectual property rights ensure inventors that they can work with others without fear of losing the legitimate advantage of their invention. For example, Argentina is a nation where greater protection of legitimate intellectual property rights would lead to greater productivity, as more technologies would become available.

Open, competitive markets mean that inventors can reach customers with new innovation. That requires both domestic competition policies and, of course, an international emphasis on enabling trade. With the right mechanisms in place, seed companies will be able to "build" the seeds that have the best combination of components for their customers.

Collaboration also works between research universities and seed companies. The important research done in universities can be invaluable in finding new approaches to seed technology.

Farmers play a critical role themselves. Choosing the best seed for their farm, while broadly encouraging better farming practices and better governmental policies.

And new types of collaboration are forming between foundations, governments and private companies with an aim to accelerate the deployment of key technology advances to regions where the markets today are less developed, but where advances like these could help prime the pump of both agricultural and economic development.

Innovation is not "wishful thinking." Think of the history of American agriculture – a legacy of experimentation, creativity and education. Diversity of plants. Breeding of crops. Competition in the market.

Or consider the Internet. From computing advances and better networks arose a global ecosystem of Internet innovation. One that has combined intellectual property with a global impulse for creativity and, of course, increased economic productivity and growth.

Agriculture can prosper in the same way. With collaboration, access to capital (and the intellectual property rights that make that possible). With smart governmental policies, ranging from agricultural extension to trade to wise monetary policy. With substantial commitments of R&D from businesses that take risk in order to achieve reward.

IV. Conclusion: Harnessing the Creativity of Collaboration

All of this explains why I believe that farmers will rise to the challenge of producing enough food for the world, growing economies here and around the globe in the process.

With collaborative innovation as our touchstone, American agriculture can:

- Employ biotechnology, conventional breeding techniques, and biological diversity to stay one step ahead of weeds resistant to Roundup® herbicide and similar challenges from Mother Nature, so long as we ensure that we are not "locked in" to a single approach;
- Improve yield per acre substantially with new combinations of technologies making new seeds;
- Develop "output" traits benefit consumers and, with it, the value of crops;
- Use fewer natural resources, while growing more, including biofuels; and
- Foster local farming in virtually all parts of the world.

And we can do one other thing. We are a nation of rising expectations and, as the global population soars, those expectations will be shared by the bigger, more urbanized, more economically-developed nations of the world. Will there be a rising tide of expectations along with the rising tides of population growth and urbanization? Yes, there will be. And I believe that the creativity of collaboration is also the way to surf that wave – because collaborative innovation encourages not just the designs of a few but the contributions of everyone, everywhere.

Thank you.

General Discussion

Reshaping Global Agricultural Production

Mark Snead, Moderator
Assistant Vice President and Denver Branch Executive
Federal Reserve Bank of Kansas City

Mr. Snead: It is obvious in the data, economies of scale are critical. You also mentioned technology and you said it was in the full paper. Could you talk a little bit about the role of technology in the shift in the data?

Mr. MacDonald: The striking thing to us is over the years we've done a lot of cost of production studies, as they are called, for crops. Our support from Congress in our data focuses on program crops. So we are talking about field crops largely. The striking thing to me is we don't see very large differences in our estimates of cost per bushel of production when we look at corn, soybeans, cotton, and sorghum production. Nevertheless, we see very strong shifts to larger operations.

What we see is substantial declines in the number of hours per hundred acres that operators have to apply to that. We see that occurring no matter what size a farm is. We think it is being driven by shifts to conservation tillage; it is being driven by shifts in corn, soybeans, and cotton to GE seeds; and it is being driven by shifts to larger, faster, and more effective pieces of equipment.

All of those mean technology is giving you a fixed input – farmer's labor versus full-time farmer or the equipment that can be applied to a much larger operation. My reading is that is a technological force, separate really from scale economies because we don't see it showing up as fewer hours per hundred acres at smaller farms than at larger ones. It gives more hours for a particular farmer to apply to more acres. This is actually consistent with a fair amount of both historical theoretical and empirical work in the agricultural economics literature. There may be others, but those are three types of driving forces that particularly in the crop area are driving shifts to larger farms and basically allow operators to manage a much larger operation.

Mr. Hollon: Good afternoon. My name is Elvin Hollon and I'm with Dairy Farmers of America. I enjoy hearing both of the USDA MacDonalds speak frequently. Your statistic on 70+ out of 80 commodity groups showing dramatic shifts from the larger scale and size and the ongoing probe of the Department of Justice of everything agriculture: Do they read your stuff?

Mr. MacDonald: Yes. I've moderated a couple of their panels. They read my stuff. Pretty much every day I talk with them. I act as the USDA liaison to the DoJ in this work for data anyway, not for policy.

Mr. Hollon: So it shouldn't seem odd to them that agricultural entities, producers who are getting larger and larger and want to go to the market, ought to look at structures to market that are larger and larger?

Mr. MacDonald: Let me step back a little and give you a quick background on where that is. There are a lot of markets in agriculture, right? It's a big complex place. A lot of those markets, particularly on the buying side, are highly concentrated – two, three, or four buyers. Concentration doesn't mean a violation of the antitrust laws, but violations are more likely to occur in highly concentrated industries. In addition, there are a lot of really distinctive business relationships in agriculture that don't appear elsewhere. Production contracts are one I point to specifically.

As background, the DoJ has run workshops like this in the past for a variety of areas. This one is different in that it is much larger. Those previous workshops are a day or two with a small room of experts in Washington. These are five days around the country with rooms of 700 to 800 people.

Part of what is going on is learning about the business. There are very few people in DoJ who actually understand much about the agriculture business, so part is learning that. Part of it is trying to explain what antitrust violations are. There are plenty of things people are angry about that may actually be cause for regulation or not, but they are not antitrust violations. So the second part of that is in a sense communicating to that broader public.

I will leave it at that. I would view it naively and believe it to be accurate. It really is obtaining information about agriculture and that is what will be going on in the next few sessions. The next one is in Madison at the end of June and we'll field a lot of dairy farmers there.

Mr. Hollon: Some of your statistics may make it into that particular session.

Mr. MacDonald: They could.

Mr. Boehlje: Mike Boehlje at Purdue. I wanted to ask you, you showed the return on equity as a function of size and I believe your dataset also shows what happens to debt utilization as a function of size. Can you summarize for me what you recall about the debt-to-asset ratio or something about that? What I'm looking for is this issue of increased vulnerability, or lack thereof, as we go to larger-scale operations as a function of utilization. The industry average is less than 10.

Mr. MacDonald: There are two things I would say about that. One is on the use of debt. I don't believe one should start looking at, say, commercial farms of $150,000 or above so something jumps out of the data at you relating debt usage to size. It does, when you break it out to particular commodities. So you will see dairy and hog farms with a lot more debt exposure, than you will see other types of large operations.

That leads to the second thing I want to point out, which is also a useful thing to say about that chart. What I showed you in that chart was a mean. I'm sure you guys are well aware of a lot of variance around that mean, as well. Part of my answer to Mike was, "If I look at the big ones, the variance comes in on the top side when I look for credit for dairy and hog users."

I would encourage you to dig into that more, because that really is a goldmine (it could be a minefield too), with a lot of useful data on debt and credit conditions. That's my quick summary and I am not the guy who prepares this credit report.

Mr. Teagarden: I'm Matt Teagarden, Kansas Livestock Association. Maybe a follow-up to the first question relative to the competition workshops: Part of that discussion is some kind of restriction or limitation on contracting, whatever contracting might mean. It might mean different things for different commodities. In your opinion based on what we talked about, the increased capital requirements for the types of operations we have today and the reliance on those types of operations to produce the volume of food we are producing today, can you comment on the impact on our ability to continue to produce that volume of food if contracting is limited or restricted?

Mr. MacDonald: That covers a lot. Let me say two things. One of the key elements if you're looking at an antitrust case on business practices, whether it's contracting for livestock or contracting for seeds, the focus for an antitrust investigation is whether that practice restricts output, drives up prices, and creates market power. The challenge, particularly in any business practice case, is those practices may be efficiency-enhancing. That is basically what the information search is about, whether you are doing these workshops or whether you actually go to court. If the antitrust division is attempting to get rid of a particular business practice, the whole focus of the argument is going to be on whether it restricts entry, raises prices, and even restricts innovation or whether it is efficiency-enhancing.

I would say the first workshop in Iowa, where there is a significant focus on production contracts in hogs, was really fascinating. There was a great deal of information there about what actually goes on in contracts and what you want them to do for you. It worked as a really nice educational tool for a lot of the DoJ people who were there.

One other point I should add, though. DoJ views itself as an advocate for competition. Another part of these workshops is to focus on other areas of law and regulation that don't have

anything to do with antitrust. Some of that actually focuses on USDA and GIPSA (Grain, Inspection, Packers and Stockyard Administration) rules. I suspect if there were contract regulations that come out of this, it'll go through GIPSA, that is, USDA and not the Department of Justice.

Audience Question: Mr. Batista, I am fascinated by your operations around the world. How do you deal with government regulation of slaughter procedures, grading, inspection, and then what are your thoughts of country-of-origin labeling?

Mr. Batista: We follow each country's each government, each regulation. We think some countries have some strong things, but some weakness. We need to respect regulations when we operate in Brazil, Brazil has their regulations and when we operate in the West… Of course, as an industry, we would like to have a presence and to have a voice of our industry to express our view. But, in the end, it is what it is and we need to work and compete with the regulations that are in front of us.

About country-of-origin labels, there has been a big discussion in our sector. Overall, my view is I see how consumers look at this. I have a big doubt if consumers are… We'll give attention to it, because at the end of the day, if it is Canadian beef or if it is U.S. beef, I am not sure if this will change consumers' perception. For me, this is the most important thing. If it's Canadian, U.S., or any beef, it doesn't matter in my view where it comes from. What matters is the quality. What are you looking for? If you are looking for the type of product, you can find in U.S. beef. If you are looking for a different kind of product, maybe you can find it in Mexican beef. For me, this is the most important thing.

Mr. Snead: Mr. Borel, m question is, can you maybe put your finger on one or two of the most important upcoming technologies and how they might reshape agricultural production and, if they are proprietary to DuPont, feel free to discuss those as well. [laughter]

Mr. Borel: I'll talk about two briefly I believe are known. We've talked about them publicly before. One is drought tolerance in corn, particularly, and maybe we should refer to it as "water utilization." As we learn more about the plant and are able to help the plant manage water better, that is not only going to help farmers in drought-stressed areas receive more consistent yields, but what it will do is allow farmers in places where they don't grow corn today have a much more competitive crop. While our focus at the beginning is going to be helping drought-stressed areas, I would not be surprised at all with this. In fact if you think about our conventional breeding over the years, corn is being raised farther west and north than we remember when I was a youngster. That is primarily because of finding the genes through normal breeding processes. What has happened with the new technology is we're speeding up that process and bringing it to market faster. That is in the United States.

But, if you take that same thing and take it to India, Africa, and places where water is a real problem, we are excited about a project we have with the Gates Foundation around some of these types of things, where we work together with collaboration as I described it. To get some of these technologies put to use in places where the market today might not justify the investment, but you know the technology can have an impact.

The second one I mentioned is nitrogen-use efficiency. It is in early testing. It will be another four or five years before things are on the market. In tests so far, we are finding up to 30 percent reduction in nitrogen and still getting the same yields per acre. We have a bigger issue in the Gulf right now. But, when you think about nitrogen runoff, if we can help farmers get better use of the nitrogen they put on and have less of it lost into the environment, that is a huge thing. It is one of the most expensive inputs farmers have, as well.

Those are a couple we are excited about.

Mr. Lorger: Gary Lorger, retired small business owner. Do you have a concern about intellectual property rights in an open market? I am specifically thinking of economies such as China.

Mr. Borel: Certainly. When you invest as much as we do in research, intellectual property protection is really critical. At the same time, different countries are in different places around the world. China is a concern. They have moved toward intellectual property rights. They have a patent law in place. They are moving forward on those fronts. But we are very careful.

You can't just count on the Rule of Law in all countries around the world to protect intellectual property. So we have additional processes to make sure we know what technology we are taking in and how we manage that. To be frank, in countries where intellectual property protection isn't as strong, oftentimes the technology doesn't get there as quickly. Good intellectual property protection is a very important piece of the puzzle for us as a society to solve the problem we are talking about on feeding the world. It really does provide the protection to be able to get the return on the investment.

Mr. Massey: Ray Massey, University of Missouri. I have one question here. I was reading the book, *Travels of a Tee Shirt*. I don't know if you guys read it. It tells an interesting story about cotton development in the United States. Part of the story is, why has U.S. productivity growth not developed in other countries? It talks about credit access, the illiteracy of the farmers, and the technological understanding of farmers being inefficient or incapable of using some of the technologies that have occurred in cotton seeds.

What is DuPont doing to make sure that, as we are talking about expanding production in other regions of the country, they will be able to use it, given their literacy, credit access, and things of that nature?

Mr. Borel: That is a really good question. First of all, it underlines the importance – it isn't just technology. We can't just provide technology, throw it out there, and expect it will help anyone. I'll give you an example. First, a bit of philosophy: One of the things that is important to our seed business is working directly with farmers. Oftentimes we sell directly to farmers, but even in situations where we have intermediaries in invoicing, being able to get information directly to farmers, helping them choose the right hybrids, and maximizing the use of the products are important.

The example I might give you is of a farmer in Ethiopia, where a number of years ago we introduced hybrid seed corn. It is mostly open-pollinated varieties in that area of the world. It wasn't just taking hybrids in and handing them off. We have a local team and they worked with this farmer, as well as a bunch of his neighbors, and helped them with the management practices and how to get the most use from the grain. He went from subsistence farming (This is just hybrid seed corn. This isn't state-of-the-art technology.) to being able to send his kids to school, put a new roof on his house, and he actually has a cell phone now to be able to check markets.

So it is fascinating the kind of impact you can have, but that wouldn't have happened if we had just shipped some hybrid seed corn in and has a dealer sell it at the corner. It takes a commitment and working directly to help people get the most from the products.

Mr. Algaier: I'm Joe Algaier. I'm from Midwest Research Institute. I am a misfit around here. I am a biochemist.

One thing I have noticed in all the projections that I've seen, there is one factor that is probably difficult to factor in. In Chinese and Third World growth, what about the factor of all the pollution in the water systems over there? I can see the projections dropping precipitously, if that is a factor considered. Could the panel just discuss that in general?

Mr. MacDonald: I'm not an expert, so I'll be short on it.

I'll go direct to where the focus is. If you look at the substantial growth in our projections, where do we show it? We show it in livestock and poultry. So the big issue in terms of the agricultural link is going to be management of the litter. There is some increase we show in pork production, but the biggest shift you see in China production is in poultry. As we know, there are significant pollution problems in China now. It is likely to impose substantial restrictions on industrial growth in the future. That is a real challenge they face.

If you are looking at poultry production growth of 50 percent, likely in fairly centralized complexes, you are right. You are going to have a significant consolidation of poultry litter in those places as well. And that is going to create a real challenge for them. Beyond that – I am not a China expert – I cannot tell you what they are going to do about it.

Mr. Gabriel: Steve Gabriel, Farm Credit Administration. Mr. Batista, I wondered about the business model JBS uses around the world. Is it consistently an integrated grower sort of model or how that might vary around the world and also whether or not you have any cropping operations at all that you may use to grow feed?

Mr. Batista: Basically our business model is the same for Brazil, Australia, Europe, or here. We buy cattle from farmers. Brazil has much more grass-fed cattle; here it is grain-fed cattle. But the business model is pretty much the same. Also it is not different in Australia.

The poultry industry here and in Brazil is the same business model. The pork sector in Brazil varies more, but the business model is pretty much the same.

I couldn't hear what you asked at the end of your question.

Mr. Gabriel: I asked whether you've had any cropping operations anywhere in the world.

Mr. Batista: No, we don't have any.

Mr. Massey: Ray Massey from the University of Missouri again. James MacDonald, you ended your presentation with a question: Do we need new instruments for managing and allocating risk? I was just wondering, do you think the changes that have occurred in the structure might be the private sector's activity to allocate risk as opposed to be the private-sector's way of managing risk?

Mr. MacDonald: As I talk with producers both individually and through our surveys, it strikes me that we have a set of marketing contracts, for example, on hogs. Some of the ways we work our production contracts in both poultry and hogs are really based on low feed prices. Producers look at this and say, "I think we have a different set of risks and we need to think about how to manage those."

And we are likely to see most of that happen through the private sector and happen through changes in contracts. I expect to see more of those happen.

In both our broiler and hog surveys, we ask a lot of questions about the types of contractual relationships farmers have. What strikes me is the heterogeneity in those relationships, many of them done in response to different changes in input price shocks and sometimes in response to some previous output price shocks. I expect you're going to see evolution and continuing changes in those in the future.

The flip side is I also expect we may see a lot more equity participation in farming operations. As someone charged with running surveys, part of my job is to figure out how we write the surveys to capture that as it goes on. But certainly everything I hear suggests we are likely to see a good deal more of that in the future.

Man from Kansas: My question is for Dr. MacDonald. I'm from Kansas and there are a number of acres that are going to come out of the Conservation Reserve Program (CRP) in the next couple years. In your surveys, are you looking at that? Do you have any projections on what the effect will be on crop production and what will happen to that land?

Mr. McDonald: We have ongoing research on it. Clearly, higher corn prices place pressure on the CRP, if you don't do anything about it. What I would suggest is to send me an email and I'll link you to our experts who do that. We have ongoing research on it. It is not an area I work on. We do track it in our surveys. I just make sure we have the questions; I don't analyze those answers.

Mr. Greenwalt: Mr. MacDonald. I'm Bert Greenwalt, Arkansas State University and also a rice and soybean farmer. I wasn't clear on your comments about the relationship or impact of government farm program payments on farm size.

Mr. MacDonald: We had a research program that looked at it. If you look at the measure I showed for the midpoint of farm size, we also calculated that just for cropland acres within agricultural counties, 1,600 or so counties. We also looked at it within zip codes. We have it changing over time. So we have a distribution of changes – in some counties it is growing very rapidly. In some counties, it is growing less. In very few counties is it declining. We take that as a measure of changes in that typical farm size where the cropland is.

We also have data from ARMS and from the Census on commodity payments per acre in a county. That is very strongly related to the growth in cropland size. I say that in the sense it is large and it is robust. It is not a few observations up and you're driving it. It is a very tight relationship.

Personally, what I think is driving it is, if we think about locations with high payments per acre, well they have high yields. They tend to have a lot of contiguous cropland, so we are talking about Delta and Cornbelt counties. In my view, the technologies we've seen driving shifts to bigger farms are more easily adaptable in those counties. That is my speculation, to tell you the truth. I keep trying to get people to test it, but I haven't gotten the right one to do it yet.

What we have is a very strong correlation between payments and farm growth. I don't think it's causal. I suspect there is technology that is driving it, but I'd like to see more work done on it.

Mr. Hoenig: Do you think there is a tendency for payment limitations to be a drag on farm size?

Mr. MacDonald: I don't think so. My flat answer is I don't think they impact many producers at all. They impact structural entities to a modest degree. I don't think they impact producers much.

Mr. Hoenig: What is a farm?

Mr. MacDonald: We actually look in two ways. We look at the FSA's entities. We also in our ARMS data look at what we call an S-farm, a statistical farm, in which we are aiming to get at things that larger than what are called FSA farms. If I look at the income rules for payment limitations, very few producers – the ARMS data we're tracking are household income as well – and very little acreage are affected by the current payment limitations. For that reason, I don't think they impact it much.

Mr. Briggeman: Brian Briggeman, Federal Reserve Bank of Kansas City. My questions are for Mr. Borel and Mr. Batista.

In your prepared comments, you had a fairly bright outlook for agriculture in your respective areas going forward, but I was curious about the challenges that you both see for your industry. In particular for Mr. Batista, the challenges you have in the transportation sector, purchasing livestock to get it to the processors, and to get it to the demand you see rising in China. And for Mr. Borel, in particular I appreciate your comments on trade liberalization and potentially breaking down those barriers for that, as well as any other challenges you might see.

Mr. Borel: First, if I have a concern in the big picture, it is that we don't figure out how to get increased productivity in the developed agricultural areas to where this population needs it. It is going to take more than just trade liberalization. It is going to take economic development. The world is figuring out that trying to skip agricultural development in Africa and go directly to industrial development didn't work. We have to change food aid policy, agricultural development investments, and a number of things to get the economic development for them to be able to afford the imports, as well as to produce more. So that's a complex challenge.

Although I am not lying awake worrying about this, if it didn't work, we didn't get that figured out. We doubled production in the United States and nobody could afford to buy it and we couldn't ship it over there. I'm not lying awake worrying about that, but it is something we need to devote some energy to and no one group can fix that. It takes governments, NGOs, and companies really working together to figure this out.

Mr. Batista: In all our business, one challenge is to work on trade barriers, definitely there are different markets. We are seeing this in the poultry segment for a long time. You asked, "Where can we pressure to fix the issue in Russia?"

But each country is trying to protect itself to some extent, so we are seeing some growth on trade barriers to protect each country's markets. This, in our view, is the biggest challenge to be able to access markets and to have a free market to move products.

Mr. Teagarden: I'm Matt Teagarden, Kansas Livestock Association. Wesley, I am curious. You have been in the beef business two or three years in the United States and you indicated you buy cattle from farmers and ranchers. What is your reaction to their perception of you and your company? How have they embraced your company's entry into the business?

Mr. Batista: As soon as we came to the United States, we felt very welcome here. We think the producers in the United States have a mentality that our sector needs to work together to improve our business overall. We have been talking with producers as a company JBS. At the end of the day for us, it is about demand. If we have more demand and if producers and packers in our business work together to improve the amount here in the United States and abroad, we will have a better business for all. If we have less demand, we will all be squeezed. We feel the American producers have the mentality – we have to do a lot more work – but they have the mentality. The question is not between farmers and packers, the question is about the whole market.

Mr. Andrew: Jim Andrew, Iowa farmer. Mr. Batista, I'm really intrigued. Growing up as a little boy in Iowa and going by packing plants – Hormel, Swift, all of these – and in comes a Brazilian and buys out big. What do you attribute your success to? I can tell by your attitude you are a very aggressive, dynamic, hard-hitting individual. Did American packers get that dumb and lazy? Or did their labor agreements take too many dollars away from their business? Or did they just kind of lay down? You've been very successful. I am just intrigued with how you did it.

Mr. Batista: I attribute that to like my dad used to say, "When you like what you do, you don't have to work, you have fun."

So we have been having fun for our entire career. We like what we do.

Mr. Hurst: Blake Hurst, corn and soybean farmer from a few hours north of here. In both sets of presentations, there was a lot of optimism and a couple of illusions to what I see as a huge problem facing us but nobody is tackling it head on. As an example of what I mean, here in the United States almost ten states have outlawed what I would call "modern meat production."

Earlier this week, they burned genetically modified seed in Chicago. They demonstrated outside the Gates Foundation in San Francisco, all against a donation of a seed corn company which will remain nameless for a donation of seed they made to Haiti. They weren't demonstrating so much against genetically modified seeds, as demonstrating against hybrid seeds.

The Haitian peasant associations have promised to burn the seed when it arrives in Haiti. My question is, are we doing enough to deal with this idea that farming, as we practice it in the West, is harmful to the culture, to the environment, to farmers, and to consumers? Do you see that as a threat to this optimistic picture almost everybody has painted here this afternoon?

Mr. Borel: I think it is absolutely a threat. I still remain optimistic. One of the things that is important about all this is, there are challenges. The question is, what are we doing about it? Are we being proactive? Are we addressing it head on?

First of all, there are always going to be some fringe groups and you have to be careful not to be distracted by those. But, at the same time, there are groups of people who have legitimate views and concerns and you have to engage them. Different groups find different ways of doing that.

We, for example, have had an external advisory panel around biotechnology since we started to do that work over a decade ago. We have an ethics person. It rotates over time, but we've had a bioethicist from the University of Pennsylvania. We have Jason Quaid, the Little Wildlife Foundation, and people who don't think like us and who didn't grow up in companies and think, "Let's put more technology out. That was a great idea."

We have some tough conversations. But it is hugely helpful. As one example, if we just say they are all fringe and ignore it, then you end up with problems you can't get through. But, if you engage, you find there is a lot of common ground.

I had a great conversation the other day with Josh Gratel, who is the head of Slow Food. You talk for awhile and realize … both of us said it at the time, "Well, we actually have more in common than you would have expected when we sat down."

But clearly we have some differences. From my point of view, let's all engage. Let's talk about the challenges and the issues and things that are important. At the end of the day, farmers' values are something that permeate agriculture. We can be proud of those and they will stand up pretty well to most people in the world if you talk about it. If we don't, then we all assume the worst and end up creating other problems.

Mr. Tiernan: Shane Tiernan from Grundy National Bank. This is primarily for Dr. MacDonald, but then Mr. Borel and Mr. Batista maybe could address part of this also.

You didn't really address the demographic changes taking place in farm producers as to how much influence that has had on the growing size of farm operations. Certainly, if you consider the average age of producers today and a less percentage of producers are age 30 years and younger, if you extend those numbers out 20 years, you have the question is, who is going to farm the ground? What does that profile look like? Do you envision, or do you have an opinion

of, legislative or policy initiatives that could be put in place to increase the attractiveness to younger generations of the production side of agriculture and how we get them in, considering it costs $5 million to farm 1,100 acres.

Also, for Mr. Borel and Mr. Batista, do you envision a future where corporations somehow control larger and larger segments of the production side of both livestock and commodity production and hire the labor in order to continue to feed the demand we all say is coming down the road, yet there are fewer and fewer producers who are going to grow that production?

Mr. MacDonald: I think the issue you point to is a real one, although I believe it is exaggerated to a degree in our statistics. You quote an average age of 58, which is true. That is the average age of operators you'll see in USDA data and is, of course, substantially older than business owners you see in other industries. The reason why it can be somewhat misleading is twofold.

First, the way you get out of agricultural statistics is to pave your land. That is, a high fraction of the farmers in our statistics are retired. When they say they are retired, they mean they are retired. They don't do anything, but we still count them as farmers. If we get rid of the people who say they are retired, that drops the age down a little. It doesn't make me all that happy. It drops the average age down to 54 or 55.

The second thing, though, is when we survey these numbers, we survey principal operators. At a multi-generation farm, the guy who fills out the census is Dad or maybe it is Granddad. He is the principal operator. More and more large organizations are, of course, multiple generation and multiple operators and employed managers working on that farm. We don't track them well in our statistics.

For that reason, I am not going to tell you you're wrong, because we don't track them. We don't know what they look like. I suspect one avenue we don't follow at all on entry into farming is working as a manager on some of these larger operations. We then see those people cycling in at 40 or so to building their own operations.

It probably is a serious problem. I don't think it is as serious as what our statistics indicate. I am going to stay away from policy advocacy, since I am not a policymaker.

Mr. Borel: I might comment quickly on a couple of elements. The concern about big corporations running the farms, it is happening on the specialty crops already. But, if we are thinking about corn, soybeans, and wheat, we are not expecting that is going to happen. Personally, I hate to see that happen in the sense that even though the operations are larger, closely held family operations are very efficient, willing to take more risk, and are good managers. Hopefully it won't, but I don't think it is going to lead to that. The returns and the

risks are not something that large corporations are going to be very excited to jump into. That's for crops. I don't know much about the livestock side.

Mr. Batista: In our view, it is the same thing for cattle. We don't expect to see, and we don't think that makes sense, for the industry to go in and try to integrate the cattle business is almost impossible. The cycle is too long to do that. The poultry industry is already integrated, so we contract growers to feed chickens and we don't see this will change. This model is not only here. In Brazil, the model is the same. Anywhere, we know the poultry industry works pretty much the same. And the cattle are pretty much the same. We will keep being a packer and buying cattle from producers.

But definitely we think this is a concern. We are not seeing the young generation. It is not only in the United States. You'll see this in Australia, Brazil, Argentina, anywhere. The young generation is not going into farming. They want to go to the big cities and to do a lot of things. We hope we can see long, very strong financial results in the farming sector to stimulate the young generation to stay and work on the farms. But I think we need to see strong results and very good profitability in farming.