Cultivating Trade:

The Economic Impact of Indiana's Agricultural Exports

April 2012

Research conducted by
Indiana Business Research Center, Kelley School of Business, Indiana University

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Executive Summary

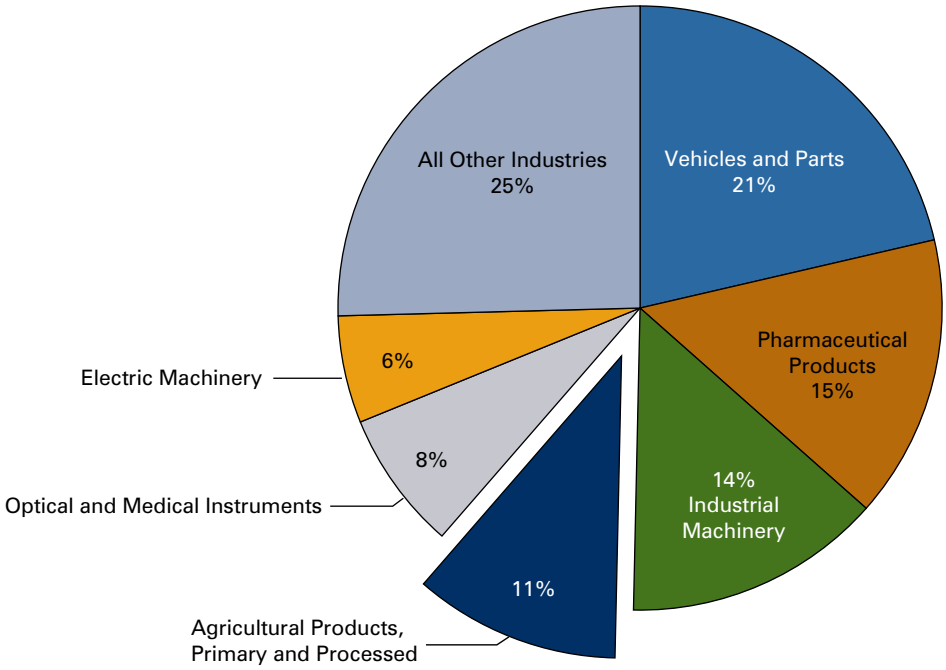
Agriculture is integral to Indiana's economy. The agricultural sector accounted for 3.3 percent of the state's GDP in 2009. According to the Bureau of Economic Analysis, more than 100,000 Hoosiers worked directly on farms or in agricultural processing and food manufacturing in 2010, producing food and food products for the state, the nation and for the global marketplace.

The growth of foreign markets for agricultural products has only enhanced the significance of this sector in the Hoosier state. For instance, the dollar value of Indiana's agricultural exports has more than doubled from $1.5 billion in 2000 to $3.4 billion in 2010. In 2010, Indiana ranked as the nation's eighth largest agricultural exporter. An estimated 18,100 Hoosier jobs, and an estimated $620 million in employee compensation and proprietors' income, can be directly linked to these exports.

These figures tell only part of the story. Indiana's farmers and food manufacturers purchase many of their production inputs from other Hoosier businesses. Agriculture industry workers and the workers of the firms that supply inputs to agricultural production generate additional economic activity when they spend their earnings. As a result, there are economic ripple effects throughout the state from agricultural exports.

This report details the economic benefits of agricultural exports on the Indiana economy. The first section provides a profile of the state's agricultural production and export trends. The second section presents the results of an economic impact analysis that captures the broad economic effects of agricultural exports. This analysis details the contributions these exports make to the state in terms of economic output, employment, income and government revenues.

Figure 1: State Export Shares by Industry, 2010



Source: IBRC, using WISER Trade and ERS data from the USDA

Key Findings

- Indiana's agriculture industry exported $3.4 billion worth of primary commodities and processed goods in 2010, accounting for 11 percent of all state exports (see **Figure 1**). The ripple effects from these sales spurred $2.2 billion in additional economic activity in the state, bringing the total economic footprint of agricultural exports to $5.6 billion.

- The combined effects of agricultural exports supported an estimated 34,800 jobs around the state. Approximately 18,100 of these jobs were on farms or in food processing activities. Purchases in the agriculture supply chain and the household spending of farm workers and other industry employees accounted for an additional 16,700 jobs.

- Every 10 jobs directly related to Indiana's agricultural exports supported an additional

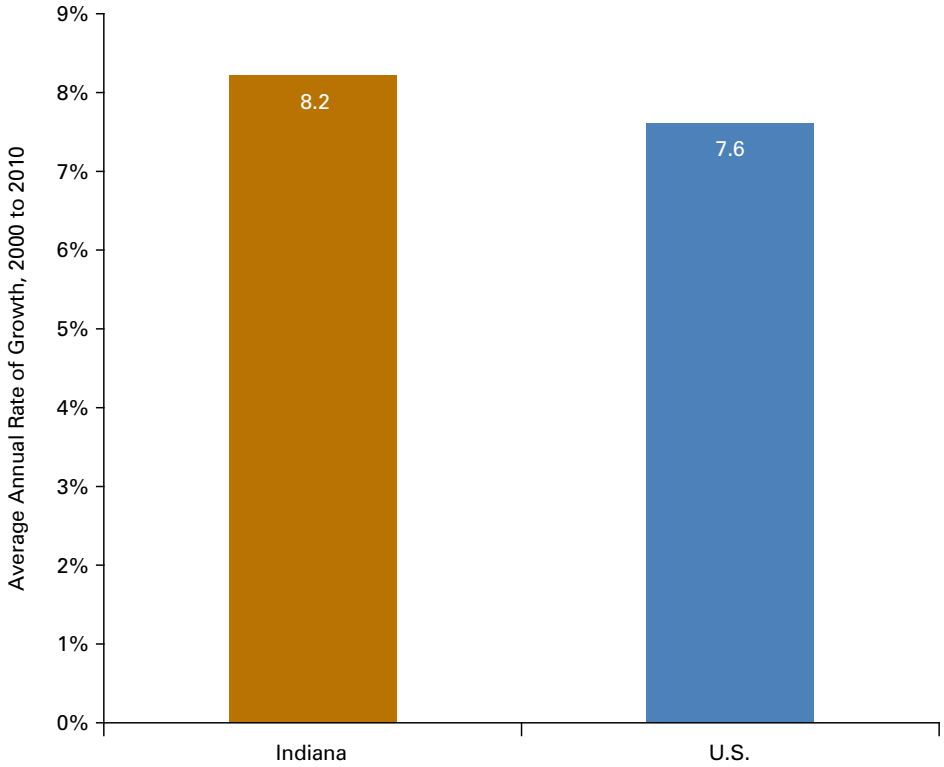
> *Soybeans and related products accounted for half of Indiana's agricultural exports in 2010, totaling $1.7 billion.*

nine jobs at other Hoosier businesses in 2010. The ratio of total employment to direct employment effects—the employment multiplier—for the agricultural sector is 1.9.

- Soybeans and related products accounted for half of Indiana's agricultural exports in 2010, totaling $1.7 billion. These exports generated an estimated $1.1 billion in economic ripple effects, supporting an estimated 17,700 jobs throughout the state.

- Indiana exported $800 million in feed grains and related products in 2010. Livestock and meat, poultry products and wheat products rounded out the state's five largest agricultural export commodity groups.

Figure 2: Growth Rate of Agricultural Exports, 2000 to 2010



Source: IBRC, using ERS data from the USDA

- Between 2002 and 2010, the state's agricultural product exports had a nominal value increase of 133 percent (92 percent in constant dollars), whereas non-agricultural product exports had a nearly 90 percent nominal value increase (50 percent in constant dollars).

- The value of Hoosier agricultural exports grew at an average annual rate of 8.2 percent from 2000 to 2010, exceeding the U.S. average rate of 7.6 percent in current dollars (see **Figure 2**).

- The economic activity generated by Indiana's agricultural exports produced an estimated $185 million in state and local government revenues and $224 million in federal government collections in 2010. ■

Indiana's Agricultural Production and Trade Volume

Agriculture is thriving in Indiana. The agricultural sector accounted for 3.3 percent of the state's GDP in 2009. According to the Bureau of Economic Analysis, more than 100,000 Hoosiers worked directly on farms or in agricultural processing and food manufacturing in 2010, producing food and food products for the state, the nation and for the global marketplace.

Agricultural production originates at the 62,000 farms covering 14.8 million acres located throughout the state. In 2010, farm income received from crop and livestock production was valued at $9.4 billion, a 104.5 percent increase since 2000.[1] In constant dollars (using 2000 as the base), farm income was $7.4 billion, reflecting a 61.5 percent increase from 2000.[2] An analysis of 2007 figures found that Indiana agriculture has a dramatic ripple effect on local economies. The Indiana State Department of Agriculture reported that for every dollar in direct wages and income from farm, food and forest workers, more than 2.5 times that amount flows into a local economy.[3] When summed up, the agriculture industry adds $25 billion to the state's economy.

> *More than 100,000 Hoosiers worked directly on farms or in agricultural processing and food manufacturing in 2010, producing food and food products for the state, the nation and for the global marketplace.*

It is clear that the sector contributes to the state's economy as an employer, but it also contributes a significant share of the state's exports abroad. While the importance of the state's agriculture industry is well documented, the impact of agricultural exports has not received as much attention. In 2010, the state exported approximately $27.6 billion in non-agricultural products, a nearly 90 percent increase since 2002. That same year, the state exported $3.4 billion of agricultural products (including both primary and processed products)—133 percent growth since 2002. In constant dollars, non-agricultural exports expanded 50 percent since 2002 (to $21.8 billion), whereas agriculture exports increased 92 percent (to $2.7 billion).

The following two sections address the production and export trends within the last decade, followed by the economic impact that Indiana's agriculture exports had on the state in 2010.

Agricultural Production

The output of primary agricultural commodities varies each year. Some commodities experience greater levels of output volatility due to weather patterns and forecasted demand, while others have remained relatively stable over time. Data from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) Indiana Field Office were used to determine the levels of production, quantity sold or marketed, and value. NASS suppresses some statistics to maintain the confidentiality of producers if reporting production figures could reveal competitive information.

Table 1 shows production volume and the current dollar value of primary agriculture commodities. Most commodities have seen an increase in production levels since 2000, likely due to increased yields

[1] This figure omits fish farming, seafood production, logs and timber production and income received from agricultural services (i.e., machine hire and custom work). These commodities were not used in this report due to the U.S. Department of Agriculture's (USDA) Economic Research Service (ERS) not reporting these commodities in their export figures.

[2] If one were to include additional farm income from machine hire and custom work, forest products sold, rental value of farm dwellings and other farm income, the value of agricultural sector production increases to $10.5 billion ($8.3 billion in constant dollars).

[3] "Indiana State Department of Agriculture," National Association of State Departments of Agriculture, www.nasda.org/cms/8769.aspx.

Table 1: Indiana Agricultural Production Volume and Value, 2010

Commodity Group	Production Volume (Millions of Units)		Production Value ($ Thousands)		Price per Unit
	2010	Change since 2000	2010	Change since 2000	Change since 2000
Grains (bushels) Includes corn, soybeans, oats, wheat and field and miscellaneous crops	1,170.9	6.5%	16,361,898	181.2%	160.4%
Livestock (pounds sold) Includes swine, cattle, sheep, chickens and turkeys	2,733.1	23.3%	1,665,359	68.2%	46.4%
Milk (pounds sold)	3,408	45.8%	594,082	94.7%	33.6%
Eggs	6,493	6.5%	373,592	42.5%	33.8%
Vegetables (pounds) Includes sweet corn, tomatoes, snap beans, tomatoes and cucumbers	459.9	-10.1%	51,916	8.5%	40.5%
Fruits (pounds) Includes cantaloupes and watermelon	393.7	44.8%	38,554	91.4%	24.2%
Specialty products (pounds) Includes honey, spearmint and peppermint	1.17	-2.1%	18,296	162.6%	116.8%

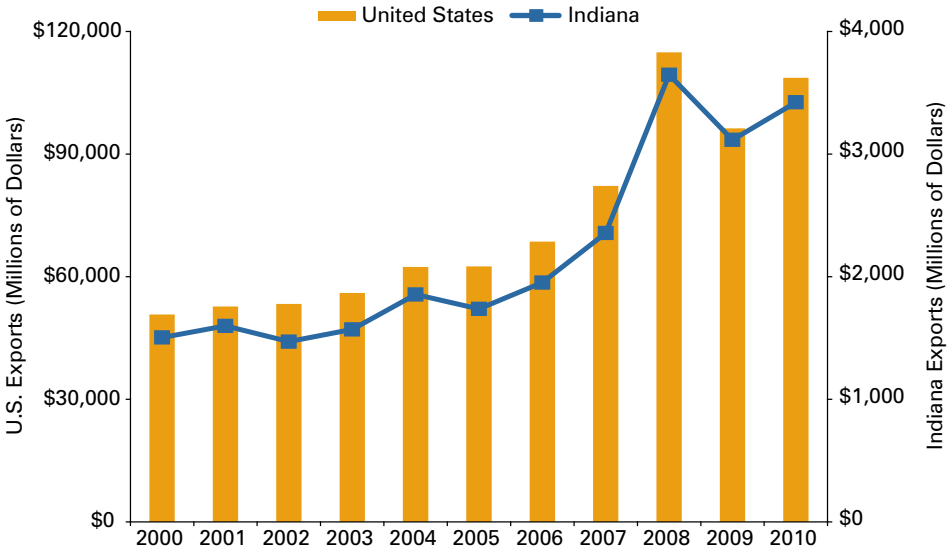
Notes: The price per unit reflects averages of the commodities within a commodity group to determine the change over time. Some data were suppressed due to confidentiality restrictions.
Source: IBRC, using Indiana NASS data

"The value of production has increased in nearly every commodity group by double or triple digits."

per acre, support for livestock production, growing demand for local agricultural goods and new entrants to the market. Specific commodities with the largest increases in production volume in the past decade include watermelons (79.1 percent), turkeys (49.4 percent), milk (45.8 percent), sweet corn (42.4 percent) and spearmint (41.4 percent). Commodities with the largest decreases in production include oats (-72.9 percent), wheat (-60.8 percent) and fresh tomatoes (-56.5 percent).

The value of production has increased by double or triple digits in every commodity group except vegetables. Changes in value can be attributed to either changes in unit prices, changes in unit volume or both. **Table 1** presents changes in both volume and price between 2000 and 2010. Grains had the largest increase in price per unit (160.4 percent) followed by specialty products (116.8 percent); however while grain production volume increased, the volume of specialty products fell slightly.

Figure 3: Value of Agricultural Exports, U.S. and Indiana, 2000 to 2010



Note: A strong correlation between the U.S. and Indiana export growth is due to the methodology used by USDA's ERS to determine state export data. See appendix for more information.
Source: IBRC, using ERS data from the USDA

Agricultural Products Exports

The USDA's Economic Research Service (ERS) division provides state-level information on the value of agricultural exports. The ERS utilizes NASS production data to determine each state's export share for each commodity group.[4]

ERS reports data on 20 commodity groups, aggregating both primary and processed goods that stem from the original commodity. For example, within the fruit and preparations category, both fresh oranges and frozen orange juice concentrate would be included in the total export value. In 2010, the nation exported nearly $108.7 billion of agricultural goods. Indiana alone exported a little more than $3.4 billion of agricultural goods, or 3.1 percent of all agricultural goods exported. Agricultural products comprise approximately 11 percent of the value of goods that Indiana exports.[5] Since 2000, the value of Indiana's agricultural exports has grown 127.5 percent, exceeding the national growth of 114.1 percent (see **Figure 3**). In constant dollars, Indiana export growth was 79.7 percent, compared to 69 percent for the nation.

Indiana's farmland produces an abundance of corn and soybeans. The Hoosier state is also known for its livestock production, particularly poultry and hogs. The state has several milling facilities that convert crops into more-processed products. As shown in **Table 2**, more than 90 percent of Indiana's agricultural exports come from just four commodities: soybeans and related products (50 percent), feed grains (23 percent), live animals and meat (11 percent), and poultry and its related products (8 percent).

Nationally, nearly all commodities have experienced an increase in export value, with tree nuts, dairy products, and soybeans and products leading the way. Likewise, nearly all of Indiana's exported commodities have seen increases, with the exception of other agricultural products, dairy products and unmanufactured tobacco. Four of Indiana's commodity groups exceeded the national growth rates: live animals and meat; poultry and products; vegetables and preparations; and hides and skins.[6] ■

Table 2: U.S. and Indiana Export Shares and Growth, 2000 to 2010

Commodity	U.S.		Indiana	
	2010 Share	Growth 2000-2010	2010 Share	Growth 2000-2010
Soybeans and Products	20.3%	232.2%	50.1%	182.2%
Other	13.7%	126.1%	1.1%	-21.9%
Feed Grains	11.0%	80.3%	23.4%	64.1%
Live Animals and Meat	8.2%	39.0%	11.0%	261.5%
Wheat and Products	8.0%	89.0%	3.2%	32.5%
Fruit and Preparations	5.6%	80.9%	0.3%	57.8%
Vegetables and Preparations	5.1%	74.5%	0.3%	91.8%
Cotton and Linters	4.5%	164.6%	0.0%	0.0%
Feeds and Fodders	4.5%	160.1%	1.5%	109.8%
Poultry and Products	4.3%	106.6%	7.7%	202.1%
Tree Nuts	3.7%	315.3%	0.0%	0.0%
Dairy Products	3.2%	246.3%	0.0%	-96.6%
Rice	2.3%	147.0%	0.0%	0.0%
Hides and Skins	2.0%	48.2%	0.1%	49.9%
Unmanufactured Tobacco	1.1%	-0.5%	0.0%	-100.0%
Seeds	1.1%	57.9%	1.1%	8.2%
Fats, Oils and Greases	0.9%	125.3%	0.3%	116.5%
Peanuts and Products	0.3%	18.8%	0.0%	0.0%
Sunflower and Products	0.2%	8.7%	0.0%	0.0%
Cottonseed and Products	0.1%	43.4%	0.0%	0.0%

Notes: Highlighted cells indicate that Indiana's percentage was higher than the nation's. The 'Other' category represents sugar and tropical products, minor oilseeds, essential oils, beverages other than juice, nursery and greenhouse, wine and miscellaneous horticultural and vegetable products. Feed grains include primary corn, rye, barley and oats and its processed products.
Source: IBRC, using ERS data from the USDA

[4] The ERS approach differs from the Census Bureau reported export data. The Census collects export data based on port locations. As a result, Census export data are based on origin of movement, not where the commodities are produced. More detailed information on the differences between these two data sources and subsequent modeling methodology used for the ERS data can be found in the appendix.

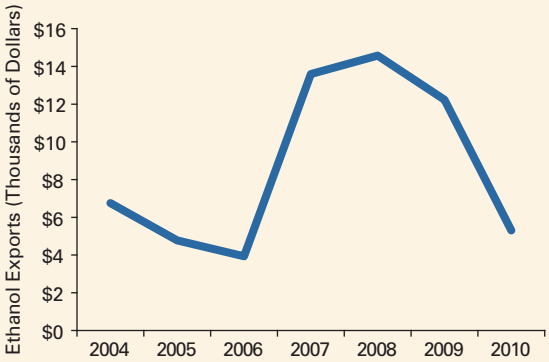
[5] This figure is approximate as two different data sources were used to arrive at this number. WISER Trade presents export figures using Census Bureau estimates; thus this calculation replaced WISER Trade's agricultural export figures with the ERS figures to generate a rough estimate.

[6] The data series for many of these agricultural products is not sufficiently detailed to determine whether the increase in value is attributed to increases in price or increases in volume.

Ethanol Exports

Approximately 40 percent of Hoosier corn production is used for ethanol production and its by-products within the state. But because ethanol production is classified within the manufacturing sector, ethanol exports are not captured in USDA's ERS state export data. An alternative data source—the Global Agricultural Trade System (GATS)—reports that Indiana exported $5.3 million worth of ethanol in 2010. This represents a 21.4 percent decrease since 2004 (earliest year reported), a reflection of the volatile nature of the ethanol exports (see **Figure 4**). The Canadian market strongly influences export trends—as it imported 69 percent of the state's ethanol exports in 2010. Given the changing economics of ethanol production and consumption in the U.S. and among U.S. trading partners, ethanol export volatility is likely to continue.

Figure 4: Indiana's Ethanol Exports, 2004-2010



Source: IBRC, using Global Agricultural Trade System data

The Economic Contributions of Indiana's Agricultural Exports

The economic benefits of Indiana's agricultural exports extend beyond the dollar value of production. The state's farmers and food manufacturers purchase many inputs from other Indiana businesses. The economic activity spurred by the purchase of these production inputs—along with the household spending of farmers and other agriculture industry employees—cascade throughout the state's economy. The research team used the IMPLAN economic modeling software in order to comprehensively account for the economic benefits associated with the state's agricultural exports.

The IMPLAN model takes into account the structure of the Indiana economy. For example, the model incorporates the fact that Indiana's grain producers purchase nearly half of their production inputs from other Hoosier establishments. The estimated economic effects of these supply chain purchases are represented in the "indirect effects" columns of the following tables. Additionally, agricultural workers—as well as employees throughout the supply chain—spend their earnings on food, clothing, health care, entertainment, etc. The estimated ripple effects from workers' spending are reported in the "induced effects" columns.[7]

Table 3: The Economic Contribution of Agricultural Exports to Indiana's Economy, 2010

	Direct Effects	Indirect Effects	Induced Effects	Total	Multiplier
Output ($ Millions)	$3,422.1	$1,343.7	$831.1	$5,596.9	1.64
Employee Compensation ($ Millions)	$620.4	$335.1	$274.6	$1,230.1	1.98
Employment	18,100	8,900	7,800	34,800	1.92
Compensation per Job	$34,300	$37,600	$35,200	$35,300	-

Note: Employee compensation includes wages and salaries as well as benefits and employer contributions to government social insurance. For the purposes of these results, the research team included estimates of proprietors' income in employee compensation. However, these are typically reported separately.
Source: IBRC, using ERS data from the USDA and the IMPLAN economic modeling software

Summary of Economic Contributions

Indiana's $3.4 billion worth of agricultural exports in 2010 is presented in the direct effects cell in **Table 3**. This level of production supported an estimated

[7] See the appendix for a more detailed explanation of the key terms used in this report.

Table 4: The Economic Contribution of Agricultural Exports by Commodity, 2010 ($ Millions)

Commodity Group	Direct Output	Indirect Output	Induced Output	Total Output	Multiplier
Soybeans and Products	$1,714.9	$634.2	$450.9	$2,800.1	1.63
Feed Grains	801.6	324.5	189.0	1,315.2	1.64
Live Animals and Meat	376.6	171.8	63.6	612.0	1.63
Poultry and Products	264.6	110.1	58.5	433.2	1.64
Wheat and Products	107.7	42.6	26.1	176.4	1.64
Feeds and Fodders	50.4	20.2	6.1	76.7	1.52
Other	37.7	14.5	9.3	61.5	1.63
Seeds	36.3	13.3	10.1	59.6	1.64
Fruit and Preparations	10.6	3.1	9.5	23.2	2.19
Vegetables and Preparations	8.4	3.1	5.8	17.3	2.06
Fats, Oils and Greases	8.7	4.1	1.5	14.3	1.64
Hides and Skins	4.5	2.1	0.8	7.4	1.64
Dairy Products	0.10	0.05	0.01	0.17	1.67
Total	**$3,422.1**	**$1,343.7**	**$831.1**	**$5,596.9**	**1.64**

Source: IBRC, using ERS data from the USDA and the IMPLAN economic modeling software

"The total economic footprint of Indiana's agricultural exports is 5.6 billion."

18,100 jobs and roughly $620 million in employee compensation and proprietor income. These figures translate to a compensation per job estimate of $34,300.

The $3.4 billion in direct output generated an estimated $2.2 billion in economic ripple effects (indirect effect plus induced effect) to bring the total economic footprint of agricultural exports to $5.6 billion.

Multipliers offer a useful way to interpret these effects. The ratio of total effects to direct output effects yields a multiplier of 1.64, meaning that each dollar of output generated by Indiana's agricultural exports stimulates another $0.64 in economic activity in the state.

The ripple effects of these exports also support additional jobs in the state. In addition to the estimated 18,100 direct jobs on farms and in agricultural processing, the purchase of production inputs from Indiana suppliers accounts for an estimated 8,900 additional jobs in the state. The household spending of these direct and indirect workers supports another 7,800 jobs locally. This brings the total employment effect to an estimated 34,800 jobs. The ratio of total employment effects to direct employment results in a multiplier of 1.92, meaning that every 100 jobs directly related to Indiana's agricultural exports supported an additional 92 jobs in the state in 2010.

Economic Contributions by Commodity[8]

Soybeans and related products accounted for more than half of the dollar value of Indiana's agricultural exports in 2010, as shown in **Table 4**. The ripple effects of soybean exports spurred an estimated $1.1 billion in additional economic activity throughout the state to bring the total impact to $2.8 billion. The combined effects of Indiana's feed grain exports, which include primary commodities such as corn and its related processed

[8] While it would have been preferable to break out crop and livestock production from the processing of food products in order to estimate the economic impacts for farming and manufacturing separately, ERS does not report the data according to the stage of production. As a result, products such as apples are aggregated with products such as applesauce and fruit roll-ups into one commodity category "fruits and fruit preparations." For the purposes of modeling the different stages of value-added—one for primary agricultural production and several for food processing—the research analysts estimated each production type's share of total production in a given commodity group and then modeled their effects in the appropriate IMPLAN industries. The results were then summed back to the original commodity groups. Please see the Appendix for more information on the data and the estimation method.

Table 5: Number of Employees Supported by Agricultural Exports by Commodity, 2010

Commodity Group	Direct Employment	Indirect Employment	Induced Employment	Total Employment	Multiplier
Soybeans and Products	9,120	4,330	4,220	17,670	1.94
Feed Grains	5,650	2,150	1,770	9,570	1.69
Live Animals and Meat	920	1,230	590	2,740	2.98
Poultry and Products	1,100	520	540	2,160	1.96
Wheat and Products	690	290	240	1,220	1.77
Seeds	380	90	90	560	1.47
Other	110	100	90	300	2.73
Feeds and Fodders	40	100	60	200	5.00
Fruit and Preparations	40	20	90	150	3.75
Vegetables and Preparations	30	20	50	100	3.33
Fats, Oils and Greases	20	30	10	60	3.00
Hides and Skins	10	20	10	40	4.00
Dairy Products	†	†	†	†	†
Total	**18,100**	**8,900**	**7,800**	**34,800**	**1.92**

† Due to the relative size of the dairy products commodity output, employment figures are suppressed
Source: IBRC, using ERS data from the USDA and the IMPLAN economic modeling software

"Indiana's soybean exports supported an estimated 9,120 direct jobs in 2010."

goods, totaled more than $1.3 billion in 2010. Livestock, meat and poultry exports combined to generate more than $1 billion in total output in the state, while wheat and related products contributed $176 million in total economic activity.

Indiana's soybean exports supported an estimated 9,120 direct jobs in 2010. The export of feed grains had a direct employment impact of 5,650 (see **Table 5**). Once the supply chain purchases and household spending associated with these exports are considered, the total employment effects jump to 17,670 and 9,570, respectively. Combining the direct and ripple effects from Indiana's livestock and meat exports accounted for a total of 2,740 jobs. Poultry exports had a total employment effect of 2,160.

Table 6: Tax Effects of Indiana's Agricultural Exports, 2010 ($ Millions)

Tax Effects	Direct Effects	Indirect Effects	Induced Effects	Total
State and Local	$60.9	$68.4	$55.9	**$185.2**
Federal	$97.6	$69.8	$56.9	**$224.3**

Source: IBRC, using ERS data from the USDA and the IMPLAN economic modeling software

Tax Effects

The direct, indirect and induced economic activity created by Indiana's agricultural exports also generates federal, state and local government revenues. The IMPLAN model estimates the tax revenues from corporate profit taxes, indirect business taxes (e.g., sales, property and excise taxes), personal taxes (e.g., income and property taxes) and employer and employee contributions to social insurance. The largest share of federal revenue comes from contributions to social insurance. On the state and local level, indirect business taxes are the largest source of government revenues. As **Table 6** shows, the economic activity related to all of Indiana's agricultural exports generated an estimated $224 million in federal revenues and $185 million in state and local collections. ■

Conclusion

Business leaders, policymakers and economic development professionals understand that exports are an important driver for robust and sustained economic growth. Agricultural products certainly play a key role in improving the export performance of the nation and the state. As the world's population multiplies and the fortunes of developing countries improve, the demand for agricultural products will continue to rise. The effect of worldwide demand has already boosted the value of agriculture production, contributing to sustained high prices for agricultural commodities.

In response to increased demand, agricultural technology improvements, support for livestock production and new entrants to the market, Indiana's production levels have increased for nearly every agricultural commodity. Concurrently, agricultural export values have grown robustly, 127.5 percent since 2000, surpassing non-agricultural products' export growth. As of 2010, Indiana was the nation's eighth largest exporter of agricultural products at $3.4 billion. Of these exports, half are soybeans and its products valued at $1.7 billion.

The ripple effects from Indiana's agricultural exports are impressive. The combined effects of these export sales in 2010 generated $5.6 billion in economic output and supported an estimated 34,800 jobs around the state. Therefore, efforts to expand existing export markets for agricultural goods, and to open new ones, should have significant positive ripple effects throughout the Indiana economy. With this in mind, the degree to which Indiana's agricultural exports increase in the coming years will be an important economic indicator to watch. ■

Appendix

About the Data

Primary agricultural products are homogeneous in nature, a trait that complicates traditional collection of export data. Due to a large share of U.S. agricultural commodity exports being produced in inland states, the origin of production is lost in the transportation process to get the commodity to its port. Consider that once a crop is harvested from the field, the commodity is typically sold to a local elevator, which in turn may sell it to a larger elevator located at a major transportation hub. At this point, the commodity may travel directly to a port or to a grain processing facility for further processing—often comingled with agricultural commodities from other regions. To reach its final port destination, the original truckload dumped at the local elevator may have traveled through multiple states, thus the production origin is lost.

The U.S. Customs and Border Protection collects and reports export data to the Census Bureau. These data reflect the origin of movement however. For agricultural products, this often means that the state from which the commodity leaves the U.S.—not the state that originally produced the commodity—is reported by the exporter.

To remedy this problem, the ERS estimates state agricultural exports by using the Custom's district-level export data compiled by the U.S. Census Bureau and the state-level agricultural production data supplied by the National Agricultural Statistics Service (NASS). Hence the state's share of production of the commodity is applied to the U.S. export figure for the commodity to derive its export value or production share.

The key difference between the ERS and Census Bureau estimates is that origin of movement estimates are developed with business and manufacturing as its focus whereas production share estimates are developed with agricultural production as the focus. Agricultural commodities traditionally exported in a less-processed form generally have a higher export value using the production share estimates for the state where the original production occurred. Conversely, commodities that are traditionally exported in a more highly processed form, the origin of movement estimates will have a higher export value in the state where the manufacturing or shipping occurred.[9]

Recognizing Indiana's dominance in corn and soybean production and the fact that neither data source was perfect nor was co-mingling the two sources possible, the researchers chose to use the ERS data. Therefore, the data associated with more processed goods may be underestimated; however we have confidence that the less-processed commodities' data are relatively accurate.

Another shortcoming of the ERS data is that the production values are reported for broad commodity groupings only. The feed grains category, for instance, includes the export of both the primary commodities as well as processed goods made from these grains. This level of aggregation presents a problem for an input-output analysis because these different types of production have very different supply chain requirements, leading to different multiplier effects.

To address this issue, IBRC researchers obtained from the USDA detailed lists of the Harmonized Tariff Schedule codes that comprise the broad commodity groupings in the ERS data. Researchers then downloaded the detailed 2010 export data for the U.S. from the Census Bureau source discussed earlier. Given that these are national-level data, the place of production versus origin of movement distinction is no longer relevant. Researchers then calculated each production type's share of the nation's total exports in a given commodity grouping and then applied that same proportion to the Indiana data. The effects of the different types of production were then modeled separately in the IMPLAN software and the results were then summed back to the original commodity groupings.

Key Terms

- ***Direct Effects:*** Refers to the increase in final demand or employment in Indiana that can be attributed specifically to agricultural exports.

- ***Indirect Effects:*** A measure of the change in dollars or employment caused when agricultural producers increase their purchases of goods and services from suppliers and, in turn, those suppliers purchase more inputs and so on throughout the economy. A corn milling operation, for instance, will buy inputs from a supplier. Those suppliers buy electricity to power their plants, buy material inputs for their products, and employ people to run the equipment. These transactions are the indirect

[9] Much of the methodology described for ERS and Census Bureau was taken from the ERS' methodology definition, found at www.ers.usda.gov/Data/StateExports/Methodology.aspx.

ripple effects associated with the corn milling operation's purchases.

- ***Induced Effects:*** These reflect the changes—whether in dollars or employment—that result from the household spending of agricultural employees and their suppliers. Induced spending will increase or decrease as output changes along the economic supply chain. For example, as a farm's production and sales increase, the output of its supply chain increases correspondingly. Those output changes also result in changes in household income and spending of suppliers' employees. Induced effects represent the change in overall economic output and employment resulting from such household spending changes.

- ***Total Effects:*** The total of all economic effects is the size of the economic impact and is the sum of the direct, indirect and induced effects.

- ***Tax Effects:*** The IMPLAN model also tracks the tax effects associated with all the transactions and economic activity associated with the direct and ripple effects. For example, household spending at retailers generates state sales tax. In addition, those retailers also pay property taxes to local governments. As a result, this analysis was also able to estimate the federal, state and local government tax flows.

- ***Multiplier:*** The multiplier is the magnitude of the economic response in a particular geographic area associated with a change—either an increase or a decrease—in the direct effects. For example, multiply every dollar of agricultural exports in 2010 by 1.64 to find an estimate of the total contribution of this activity to Indiana's economy. Another way to look at it is that every dollar of output supports $0.64 in additional economic activity in the state.

- ***Output:*** The value of an industry's total production. Output includes both the price of production inputs and the value-added of the industry.

- ***Employee Compensation:*** This measure includes wages and salaries as well as benefits and employer contributions to government social insurance. This term can be thought of as the total cost of labor to an employer. For the purposes of this study, compensation includes both employee compensation and proprietor's income. However, these are typically reported separately.

About IMPLAN Economic Impact Modeling Software

Minnesota IMPLAN Group, Inc. (MIG) is the company responsible for developing IMPLAN data and software. Using classic input-output analysis, IMPLAN can be used to measure the economic effects of an economic event, such as a factory closing or a new plant opening, or the size of the economic footprint of an economic entity like a production facility, headquarters or university.

IMPLAN is built on a mathematical input-output (I-O) model that expresses relationships between sectors of the economy in a chosen geographic location. In expressing the flow of dollars through a regional economy, the input-output model assumes fixed relationships between producers and their suppliers based on demand. It also omits any dollars spent outside of the regional economy—say, by producers who import primary goods from another area, or by employees who commute and do their household spending elsewhere.

The idea behind input-output modeling is that the inter-industry relationships within a region largely determine how that economy will respond to economic changes. In an I-O model, the increase in demand for a certain product or service causes a multiplier effect, layers of effect that come in a chain reaction. Increased demand for a product affects the producer of the product, the producer's employees, the producer's suppliers, the supplier's employees, and so on, ultimately generating a total effect in the economy that is greater than the initial change in demand. Say demand for Andersen Windows' wood window products increases. Sales grow, so Andersen has to hire more people, and the company may buy more from local vendors, and those vendors in turn have to hire more people... who in turn buy more groceries. The ratio of that overall effect to the initial change is called a regional multiplier and can be expressed like this:

(Direct Effect + Indirect Effects + Induced Effects) / (Direct Effect) = Multiplier

Multipliers are industry and region specific. Each industry has a unique output multiplier, because each industry has a different pattern of purchases from firms inside and outside of the regional economy. (The output multiplier is in turn used to calculate income and employment multipliers.)

Estimating a multiplier is not the end goal of IMPLAN users. Most wish to estimate other numbers and get the answers to the following questions: How many jobs will this new firm produce? How much will the local economy be affected by this plant closing? What will the effects be of an increase in product demand? Based on those user choices, IMPLAN software constructs "social accounts"

to measure the flow of dollars from purchasers to producers within the region. The data in those social accounts will set up the precise equations needed to finally answer those questions users have—about the impact of a new company, a plant closing or greater product demand.

IMPLAN constructs its input-output model using aggregated production, employment and trade data from local, regional and national sources, such as the U.S. Census Bureau's annual *County Business Patterns* report and the U.S. Bureau of Labor Statistics' annual report called *Covered Employment and Wages*. In addition to gathering enormous amounts of data from government sources, the company also estimates some data where they haven't been reported at the level of detail needed (county-level production data, for instance), or where detail is omitted in government reports to protect the confidentiality of individual companies whose data would be easily recognized due to a sparse population of businesses in the area.

IMPLAN's accessibility and ease of use also make it a target of criticism by some economists, who charge that in the wrong hands, the software—or any input-output model—will produce inflated results at best, and at worst, completely ridiculous projections. Anyone can point and click their way to an outcome without fully understanding the economics in which the tool is grounded and without knowing how to look at data sets with a nuanced eye. The IBRC has two analysts that have attended advanced training in the use of the IMPLAN modeling software. The estimates that the IBRC analysts generate are pressure-tested and triple-checked to ensure that they are accurate and reflect the most trustworthy application of the modeling software. In all instances, the most conservative estimation assumptions and procedures are used to produce the IMPLAN results. ■

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