

U.S. Agricultural Trade and Its Impact on the Midwest Rural Economy

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**William Edmondson, Economist
RED, Economic Research Service**

**Gerald Schluter, Agricultural Economist
RED, Economic Research Service**

**Chinkook Lee, Agricultural Economist
RED, Economic Research Service**

**Lowell Dyson, Social Science Analyst
RED, Economic Research Service**

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I. Introduction

Rural American prosperity, while largely dependent upon domestic economic events, has always been vulnerable to international influences. This has been true since the beginning of the nation. Tobacco and cotton were important export commodities in the first century, followed in the second half of the nineteenth century by wheat and flour and other grain products. According to agricultural economist and historian, Willard Cochrane:

“The absolute expansion in the exports of agricultural products, particularly in grains, between 1866 and 1900 contributed importantly to the development of American agriculture during that period.”

(Cochrane, pp. 268)

The rural economy remains closely tied to global economies, making it sensitive to changes in global competition. For example, agricultural trade, which was constrained by the protectionist policies pursued by many countries, is now moving toward both multilateral and regional free trade through the GATT agreements, establishment of the World Trade Organization (WTO), and regional pacts such as NAFTA. Recently, the weaker dollar and the U.S.’s support of multilateral trade liberalization, which worked to open other countries’ agricultural markets, resulted in strong exports for U.S. products. For example, U.S. agricultural exports surged to a record \$55.8 billion for calendar year 1995, \$10.1 billion over the previous calendar year. With some year to year variation, this trend of agricultural trade growth will likely continue in the future and will have economic impacts in rural America.

The production of agricultural exports requires farmers to purchase fuel, fertilizer, and other necessary inputs. Agricultural exports also spur economic activity down the line in the manufacturing, trade, and transportation of these products. Conversely, agricultural imports could replace domestic production activity and could result in a loss of income and employment in rural areas.

The purpose of this paper is to estimate employment effects of U.S. agricultural trade in the Chicago Federal Reserve District and its rural economy. Using input–output (I/O) analysis, we measure the effect on the national economy, in terms of employment, of agricultural trade in calendar year 1995. We further refine the model, using *County Business Patterns* (CBP) data, to distribute these effects to states and to nonmetro or rural areas of the states and the nation.

II. Background

Many studies have analyzed trade effects of agriculture in the national arena. Edmondson, Petrulis, and Somwaru (1995) and Lee, Schluter, Edmondson, and Wills (1987) analyzed the economy-wide effects of the U.S. food and fiber system. Edmondson (1994) and Harrington, Schluter, and O’Brien (1986) examined the agricultural trade effects on the national economy. However, until recently (references 3 and 7), no specific studies have linked agricultural trade and rural employment. Many regional planners and rural development advocates have looked at the current boom in agricultural trade and seen an opportunity for further economic expansion. This analysis measures the contribution of 1995’s agricultural trade to the economy of the five states in the Chicago Federal Reserve District (Illinois, Indiana, Iowa, Michigan, and Wisconsin).

III. Exports Have Gained in Importance to Rural Areas

In the 1990s, both the weaker dollar and the U.S.'s support of multilateral trade liberalization, which worked to open other countries' agricultural markets, have stimulated U.S. exports. In 1988, U.S. agricultural exports amounted to \$35.3 billion. They grew to \$42.4, \$42.5, and \$45.7 billion in calendar years 1992, 1993, and 1994, respectively, and then jumped \$10.1 billion to a record \$55.8 billion in 1995. The 1995 export value surged on higher shipments and prices of wheat, corn, and soybeans (about 57%, 31%, and 39%, respectively, of crop year 1995-96 production was exported) and increases in high-value products (HVP) shipments, primarily poultry meat, beef, fruits, and vegetables.

Previous studies by Lee and Schluter (1993 and 1995) suggest that in the 1970s and 1980s much of the demand growth supporting the increased output of grain and oilseeds came from exports. The leading agricultural commodities exported nationally—corn, wheat, and soybeans—use land and capital inputs extensively, resulting in direct and indirect demand for rural land and capital while also generating employment in rural areas (Lee, Wills, and Schluter, 1988, pp. 267). The Chicago Federal Reserve District accounted for about 40% of the corn, 50% of the soybeans and 5% of the wheat produced in 1995. In the 1990s, however, export value has increased not only in shipments of traditional bulk wheat, corn, and soybeans but also in HVP shipments, primarily poultry meat, beef, fruits, and vegetables. While the Chicago Federal Reserve District is not quite so heavily represented in the production of these particular products, it is well represented in producing processed foods and, of course, the grain and oilseed inputs into the processed foods, and so has shared in the growth of this category of exports. The commodity composition of agricultural exports is changing and if recent trends continue, most of the regional employment benefits related to agricultural exports will shift to areas that produce and process HVP.

What are some implications of expanded agricultural trade to the Chicago Federal Reserve District economy? Because the U.S.'s rural and general economy is extremely diverse, differences in various regions make broad generalizations difficult. The mix of farm and processed food products produced in the District, however, suggests that this District should be favorably affected by such an expansion.

IV. Methodology and Sources of Data

The method used here is an I/O analysis, similar to the methodology used to analyze income and employment generation in the food and fiber system (Edmondson, Petrulis, and Somwaru, 1995, and Lee, Schluter, Edmondson, and Wills, 1987). For this analysis, we use the 1987 U.S. I/O tables (USDC/BEA, 1994), the latest available. An I/O table provides an economy-wide environment in which to analyze the corresponding levels of sectoral output, income, and employment needed to meet differing levels of agricultural trade. Specifically, we examine the effect of 1995 agricultural trade on sectoral output, income, and employment. Our focus will be on estimating rural employment.

First, sectoral income for the base year (1987) is derived as:

$$\text{Income} = \sum_{j=1}^n V_j$$

where V_j is value added in sector j . In the U.S. I/O tables, $n=524$ sectors.

Sectoral output for the base year is derived as:

$$X = [I-A]^{-1} * f$$

where,

X = an $n \times 1$ vector of sector outputs

$[I-A]^{-1}$ = an $n \times n$ I/O total requirements matrix, and

f = an $n \times 1$ vector of agricultural exports or imports.

Under an I/O structure, value added is a fixed proportion of output, so that income can be written in a matrix form as:

$$1) \text{ Income} = v * X = v * [I-A]^{-1} * f$$

where, v = an $n \times n$ diagonal matrix of value added per dollar of sector output coefficients.

Using the above notation, employment in each sector can be derived as:

$$2) \quad E = l * [I-A]^{-1} * f$$

where, l = an $n \times n$ diagonal matrix of civilian employment coefficients per dollar of sector output.

E = an $n \times 1$ vector of sector employment needs, e_j 's, for meeting the total output required to satisfy agricultural exports or imports.

To estimate nonbase year (such as 1995) income, we have to incorporate price deflators for the income to make the "constant dollar" measure of agricultural trade to the base year (1987) prices. Thus equation (1) becomes:

$$3) \quad \text{Income} = v * [I-A]^{-1} * f'$$

where, f' = 1995 agricultural exports or imports in 1987 prices.

Similarly, to estimate nonbase year (1995) employment, labor productivity changes in both the farm and nonfarm sectors have to be incorporated. Without this adjustment of productivity, elements e_j of vector E in equation {2} would either overestimate or underestimate the total employment in j th sector. Thus, equation {2} becomes:

$$4) \quad E' = p * l * [I-A]^{-1} * f'$$

where, p is a diagonal matrix showing the ratio of base year labor productivity to

current year productivity. Now rural employment is generated by using the CBP matrix as:

$$5) \quad R = dE' * C$$

where, R is 524 by 51 matrix of rural employment of 524 sectors (in the row) for 50 states and the District of Columbia (in the column), dE' is a diagonal matrix of E' , and C is a 524 by 51 matrix of rural employment share coefficients derived from the CBP (USDC/Bureau of Census, 1993). We allocate calendar year 1995 agricultural trade using a 1993 CBP share matrix because that is the latest available data. We use the results of equation 5 to estimate rural employment due to agricultural trade. We then aggregate 524 sectors to seven categories, three farm categories - Livestock, Grains & Oilseeds, and Other Crops—plus Food Processing, Manufacturing, Transportation and Trade Services, and All Other, for ease of presentation.

For the estimation, we derive the agricultural trade data from published USDA trade statistics (USDA/ERS/FATUS, 1996). Labor coefficients for each industry are derived using employment data from various issues of *Employment and Employment Earnings*, (USDL/BLS). To incorporate changes in labor productivity from 1987 to 1995, broad indexes of output per worker in each industry are used to adjust the estimate of required labor use.

This procedure is not perfect. Any regional estimation of a national effect, i.e., total employment due to agricultural trade, carries with it some implicit assumptions. In this case, distributing employment to the states according to the location of production will cause underestimations in areas where production is in surplus and the capacity and environment are already geared toward the movement and transport of agricultural commodities. We may also be missing some ancillary industries in regional economies that exist solely to facilitate exports and related input industries. With the Chicago Federal Reserve District including areas along the Mississippi and Great Lakes, these caveats may especially apply to the estimates presented in this paper. On the other hand, since the regional employment adds to a national total, we must be overestimating in regions that have some agricultural production but not enough to meet regional demands and/or in regions with adequate production but not the means to take advantage of added commodity exports. Regional models designed to capture the differences in regional economies, such as IMPLAN, RIMS, etc., have their own set of assumptions and conditions and have difficulty measuring national level impacts (Edmondson and Schluter, 1989).

V. Empirical Analysis of Chicago Federal Reserve Region Employment

Agricultural exports amounted to \$55.8 billion in 1995, which was composed of \$23.4 billion farm exports (\$22.9 billion crops and \$0.5 billion livestock), \$21.0 billion processed food exports, and \$11.4 billion other exports, e.g., manufactured tobacco, trade, and transportation services. We estimate these exports supported 895,000 full-time jobs, of which 292,000, almost a third (33%), were in nonmetro (rural) areas.

U.S. agricultural imports amounted to \$21.6 billion in 1995, composed of \$5.6 billion farm imports (\$3.8 billion crops and \$1.8 billion livestock), \$11.3 billion processed food imports, and \$4.7 billion other imports, e.g., manufactured tobacco

and misc. semimanufactured fibers. These imports represented the equivalent of 386,000 full-time domestic jobs if the imports had been produced domestically, according to our estimation. Of these 386,000 jobs, 118,000 or about 30%, would have been in nonmetro (rural) areas.

Figure 1 presents our estimates of employment related to U.S. agricultural exports in 1995. More than 143,600 jobs in the region can be traced to U.S. agricultural exports in 1995 (figure 1, next to last row.) Nearly 56,600 or 39.4% were jobs located in nonmetro areas and slightly more than 87,000 or 60.6% were in metro areas. While the Chicago Federal Reserve District labor force is less metropolitan-based than the national labor force (76.8% versus 80.8% nationally), the employment effect of agricultural trade on the District has an even smaller effect on metropolitan areas.

Within the District's five states, agricultural exports generated the most full-time jobs in Illinois, about 53,600 or 0.93% of the total employment in the state. Iowa, with 28,027 jobs, had the highest ratio (1.86%) within the five states, of jobs supported by agricultural exports and of rural jobs supported by agricultural exports (2.45%).

Feed grain and oilseed exports dominate these results. Two factors that affect estimates of rural employment are the percentage of nonmetro employment in each sector and the level of employment in those sectors of the economy. Nationally both feed grains and oilcrops are rural-based with nonmetro production shares of nearly 72% for each. And, as noted previously the five states dominate feed grain and oilseed production. These two facts about feed grains and oilseeds—predominately rural and concentrated in the Chicago Federal Reserve District underlie most of our results.

In the figure we listed seven aggregated sectors that show that even with the aforementioned dominance of feed grain and oilseed, employment related to agricultural exports covers a range of sectors. Nationally, the farm sector, as expected, receives most of the employment generated in rural areas from agricultural exports for two reasons. First, 13 of the 17 agricultural sectors in the national I/O accounts have more than 50% of their employment in rural areas and four (food grains, meat animals, oil bearing crops, and feed grains) have more than 70% of their total employment in rural areas. In 1995, 183,930 full-time farm jobs in nonmetro areas resulted from the \$55.8 billion agricultural exports. This was 63% of total rural employment generated by agricultural exports. But there are 453,600 nonfarm metro and 108,000 nonfarm nonmetro jobs nationally and 70,900 nonfarm metro (including 9,500 food processing jobs) and 18,200 nonfarm nonmetro jobs (including 5,800 food processing jobs) in the Chicago Fed District supported by agricultural exports. This is due to the “indirect” effect of agricultural exports. That is, the effects of agricultural exports on the economy are not limited to the farm sector, but also affect “upstream and downstream sectors linked to agriculture by supplying its inputs and handling its products” (Harrington, Schluter, and O'Brien).

These indirect effects are important to rural communities. Some financial and economic stress that has characterized farms and rural areas in the 1980s can be traced to the volatility of export markets. During the 1990s, however, these markets have been expanding rapidly and prospects for more exports are good, considering the GATT, WTO, and regional pacts such as NAFTA.

Figure 1 Estimated Domestic Employment Equivalents of Agricultural Exports, 1995

Metro	Illinois	Indiana	Iowa	Michigan	Wisconsin	Chi-Fed	U.S. Total	Chi-Fed Share
Livestock	579	570	614	420	560	2,743	21,854	0.126
Grains & Oilseeds	4,911	3,298	1,515	1,141	430	11,295	28,914	0.391
Other Crops	221	216	15	1,285	411	2,148	98,549	0.022
Food Processing	3,053	1,155	2,315	1,463	1,505	9,491	50,649	0.187
Manufacturing	3,466	1,942	566	2,320	1,621	9,916	53,495	0.185
Trans & Trade	16,966	3,463	2,113	5,078	3,034	30,654	173,898	0.176
All Other	8,493	3,094	1,215	5,256	2,774	20,831	175,524	0.119
Total	37,689	13,738	8,353	16,963	10,334	87,077	602,882	0.144
Metro Employment Share	4,912,355	2,250,583	701,079	3,750,848	1,892,367	13,507,233	100,851,134	0.134
	0.0077	0.0061	0.0119	0.0045	0.0055	0.0064	0.0060	
Nonmetro								
Livestock	1,210	901	4,187	357	1,192	7,847	48,302	0.162
Grains & Oilseeds	10,270	5,212	10,329	970	916	27,697	76,414	0.362
Other Crops	463	341	100	1,093	874	2,870	59,227	0.048
Food Processing	1,168	878	2,325	401	1,017	5,789	33,603	0.172
Manufacturing	719	762	723	440	690	3,335	17,801	0.187
Trans & Trade	1,140	810	1,075	560	1,019	4,603	25,623	0.180
All other	992	720	935	799	985	4,431	30,926	0.143
Total	15,961	9,624	19,674	4,619	6,694	56,572	291,897	0.194
Nonmetro Employment Share	857,186	837,269	803,316	740,074	848,285	4,086,131	24,027,038	0.170
	0.0186	0.0115	0.0245	0.0062	0.0079	0.0138	0.0121	
Total								
Livestock	1,789	1,472	4,801	777	1,751	10,590	70,156	0.151
Grains & Oilseeds	15,180	8,511	11,844	2,111	1,346	38,991	105,328	0.370
Other Crops	684	557	114	2,378	1,285	5,018	157,776	0.032
Food Processing	4,221	2,033	4,640	1,864	2,522	15,280	84,252	0.181
Manufacturing	4,185	2,704	1,290	2,760	2,312	13,251	71,296	0.186
Trans & Trade	18,105	4,273	3,188	5,638	4,053	35,257	199,521	0.177
All Other	9,485	3,814	2,150	6,054	3,759	25,262	206,450	0.122
Total	53,650	23,362	28,027	21,582	17,028	143,649	894,779	0.161
Total Employment Share	5,769,542	3,087,852	1,504,395	4,490,922	2,740,652	17,593,364	124,878,172	0.141
	0.0093	0.0076	0.0186	0.0048	0.0062	0.0082	0.0072	

The Chicago Federal Reserve District is less affected by agricultural imports. If all the 1995 agricultural imports had been produced domestically, 56,000 more workers would have been needed in the five states, 35,200 metro jobs and 20,800 nonmetro jobs (figure 2). These lower import-related employment estimates result from both lower imports than exports (the positive agricultural balance of trade) and the lower importance of imported competitive commodities, such as sugar and fruits and vegetables, in the region. An exception is Michigan where its role in national fruit and vegetable production results in about half its nonmetro employment influenced by imports being in the “Other Crop” category (1,049 of 2,464).

The figure 2 import-related employment estimates are not estimates of jobs lost to imports. Such a study would require more sophisticated identification of imported products and the reason for their importation. Some may not have domestic counterparts. We present these estimates as a rough indication of import vulnerability. As such, even if one takes the extreme assumption that all import-related jobs replaced domestic jobs, the Chicago Federal Reserve District was 87,700 jobs (143,650–55,950) better off after agricultural trade in 1995. Rural areas were 35,740 jobs better off.

VI. Summary and Conclusions

Agricultural exports, like other exports, are sources of income and employment in the economy. Income and employment are generated as the sector produces goods and services to satisfy foreign demands. Agricultural trade, which had often been limited by many countries, has been moving toward multilateral and regional free trade through GATT agreements and the general acceptance of the WTO. This trade liberalization, which continues to open agricultural markets, should result in strong exports for U.S. products, with concomitant gains in employment for the Chicago Federal Reserve District.

An important lesson to emerge from this analysis is the significant interest that some rural areas have in the demand for agricultural exports. Agricultural exports require employment in rural industries, because rural areas possess a large share and level of employment in industries tied to both production (farm) and supporting (nonfarm) activities. More than 50% of the farm sector’s employment was in rural areas (four subsectors are more than 70% rural). In 1995, 63% of the jobs supporting agricultural exports in nonmetro areas were on the farm. While this analysis emphasized employment effects, the primary export commodities in the region are capital intensive rather than labor intensive, so a labor-oriented measure of trade dependence may actually understate the importance of agricultural trade to rural areas of the region.

In the 1990s, the commodity mix of agricultural exports has changed. Rural employment and other economic benefits associated with agricultural trade will shift from the regions producing traditional bulk commodities to regions producing more HVP. This may have a significant implication for rural development policymakers. A region such as the Chicago Federal Reserve District that has a large share of rural employment due to agricultural exports may lose its dominant share over time as more HVP are exported. The metro areas of the region that had a relatively lower share of employment due to agricultural exports in 1995 (39%) may increase their share over time as more HVP, such as processed foods, are exported.

The estimates provided in this paper are valuable because they are sufficiently reliable, both conceptually and empirically, to make policy decisions based on them. Rural policymakers and rural planners often seek viable and defensible ways of assessing the role of agriculture in a rural economy and our analysis gives them information on how important agricultural exports are to regional rural employment.

Figure 2 Estimated Domestic Employment Equivalents of Agricultural Imports, 1995

Metro	Illinois	Indiana	Iowa	Michigan	Wisconsin	Chi-Fed	U.S. Total	Chi-Fed Share
Livestock	408	328	430	275	407	1,847	12,279	0.150
Grains & Oilseeds	826	558	267	191	89	1,930	4,775	0.404
Other Crops	262	196	17	1,234	392	2,101	58,579	0.036
Food Processing	1,820	543	689	846	1,101	5,000	30,815	0.162
Manufacturing	1,637	856	226	1,021	753	4,493	24,359	0.184
Trans & Trade	6,317	1,536	806	2,250	1,344	12,254	74,893	0.164
All Other	3,077	1,105	429	1,901	983	7,495	62,870	0.119
Total	14,345	5,121	2,866	7,718	5,069	35,119	268,569	0.131
Metro Employment Share	4,912,355	2,250,583	701,079	3,750,848	1,892,367	13,507,233	100,851,134	0.134
	0.0029	0.0023	0.0041	0.0021	0.0027	0.0026	0.0027	
Nonmetro								
Livestock	853	518	2,935	233	866	5,405	28,790	0.188
Grains & Oilseeds	1,727	881	1,818	162	190	4,778	12,431	0.384
Other Crops	547	309	119	1,049	835	2,859	32,959	0.087
Food Processing	450	340	897	297	758	2,742	13,729	0.200
Manufacturing	350	382	262	190	308	1,492	7,766	0.192
Trans & Trade	490	358	475	245	451	2,019	11,091	0.182
All Other	351	254	315	288	326	1,534	10,749	0.143
Total	4,768	3,041	6,822	2,464	3,734	20,829	117,587	0.177
Nonmetro Employment Share	857,186	837,269	803,316	740,074	848,285	4,086,131	24,027,038	0.170
	0.0056	0.0036	0.0085	0.0033	0.0044	0.0051	0.0049	
Total								
Livestock	1,261	845	3,366	508	1,272	7,252	41,069	0.177
Grains & Oilseeds	2,553	1,439	2,085	353	279	6,708	17,206	0.390
Other Crops	809	505	137	2,282	1,227	4,960	91,538	0.054
Food Processing	2,269	883	1,586	1,143	1,859	7,742	44,544	0.174
Manufacturing	1,987	1,238	488	1,211	1,061	5,985	32,125	0.186
Trans & Trade	6,807	1,894	1,282	2,496	1,795	14,273	85,984	0.166
All Other	3,428	1,358	745	2,189	1,310	9,029	73,619	0.123
Total	19,113	8,163	9,688	10,182	8,803	55,949	386,156	0.145
Total Employment Share	5,769,542	3,087,852	1,504,395	4,490,922	2,740,652	17,593,364	124,878,172	0.141
	0.0033	0.0026	0.0064	0.0023	0.0032	0.0032	0.0031	

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