

# The Importance of Meat Exports as a Source of U.S. Feed Grain Demand

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## Abstract

Indirect corn and soybeans exported through beef, pork, and broilers are estimated by converting meat exports for 1995-2007 into corn and soybean meal fed. Acreage requirements also are estimated. Results suggest meat export growth could be an important source of future demand for feed grains.

## Introduction

U.S. exports of beef, broilers, and pork have risen significantly in recent years (table 1), and the prospects for continuing overseas demand are good, particularly from China. Beyond the livestock sectors, this continuing trend toward increased meat exports has implications for the feed grain industry in terms of livestock feed demand and the acreage necessary to meet it. While the U.S. Department of Agriculture (USDA) tracks feed purchases, its data for feed utilization are estimated as the balance of production which remains after all other utilization categories are calculated (USDA, 1989).

**Table 1. Growth in U.S. Beef, Pork, and Broiler Exports**

Years	Beef Exports		Pork Exports		Broiler Exports	
	<i>Million Pounds</i>	<i>Percent of Ttl Production</i>	<i>Million Pounds</i>	<i>Percent of Ttl Production</i>	<i>Million Pounds</i>	<i>Percent of Ttl Production</i>
1985	328	1.3%	128	0.8%	417	3.1%
1990	1,006	4.0%	238	1.5%	1,143	6.2%
1996	1,887	6.8%	951	5.4%	4,420	17.0%
	<i>Percent Change in Exports</i>		<i>Percent Change in Exports</i>		<i>Percent Change in Exports</i>	
1990-96	86.6%		229.6%		286.7%	
1985-96	472.3%		643.0%		960.0%	

Sources: USDA (1997a), Ray et al. (1994)

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This paper estimates the national-level, indirect demand and acreage requirements for two feed grains – corn and soybeans – evidenced through exports of beef, broiler, and pork. Demand and acreage are estimated for historical exports as well as preliminary export and yield projections of the Food and Agricultural Policy Research Institute through 2007 (FAPRI, 1997). First, some background on the estimation of feed demand will be presented. Next, the data and methodology are discussed, followed by presentation of the results and discussion.

## **Background**

Estimating feed use by livestock is complicated by the diverse and changing nature of the livestock industry. There can be significant regional and temporal variations in what livestock are fed. Some regions of the country will favor some feed crops over others and, as prices vary, feed grains can be temporarily priced attractively or unattractively for use in feed. More fundamentally, the livestock sector has undergone significant changes such as increasing integration and consolidation of pork and broiler sectors during the past few decades. Other important changes have to do with feed requirements, particularly feed grain and particle size and their effects on animal performance (Bhenke, 1996).

Among livestock categories, cattle is a particularly difficult case to estimate. Feed generally is responsible only for the final 40 percent of weight gain before slaughter, although some foraging cattle also are fed grain to boost calving potential. The weight gain which cattle experience while on feed varies further depending on an animal's weight when it is put on feed (McLemore, 1997).

For hogs, feed conversion by hogs can vary by 0.7 pounds of feed per pound of weight gain over an animal's life (National Research Council, 1994). Even more variable when it comes to hog production is the efficiency of the producer. McBride (1995) found that low-cost producers enjoy a pound-per-hundredweight-gain in efficiency which is nearly double that of high-cost producers.

Some previous research has focused on estimating feed use. During the 1980s, the National Research Council convened a Subcommittee on Feed Intake under the aegis of its Committee on Animal Nutrition (National Research Council, 1987). In the mid-1980s, several efforts were made to model domestic and corn and soybean feed utilization (Hull et al., 1984; Hull and Westcott, 1985; Van Meir, 1985), in part as an alternative to the use of grain-consuming animal units as an indicator of feed utilization.

### Data and Methods

This paper examines three categories of meat exports (beef, pork, and broilers) and the two feed grains most commonly fed to livestock, corn and soybeans. The analysis covers the period, 1995-2007, with FAPRI baseline export and yield projections used for the years subsequent to 1997. Export and yield data for 1995 and 1996 as well as 1997 projections are from USDA (1997a, 1998). These data – which show significant increases in meat export demand – are provided in table 2.

**Table 2. Historical and Projected Beef, Pork, and Broiler Exports and Corn and Soybean Acreage and Yields, 1995-2007**

Year	Exports			Corn		Soybeans	
	Beef	Pork	Broilers	Harvested Ac.	Yield	Harvested Ac.	Yield
	-----Million Pounds-----			<i>Mil. Ac.</i>	<i>Bu. Per Ac.</i>	<i>Mil. Ac.</i>	<i>Bu. Per Ac.</i>
1995	1,821	771	3,894	72.9	138.6	60.9	41.4
1996	1,877	951	4,420	65.0	113.5	61.6	35.3
1997	1,915	1,250	4,580	73.1	127.1	63.4	37.6
1998	2,582	1,310	4,762	76.6	128.6	68.1	38.6
1999	2,620	1,713	5,133	76.9	130.3	67.2	39.3
2000	2,598	1,641	5,285	76.2	132.2	67.4	39.8
2001	2,590	1,571	5,423	76.8	133.7	66.9	40.4
2002	2,849	2,034	5,723	76.7	135.4	67.3	40.8
2003	3,157	2,551	5,977	77.5	136.9	67.0	41.3
2004	3,498	2,233	6,139	78.0	138.5	67.3	41.8
2005	3,843	2,008	6,308	78.6	140.0	67.1	42.3
2006	3,940	2,558	6,547	78.9	141.5	67.5	42.7
2007	4,008	3,222	6,851	a	a	a	a

<sup>a</sup> FAPRI Harvested Acreage and Yield Projections end with the 2006/2007 crop year.

Sources: FAPRI, 1997; USDA, 1997a

The general research strategy is to begin with data for the volume of beef, pork, and broiler exports and, using a series of conversions, estimate:

- (a) The liveweight of animals estimated from a given level of meat exports using a general dressing percentage which represents the amount of liveweight animal remaining after dressing;
- (b) The amount of feed necessary to produce the liveweight of animals using feed-conversion factors (i.e., the pounds of feed necessary to produce 1 pound of weight gain);
- (c) The proportion of corn and soybeans in feed rations; and
- (d) Measurement conversions from USDA (1992) to calculate the number of bushels present in pounds of corn (56 pounds per bushel) and soybean meal (47.6 pounds of 44 percent protein meal per bushel).

For beef, the amount of liveweight cattle which generated beef exports is estimated using a dressing percentage of 59.36 percent calculated as the average dressing percentage over 1992-96 (USDA, 1997c). Of those million pounds of liveweight cattle, 60 percent are eliminated from the analysis to address the issue of weight gain mentioned earlier. Then, a feed conversion of 6.083 developed by Cattle-Fax (1996) is applied to the resulting million pounds of liveweight cattle to estimate the amount of feed needed to produce that amount of liveweight. Based on Carter (1997), the aggregate composition of cattle feed ration is assumed to be 61.9 percent corn and 4.2 percent soybeans.

For pork, million pounds of pork exports are converted to liveweight using a 72.4 dressing percentage calculated from USDA (1996). Then, an aggregate feed conversion rate of 4.19 from McBride (1995) is applied to obtain aggregate feed consumed by hogs. The aggregate feed ration is assumed to be 78 percent corn (Carter, 1997), and 90 percent of the protein (or 16.11 percent of total feed) fed is soybeans, as indicated by Ash (1992).

For broilers, liveweight is estimated using a dressing percentage of 72.1 percent (USDA, 1992), and feed conversion is estimated using a factor of 2.03 percent (USDA, 1991). For this analysis, feed for broilers is assumed to be composed of 65 percent corn and 28 percent soybeans

(McLemore, 1997). A range of potential values drawn from the literature and considered for this analysis are presented in table 3.

**Table 3. Livestock Conversion Factors Drawn from the Literature**

Source	Dressing Yield	Feed Efficiency (Feed: 1 Lb. of Gain)	Corn % of Ration	Soybean Meal % of Ration
	<i>Percent</i>	<i>Pounds</i>	<i>Percent</i>	<i>%</i>
<b>Beef</b>				
Carter, 1997	61.5 - 63.0	7.1 - 7.6	61.9	4.5
USDA, 1997c (calculated for 1992-96)	59.4	—	—	—
CattleFax, 1996	—	5.8 - 6.3	—	—
USDA, 1992	60.2	—	—	—
Mosely et al., 1992	—	6.9	—	—
Peel, 1994 (calculated)	—	5.7 - 10.0	—	—
Kalter and Milligan, 1990 (calculated)	—	—	28.8	1.2
<b>Pork</b>				
USDA, 1997b	71.5 - 72.7	—	—	—
Carter, 1997	70.4 - 72.8	3.6 - 4.0	78 - 80	17 - 18
McBride, 1995	—	3.33 - 6.58	—	—
USDA, 1992	72.4	—	—	—
Bailey et al., 1995	—	2.8 - 3.5	—	—
Ash, 1992	—	—	—	16.1
Kalter and Milligan, 1990 (calculated)	—	—	76.4	9.2
<b>Broilers</b>				
Carter, 1997	72 - 73	1.99 - 2.25	68	26
McLemore, 1997	—	—	65	28
USDA, 1996	73.3	—	—	—
USDA, 1992	72.1	—	—	—
Kalter and Milligan, 1990 (calculated)	—	—	56.4	19.8
Lasley et al., 1988	75	2.03	70	30

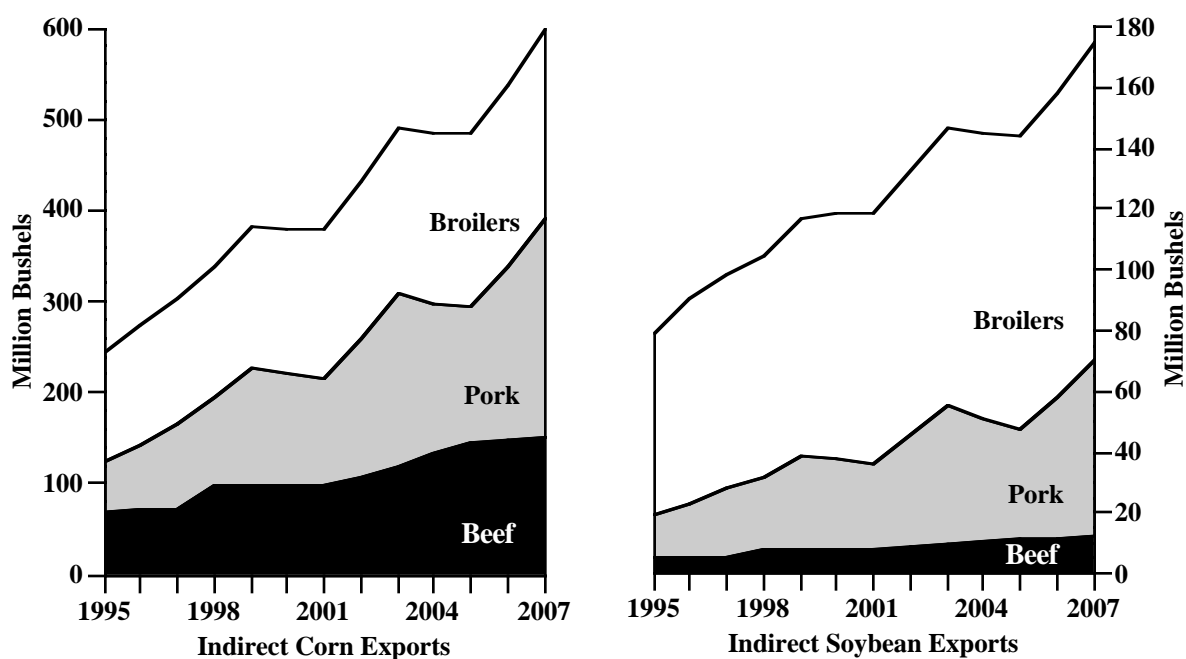
Once indirect corn and soybeans exports are estimated using spreadsheet software, the acreage required to produce that amount of corn and soybeans is estimated using the dividend of export estimates and historical and projected average annual yields for the period 1995-2008.

## Results

As table 2's export levels would indicate, broiler exports generally provide the largest indirect corn exports and by far the greatest indirect soybean exports (figure 1). Indirect corn exports through broilers nearly double between 1995 and 2007 – growing from 117.4 million bushels to 206.5 million bushels. Corn exported through pork experiences a more than fourfold increase from

the 1995 estimate of 57.3 million bushels. In 2007, corn exported through pork reaches 239.9 million, surpassing exports from broilers. Indirect corn exports through beef also more than double during the study period – from 68.9 million bushels in 1995 to 151.6 million bushels in 2007.

As with corn, indirect soybean exports through beef double during the study period, growing from 5.5 million bushels in 1995 to 12.1 million bushels in 2007. Soybeans exported through pork quadruple to reach 58.3 million bushels by 2007. Soybeans exported via broilers grow from 59.5 million bushels in 1995 to reach 104.6 million bushels by 2007. As suggested earlier, these results reflect the significant increases in meat exports projected by FAPRI.



**Figure 1. Indirect Corn Exports Through Beef, Pork and Broilers, 1995-2007**

Figures 2 and 3 compare indirect corn and soybean exports with direct exports; for comparison purposes, direct soybean exports are the sum of soybean exports and the soybean equivalency of soybean meal exports. The stacked bar on figure 2 shows that in 1995, combined direct and indirect corn exports totaled 2,420.6 million bushels. The line on figure 2 shows that indirect corn exports were 11.2 percent of combined corn exports in 1995; this percentage rises to 17.8 percent

of combined exports by 2006. Similarly, the stacked bar on figure 3 shows combined soybean exports of 1,169 million bushels in 1995, while the line indicates that indirect soybean exports comprised 7.2 percent of combined exports in 1995. This percentage of combined soybean exports grows to 11.6 percent by 2006. Export comparisons and acreage estimates do not include 2007 because FAPRI projections end with the 2006-7 crop year.

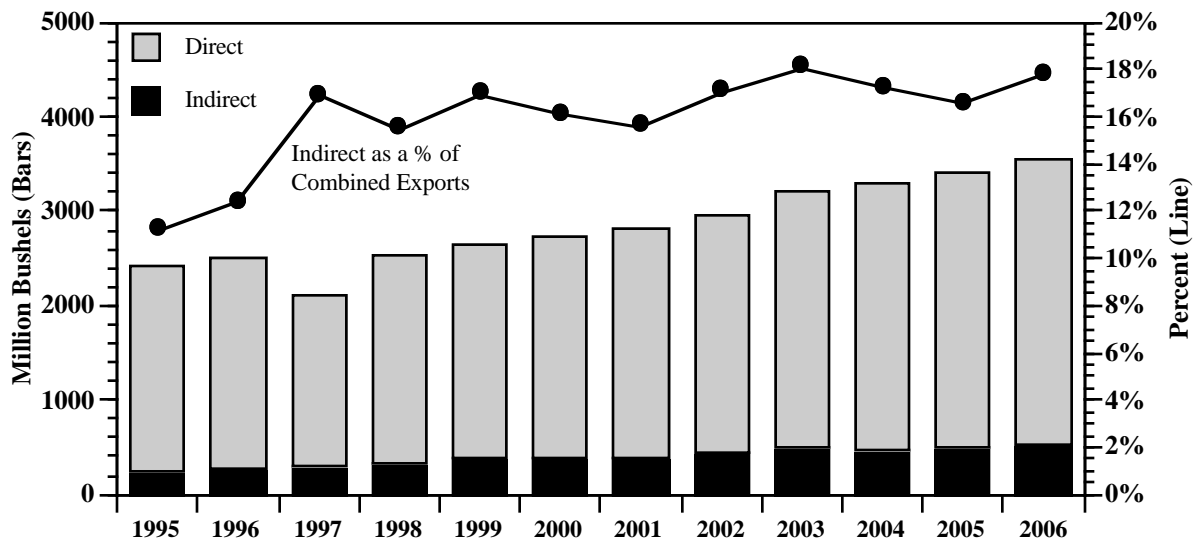


Figure 2. Direct and Indirect Corn Exports, and Indirect Exports as a Percent of Combined Exports, 1995-2007

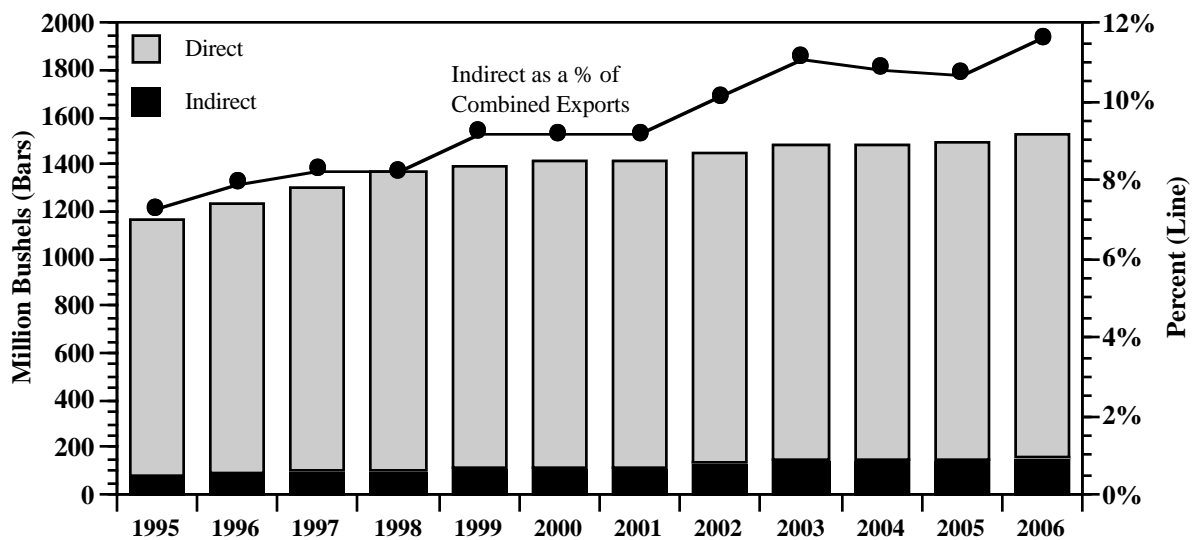
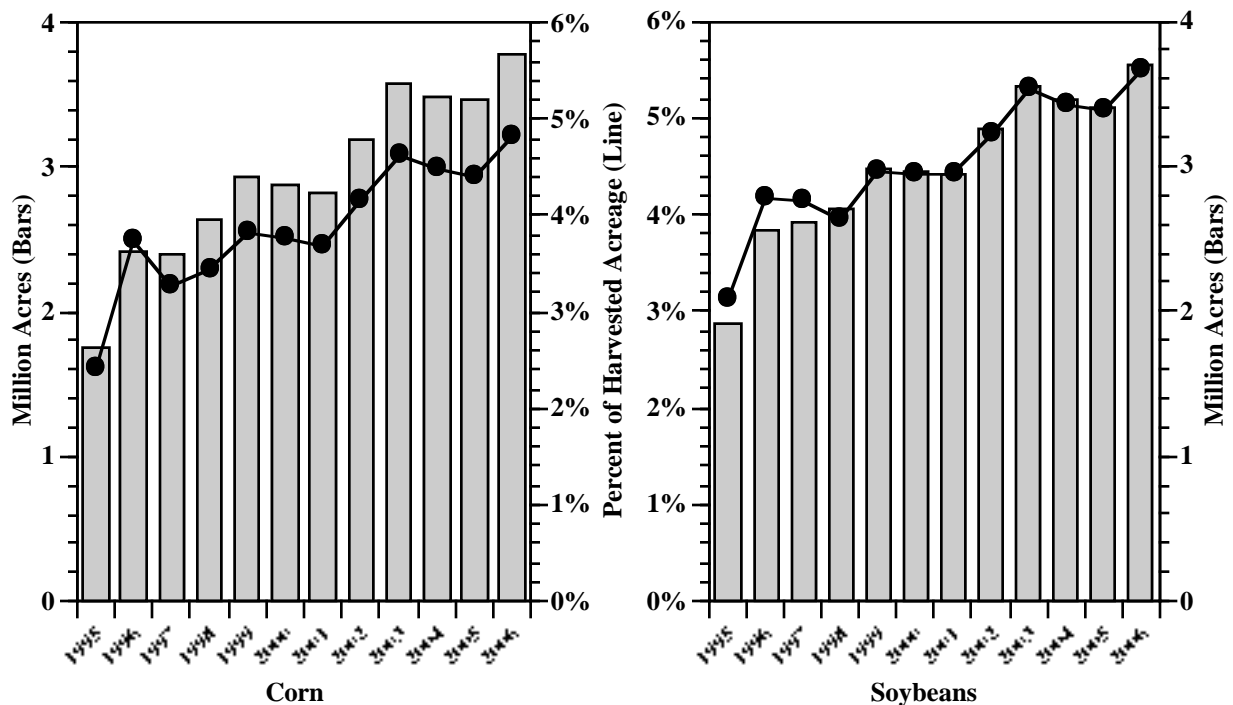


Figure 3. Direct and Indirect Soybean Exports, and Indirect Exports as a Percent of Combined Exports, 1995-2007

Estimates of the acreage required to produce indirect corn and soybean exports through beef, pork, and broilers are illustrated in figure 4. Acreage to produce indirect corn exports (the bars on the left-hand graph in figure 4) grows from 1.8 million acres in 1995 to 3.8 million acres by 2006. The line on figure 4's left-hand graph shows acreage required for indirect corn exports comprises 2.4 percent of total corn harvested acreage; this percentage grows to 4.8 percent by 2006. For indirect soybean exports, the acreage requirements grow from 1.9 million acres in 1995 to 3.7 million acres by 2006. The estimated acreage is 3.1 percent of total harvested soybean acreage in 1995 and reaches 5.5 percent of total harvested soybean acreage by 2006.



**Figure 4. Acreage Required to Produce Indirect Corn and Soybean Exports, and its Percent of Total Harvested Corn and Soybean Acreage, 1995-2007**

## Discussion

These results should be considered in the light of their dependence on the conversions used; results likely will be quite sensitive to small changes in the conversion factors employed. Further,

this study does not consider two additional factors which future should be considered in future research. This analysis does not consider how dressing percentages, feed conversion, and the future composition of feed rations may change over time. As biotechnological advances introduce changes in the animal genetic stock, it is most likely that these factors will change. Also, this analysis does not consider the corn and soybean meal required for herd or flock maintenance.

Further, the depth of the impact on corn and soybeans production reflected in these results stems directly from the growth projected in beef, pork, and broiler exports by FAPRI. If export growth performance over time is not as strong as these projections suggest, then indirect exports will not assume as important a role in the feed sector as they appear to in this analysis. If export growth occurs as projected, meat exports could grow to become an important demand source for corn and soybeans production agriculture.

Regardless of these caveats, these results point to several implications:

- The exported component of domestic corn and soybeans production actually is greater than is normally considered (i.e., agricultural markets are somewhat more global than we normally view them).
- Corn and soybean prices will be buoyed somewhat by increasing meat export demand. If the trend continues, meat exports may play a slight stabilizing role for corn and soybean prices, which could be important as agriculture's potential for volatility increases under the 1996 farm bill (Ray, 1996).
- If meat exports are expanding, then one manner in which the market for U.S. farm products could be increased is to take steps to improve livestock export markets. Examples are trade agreements like the General Agreement on Tariffs and Trade (GATT) and the North American Free Trade Agreement (NAFTA).

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