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Evaluating the Impacts of Agricultural Exports on a Regional Economy

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ABSTRACT

Agricultural exports are important to many regional economies, as is the case for agricultural exports either produced in or shipped through Louisiana. A hybrid (revised and verified) IMPLAN model of the Louisiana economy is used to estimate the direct and indirect impact of agricultural exports. Original model estimates of foreign exports lacked holistic (overall) accuracy. However, other, more general uses of the model were unaffected by this lack of accuracy. While the contributions of agricultural exports to the state economy were substantial, impacts were concentrated in unprocessed products. Increasing the export of processed agricultural products should enhance economic activity.

Key Words: agricultural exports, holistic accuracy, IMPLAN, input-output models, processed exports.

International trade is important to the economic well-being of a nation and a region. In 1991, the United States was the world's largest trading nation, accounting for 14% of world imports and 12% of world exports. The European Community, Canada, and Japan are the major U.S. trading partners. However, exports to many developing countries, particularly in Asia and Latin America, have increased in recent years (see "The United States," in *Trade Policy Review*).

Further increases in U.S. trade are projected due to signing of the General Agreement on Tariffs and Trade (GATT) and of the North American Free Trade Agreement (NAFTA). The former will eventually lower trade barriers on a worldwide basis, while the latter will eliminate most trade barriers among the United States, Canada, and Mexico.

Exports of U.S. agricultural commodities increased dramatically in the 1970s. By 1990, agricultural exports accounted for about 15% of total U.S. merchandise exports. The United States is the world's leading exporter of feed grains, wheat, livestock products, soybean products, horticultural products, and rice ("The United States," *Trade Policy Review*). Yet, U.S. agricultural exports are concentrated in low-value, often unprocessed products (Burfisher and Missiaen).

Louisiana ports are major points of departure for U.S. agricultural exports (Falgout). Louisiana ports shipped $16.5 billion worth of exports in 1992, making the state the sixth largest port of exit in the nation. Between 55% and 60% of all commodities shipped through Louisiana ports were agricultural products (Falgout).

Louisiana also produces several agricultural commodities that depend heavily on foreign markets, such as cotton, rice, and soybeans.

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Certain processed food products, such as Louisiana poultry products, are also shipped overseas. Louisiana enjoys a strategic location for export markets in Latin America. As a result, the state may receive a disproportional benefit from expected increases in agricultural exports. This benefit will be enhanced if increases in Louisiana-produced agricultural exports are concentrated in higher valued, processed commodities.

This article summarizes findings regarding the impact of agricultural exports on the Louisiana economy using a revised (a so-called hybrid) input-output (I-O) model constructed with IMPLAN (Alward et al.). Emphasized here are revised estimates of agricultural exports in the model. Estimates of foreign exports can influence accuracy of study results when the variable is of direct concern. However, estimates of foreign exports influence estimates of regional supply available for regional consumption for IMPLAN models in all situations. Hence, a comparison is made of the effect of verified versus unverified foreign exports on general (holistic) model accuracy in evaluating the impact of foreign exports and in evaluating changes in final demand that are unrelated to foreign markets. Model results based on revised estimates of agricultural exports are used to examine the impact of processed versus unprocessed exports. Finally, model results are reviewed, summarized, and used to make policy recommendations.

Input-Output Models and International Exports

International trade activity influences most sectors in a regional economy. Sectors with direct sales to foreign markets are linked to many other local sectors. Because of these interindustry linkages and because of projected growth in exports, agricultural exports are expected to be an important determinant of future state economic growth. I-O analysis was selected as the analytical tool for this study because of its ability to analyze interdependencies among industries in an economy (Miller and Blair).

I-O models have been used in a number of studies examining the regional and national impacts of foreign trade. Belous and Wyckoff used I-O analysis to look at the net effect of increases in imports and exports on the U.S. economy. Holding the composition of imports and exports constant, they concluded that a million dollar increase in exports generated more jobs than were destroyed by a million dollar increase in imports. Martin and Holland examined the sources of change in national output from 1972 to 1977. They concluded that international trade had contributed to net increases in U.S. total output. Balassa and Noland applied forecasts of U.S. imports and exports for the year 2000 to I-O coefficients. They projected large employment losses in the apparel, footwear, and automobile industries and large employment gains in the coal, computing equipment, and machinery industries. Sharp employed an I-O model to predict the effects of increased exports to Mexico on the Texas economy. He predicted that increased exports to Mexico could generate a total of 113,000 state jobs. Hughes, Holland, and Wandschneider used results from an IMPLAN model of the Washington state economy to argue that growth in exports could help fill anticipated losses in employment due to cuts in military spending.

Holistic Accuracy and Hybrid I-O Models

An I-O model of the 1985 Louisiana economy built with the IMPLAN (IMpact PLANning) model building system is used in this study. IMPLAN is one of several so-called ready-made model building systems that provide access to databases and model construction methods in a computer software package. Such systems allow researchers to construct models by combining the national I-O table with secondary regional data. Hybrid I-O models are ready-made models that have been adapted and verified for a particular set of uses by incorporating additional secondary and primary data about the regional economy (Jensen; Brucker, Hastings, and Latham).

The Louisiana IMPLAN model had previously been converted to a hybrid model by applying secondary employment and income

data, by introducing new regional absorption vectors for eight major agricultural producing and processing sectors based on published and unpublished budgets for state firms, and by adjusting levels of regional exports and imports for 96 commodities based on expert opinion (Hughes). A major focus here is on incorporating other primary and secondary data not initially used in IMPLAN to more accurately estimate sales to foreign markets by Louisiana agricultural producers.

The concept of holistic versus partitive accuracy provides a guideline in constructing regional hybrid input-output models. Partitive accuracy can be defined as the closeness of any given cell in an input-output table to the actual but unknown value for the represented economy. Holistic accuracy concerns the ability of an input-output table to represent the essential elements of an economy (Jensen). Only the latter is a worthy goal in the construction of any regional input-output model because the accuracy of relatively small values in an input-output table has little bearing on model results, as demonstrated by Jensen and West.

The concepts of partitive and holistic accuracy are best understood in terms of model use—a fact that has been underemphasized in the literature in our view. For example, assume that a major sector of a regional economy is poorly represented in a regional economic model, but that the model is an adequate representation in other respects. For a general study of the economy or for a study where the sector is directly or indirectly affected in a substantive way, the model in question would lack holistic accuracy (i.e., use of the model would cause researchers to draw misleading inferences). However, if the sector is not affected in a substantive way in the scenarios evaluated for a given study, then the model is accurate from a holistic perspective *for that particular study* (if not for other studies). This perspective provides the justification for examining the impact of changes in export estimates on the holistic accuracy of the IMPLAN model.

While IMPLAN-based models are widely used in regional impact analysis, little analysis has been conducted concerning the accuracy of IMPLAN-based estimates of foreign trade. Therefore, a question arises concerning the holistic accuracy of IMPLAN in studying the regional effects of trade policies. Perhaps more important—because estimates of foreign trade are deduced from estimates of regional commodity supply—estimates of the former can influence the holistic accuracy of IMPLAN models for studies unconcerned with foreign trade. Comparing model results under original export estimates to model results under new export estimates should provide an indication of how holistic accuracy is affected when the variable is of direct concern and when estimates of foreign exports only indirectly influence model accuracy.

Estimating New Levels of Louisiana Agricultural Exports

The hybrid IMPLAN I-O models for Louisiana in 1985 provided initial estimates of international exports for state firms. Estimates of exports for 20 agricultural industries in the IMPLAN I-O model were supplemented by secondary and primary data. Using the Standard Industrial Classification (SIC) sector codes, information was gathered on agriculturally based products classified as production agriculture (SIC 01 and 02), processed foods (SIC 20), wood and lumber (SIC 24), and pulp and paper products (SIC 26).

Assume that the level of agricultural exports shipped through Louisiana is known. Also assume that all foreign agricultural exports originating in Louisiana are shipped through its ports. Estimates of foreign exports of Louisiana agricultural commodities are then obtained by determining the proportion of the agricultural commodities shipped through Louisiana that are produced in Louisiana.

The New Orleans U.S. Customs District export data provided an estimate of agricultural products shipped through Louisiana. The district includes all Louisiana ports and ports in Mississippi, Tennessee, and Arkansas that are situated on the Mississippi River and its tributaries. Of these ports, only the Louisiana ports of New Orleans, Baton Rouge, Lake

Charles, and the port of South Louisiana (the Mississippi River between Baton Rouge and New Orleans) are capable of accommodating ocean-going vessels (U.S. Army Corps of Engineers). Thus, all export data for the customs district were compiled at one of these ports of exit.

The value of all agricultural commodities shipped through the New Orleans Customs District for 1989 through 1992 was taken from "U.S. Exports and Imports of Merchandise" on CD-ROM (U.S. Department of Commerce, Bureau of the Census). To be consistent with the 1985 IMPLAN model, these values were deflated to 1985 dollars using the appropriate producer price index.

The total estimated annual average value from 1989–92 of agricultural exports shipped through Louisiana ports was $10.897 billion in 1985 dollars. Food grains, oil-bearing crops, and feed grains were the three IMPLAN industries with the largest share of the value of agricultural exports shipped through Louisiana ports. These three industries included wheat, rough rice, corn, sorghum, and soybeans, which contributed more than 75% (or $8.212 billion) in total agricultural exports annually shipped through Louisiana over this period.

A telephone survey of major agricultural exporters in Louisiana was conducted to obtain the percentage of agricultural exports going through Louisiana ports that originated there. A stratified random sample, based on the four-digit Standard Industrial Classification (SIC) code, was used to ensure coverage of all agricultural exports. A list of 100 trading companies that exported agricultural products was drawn from the *Louisiana Agricultural Export Directory* (Louisiana Department of Agriculture and Forestry). Firms were contacted based on industry prevalence in the Louisiana economy and involvement in export markets. For example, 10 firms involved with the export of milled rice—an important state industry that is heavily dependent on foreign markets—were surveyed. On the other hand, only three firms involved in the export of cottonseed oil—a less important state industry—were contacted.

Across the 20 major industry categories in the Louisiana IMPLAN model shown in table 1, the number of surveyed firms ranged from three to 10. For seven out of the 20 IMPLAN industry categories, seven firms were represented (the mode for the distribution of contacted firms by industry category).

The distribution of respondents indicated broad coverage of Louisiana agricultural exporters. For agricultural products that they handled, 63 of the 100 firms were willing to estimate the percentage produced in Louisiana out of the amount shipped through Louisiana ports. The number of respondents in each of the 20 IMPLAN industry categories ranged from one to seven, with four respondents represented in six of the 20 categories (the mode of the distribution of responding firms). At least three firms responded to the survey question for 15 out of the 20 IMPLAN industry categories. The percentage of surveyed firms in each IMPLAN industry category willing to provide an estimate of the percentage level of exports ranged from 33.3% to 100%. For 16 out of 20 of the IMPLAN industry categories, at least 50% of the surveyed firms were willing to provide an estimate of the percentage of Louisiana-produced commodities versus goods produced elsewhere. Further, response rates tended to be high for important state industries with large levels of exports, such as a 70% (seven firms) response rate for rice milling and an 85.8% (six firms) response rate for lumber products.

The estimated value of agricultural exports originating in Louisiana, the percentages obtained from the survey, and the levels of agricultural exports moving through Louisiana are provided in table 1. Within each major IMPLAN industry category, responses by each firm were given equal weight in assigning the survey-based coefficients.[1] Louisiana ports provided an export channel for $9.989 billion in agricultural commodities produced in other states. Louisiana itself exported $962.632 mil-

[1] An equal weight was used because surveyed firms were, in general, unwilling to provide information concerning the actual dollar value of exports.

Table 1. Trade and Survey Data Estimates of Agricultural Exports Originating in Louisiana as an Annual Average, 1989–92 (millions 1985 $)

IMPLAN Industry by Sector Code		Exports Through Ports of Louisiana ($ mil.)	Survey-Based Coefficient	Louisiana-Produced Exports ($ mil.)
10	Cotton	185.650	0.3	55.695
11	Food Grains	1,254.950	0.02	25.099
12	Feed Grains	3,843.720	0.01	38.437
21	Oil-Bearing Crops	3,112.971	0.025	77.824
82	Meat Packing	13.153	0.9	11.838
84	Poultry & Egg Processing	10.593	0.9	9.534
87	Dairy Products	45.232	0.9	40.709
91	Processed Fish & Seafood	8.928	1.0	8.928
92	Other Canned & Frozen Products	17.784	0.6	10.670
93	Canned Fruits & Vegetables	3.280	0.6	1.968
99	Bread Products	66.516	0.6	39.910
103	Other Processed Fats, Feeds	300.302	0.1	30.030
104	Rice Milling	337.617	0.4	135.047
109	Sugar Processing	106.441	0.8	85.153
112	Beverages	31.653	0.7	22.157
118	Cottonseed Oil Mills	1.738	0.5	0.869
119	Soybean Oil Mills	994.559	0.01	9.946
124	Miscellaneous Food Processing	43.284	0.05	2.164
160	Lumber	125.533	0.7	87.873
187	Paper Products	447.969	0.6	268.781
	Total	10,951.876	0.08	962.632

lion in agricultural products grown or manufactured in the state.

The paper products category reflected the largest level of Louisiana agricultural exports, with a value of $268.781 million (table 1). Rice milling was also a major contributor with state agricultural exports of $135.047 million. Lumber, sugar processing, and oil-bearing crops were other industries with high levels of agricultural exports. These five industries together were responsible for 67.9% of agricultural exports produced in Louisiana.

Other data sources were used to evaluate the assumption that all Louisiana-produced products were shipped through the state. The only studies addressing this issue consisted of a set of publications concerning movement of soybeans, wheat, oats, sorghum, and corn. Studies of product movements were not available for other unprocessed or for any processed agricultural products. Researchers estimated that 3.7% of Louisiana soybean exports and 5% of Louisiana wheat exports went through ports outside Louisiana (Larson, Smith, and Baldwin; Reed and Hill). Accordingly, exports of Louisiana oil-bearing crops were increased from $77.824 million to $80.772 million. Exports of Louisiana food grains were increased from $25.099 million to $26.420 million. Other studies examining feed grains (corn, oats, and sorghum) indicated no export of these Louisiana crops through ports outside Louisiana (Fruin, Halbach, and Hill; Baldwin et al.; Hill et al.).[2]

[2] Results from these other studies also indicated a total increase of exports for the three sectors of only 2.9%, implying that the assumption of all Louisiana agricultural exports moving through Louisiana ports was generally acceptable. Estimates of Louisiana foreign exports for agricultural crops were also compared to estimates derived from these sources for unprocessed agricultural crops and to U.S. Department of Commerce survey-based estimates for processed agricultural products (food processing, paper, and timber

Transportation, wholesale trade, and port margins were included in the estimates of Louisiana agricultural exports because the estimates were at the port of exit. The margins were allocated from each of the agricultural industries to the proper trade or transportation sector.

The wholesale trade margin for agricultural exports was allocated to the IMPLAN industry category of other wholesale trade. Such treatment of trade margins is standard in I-O models. The IMPLAN table wholesale margins for household consumption were used to estimate trade margins for all agricultural exports (Alward et al.). The estimated total wholesale margin was $44.769 million (4.7% of the total value of state agricultural exports).

The transportation margin was allocated to the IMPLAN motor freight transportation and warehousing industry, to the water transportation industry, or to a combination of the two industries. This allocation was based on assumptions concerning how Louisiana agricultural products moved to ports. Products were assumed to move to port by truck, by barge, or by a combination of the two. The mode of transportation was based on information obtained from three Baton Rouge companies: Eckstein Marine Co. (a water transportation firm), SAIA Motor Freight Co. (a truck transportation firm), and Union Pacific (a railroad company). Transportation charges obtained from these firms were also used in calculating total transportation costs.

Distances from point of production to export port also had to be calculated to obtain total transportation costs. Unpublished state employment data (Louisiana Department of Labor) were used to distribute exports of food processing, paper, and wood products among the nine state agricultural production districts. The geographical center of each district was then used to estimate the distances between point of production and port of export. Unprocessed agricultural products were treated in the same manner. But estimates of farm production in the agricultural production districts (from Zapata and Frank) were used to calculate the distribution of crop exports among the districts.

Port service charges (National Ports and Waterways Institute) were deflated to 1985 dollars. The estimated port service charge was $4.75 per metric ton in 1985 dollars. For each of the 20 agricultural industries, the estimated weight of total exports by industry was used along with the per ton charge to estimate a total port charge. The margin for port activity for all agricultural exports was allocated to the water transportation sector based on the approach used in other studies (e.g., Yochum and Agarwal).

The total transportation cost of exporting agricultural products produced in Louisiana was estimated to be $27.973 million in 1985 dollars. Total port charges were estimated at $11.146 million for all Louisiana agricultural products. Together, port and transportation charges represented 4.1% of the total value of Louisiana agricultural exports. Of the $39.119 million total charges, $25.297 million was allocated to the motor freight transportation and warehousing sector, and $12.787 to the water transportation industry.[3]

Agricultural exports for most Louisiana industries were larger than the estimates of Louisiana agricultural exports in the original 1985 IMPLAN hybrid I-O model. The total estimate of agricultural exports for Louisiana industries was $880.816 million (table 2), reflecting an increased value of $286.866 million, or 48.3% larger than the same total in the original model.

Estimates of exports for 13 out of the 20 industries increased in the new version of the hybrid IMPLAN model (table 2). Industries with considerable increases in current versus original estimates of foreign exports included

products) for 1987–89. In all cases, estimates of foreign exports used in this study were closer to estimates obtained from these other sources than were the original IMPLAN estimates. (For additional details, see Bairak.)

[3] The estimate of the total trade and transportation margin (8.9%) was compared to national estimates of margins for processed agricultural products found in the U.S. Department of Commerce census data. As expected, the estimates used here were less than the national values because of lower transportation cost charges. (For further details, see Bairak.)

Table 2. Original versus New Export Estimates by Louisiana Agricultural Industries in the 1985 Hybrid IMPLAN I-O Model (millions 1985 $)

IMPLAN Industry by Sector Code		Estimated Louisiana Agricultural Exports ($ mil.) Original Model	New Model	Change ($ mil.)
10	Cotton	64.468	49.733	−14.735
11	Food Grains	22.862	19.154	−3.708
12	Feed Grains	1.635	30.684	29.049
21	Oil-Bearing Crops	68.754	70.103	1.349
82	Meat Packing	4.117	10.036	5.919
84	Poultry & Egg Processing	3.480	8.341	4.861
87	Dairy Products	2.148	35.830	33.682
91	Processed Fish & Seafood	26.171	7.541	−18.630
92	Other Canned & Frozen Products	1.357	8.488	7.131
93	Canned Fruits & Vegetables	1.897	1.843	−0.054
99	Bread Products	2.926	35.550	32.624
103	Other Processed Fats, Feeds	29.487	28.384	−1.103
104	Rice Milling	149.512	127.760	−21.752
109	Sugar Processing	19.772	77.330	57.558
112	Beverages	2.559	16.740	14.181
118	Cottonseed Oil Mills	6.659	1.161	−5.498
119	Soybean Oil Mills	7.192	9.670	2.478
124	Miscellaneous Food Processing	0.972	2.136	1.164
160	Lumber	67.794	79.585	11.791
187	Paper Products	110.188	260.747	150.559
	Total	593.950	880.816	286.866

feed grains, dairy products, and bread products. Other industries, such as oil-bearing crops, had small increases in export estimates. New export estimates were slightly smaller than original estimates for food grains, canned fruits and vegetables, and other processed fats, feeds. New export estimates were markedly less than original estimates for cotton, processed fish and seafood, and rice milling.

Differences in original estimates of foreign trade of Louisiana agricultural products and those calculated in this study may be explained by differences in the years covered (1985 versus 1989–92).[4] But differences may also be explained by the way in which estimates of exports are calculated in the IMPLAN modeling system. For a given industry, Louisiana's proportion of national commodity output was used in the original IMPLAN estimates to calculate Louisiana's share of national exports in that commodity. While this approach is standard procedure for IMPLAN models, it may yield inaccurate results because of differences in commodity mixes at the regional and national levels. Further, the method does not account for the locational advantage (for a state such as Louisiana) or disadvantage (for a given interior state) of a region in moving goods to port of export. The large difference (48.3%) between the calculations of foreign exports found in this study and those contained in the original IMPLAN export estimate implies that IMPLAN users should be cautious in using unverified estimates of exports in evaluating the

[4] A review of the 1991 Louisiana ready-made IMPLAN model indicated that these estimates were also problematic. For example, exports by sugar producers (not sugar mills or refineries) of unrefined sugar (exclusively sugarcane in Louisiana) were reported at $53 million when it is well known that Louisiana sugarcane is never exported prior to milling and refining.

impacts of such markets on regional economies.

Effect of Foreign Trade Estimates on Holistic Accuracy in Other Model Uses

Another relevant concern about model accuracy arises because estimates of regional exports to foreign markets can influence the holistic *accuracy* of IMPLAN-based models for use in studies unrelated to trade analysis. The supply demand pool (SDP) coefficient is the maximum amount of regional supply that is available to meet regional demand. Or, it is the ratio of regionally produced commodity supply, net of foreign exports, to gross regional commodity demand. An SDP coefficient of one means that regional supply at least equals regional demand for the commodity in question. An SDP coefficient of less than one implies that the commodity will have to be imported even if the commodity is not a domestic export (Alward et al.).

The regional purchase coefficient (RPC) for a commodity is the ratio of local demand met by local production to regional supply net of foreign exports. Hence, the ratio provides a measure of how much local demand is satisfied by local production. An RPC of 0.9 means that 10% of the commodity consumed is imported into the area. Over time, if regional firms substitute imports for regional production, the RPC for the commodity would decrease. As a result, the estimate of the regional impact of a given change in final demand would decrease. RPCs for all nonservice commodities in IMPLAN (1–445) are estimated through an econometrically based procedure. RPC estimates for IMPLAN service commodities (446–528) are calculated based on observed 1977 state supply, exports, and imports. Because the SDP is the maximum amount of regional supply available to meet regional demand, it is an upper bound for the RPC values used in IMPLAN models (Alward et al.).

A commodity's SDP is calculated by first subtracting estimates of foreign exports from gross commodity supply. Hence, foreign exports always influence the coefficient. Foreign exports influence the RPC for commodities where the SDP coefficient equals the RPC (i.e., the independently estimated RPC is at its SDP upper bound).

SDP and RPC values under the original export estimates were compared to SDP and RPC values under the new export estimates. The comparison showed that under the new estimates of foreign exports, the SDP for 18 commodities increased, while the SDP decreased for 29 commodities. Similarly, the RPC increased for nine commodities and decreased for 13 commodities. While most of these changes were small, a few commodities had large changes, such as the difference of 0.4087 for condensed and evaporated milk (IMPLAN commodity 88).

To compare the potential effect of changes in RPCs on model estimates, the impact of a $10 million dollar change in final demand for each of the 20 agricultural industries listed in table 2 was calculated for the state model with original versus new estimates of foreign exports. Changes in RPCs due to differences in the estimates of foreign exports did not affect the holistic accuracy of the model in this case. For example, estimates of the employment impacts under the two models only differed by 0.3% (7,487 versus 7,511). Substantially different estimates of foreign exports of agricultural products had little impact on model results. One can conclude that IMPLAN model users should not be too concerned with the effect of estimates of foreign exports on holistic model accuracy where this variable is not of direct relevance.

Impact of Foreign Exports on the Louisiana Economy

A comparison of the level and composition of the impact of original and new estimates of foreign exports on the Louisiana economy also provides insight into model holistic accuracy. If the impacts of foreign trade on the Louisiana economy under the two estimates are similar, then holistic accuracy is retained for the original model for the purpose of examining the effects of such markets on the state economy. Holistic accuracy in this case would im-

ply that researchers using IMPLAN in examining the regional effects of trade policies should not be overly concerned about the accuracy of the method used in IMPLAN to generate regional foreign export estimates.

The impact analysis for Louisiana agricultural exports had two basic components. One part was the direct effect of current export levels in 20 agriculturally related industries. The second part was the direct effect in the three trade and transportation sectors of motor freight transportation and warehousing, wholesale trade, and water transportation. This direct effect occurred because Louisiana agricultural exports were moved to and shipped through state ports. The impact analysis simulated the total effect of exports for agricultural products, including the three margin industries.

Particular care should be taken in interpreting model results because I-O models may overestimate actual levels of change in economic activity. Because of the assumptions of fixed relative prices, fixed per unit of output input requirements, and unlimited supply of factors of production at constant costs, supply response may be overestimated in comparison to a model where relative prices and input requirements are allowed to change. Adjustment in regional labor markets—and in this case substitution of domestic for lost foreign markets—could be especially important in dampening the effect of the foreign export shock. Hence, estimates of changes in output, income, and jobs from the shock should be regarded as an upper bound estimate of the actual change under such a scenario.

For comparison purposes, the impact of foreign exports of agricultural products was estimated in the original hybrid IMPLAN model. Model results are discussed in terms of total industry output (TIO), total income, value added, and employment.[5] The original estimates of agricultural exports ($593.950 million) resulted in a total impact on TIO of $1.510 billion ($915.993 billion indirect and induced effects), or 1.1% of estimated TIO in the Louisiana economy in 1985. The total effect of agricultural exports on total income was $585.972 million, or 0.9% of total income in the Louisiana economy in 1985. The total effect on value added was $667.532 million, or 1.1% of state value added. An estimated total of 25,818 jobs were generated in the Louisiana economy due to the export of Louisiana agricultural products.

The same procedure was repeated with the newly estimated levels of Louisiana foreign agricultural exports. A comparison of impact analysis with the two estimates of Louisiana agricultural exports implied that the original export estimates may have substantially underestimated the importance of such markets. The total effect of Louisiana agricultural exports on TIO was $2.197 billion, which was a $686.867 million (45.5%) increase from the original hybrid model TIO estimate (table 3). The export of agricultural products to foreign markets was estimated to be responsible for $854.886 million in total income, an increase of $268.914 million over the original estimate. Louisiana exports were estimated to be responsible for $979.411 million in total value added in the Louisiana economy, an increase of $311.878 million over the original hybrid model estimate.

The number of jobs generated in the Louisiana economy by foreign agricultural exports was also larger than in the original hybrid model of the 1985 Louisiana economy. Export of Louisiana agricultural products generated 35,241 jobs in the state economy (table 3), or 9,423 (36.5%) more jobs than in the original hybrid model estimates. The 35,241 jobs represented 1.8% of the total work force of 1,984,043 jobs in 1985. This percentage value was 0.5% greater (1.8% versus 1.3%) than the same estimate calculated with results from the original hybrid model.

The total (direct, indirect, and induced) effect of Louisiana agricultural exports on TIO provided an indication of the nature of export impacts (figure 1). Of the state TIO impact, $970.438 million (44.2%) was characterized

[5] In the hybrid IMPLAN model, employment represents the number of full- and part-time jobs for the sector in question. In the original 1985 version (but not later versions) of *original* IMPLAN models, employment is given in terms of full-time equivalent jobs (Alward et al.).

Table 3. Total Effect of Updated Louisiana Agricultural Exports on Selected Industries (millions 1985 $)

IMPLAN Industry by Sector Code	Total Output ($ mil.)	Total Income ($ mil.)	Value Added ($ mil.)	No. of Jobs
10 Cotton	52.368	17.294	18.328	1,379.0
11 Food Grains	85.770	42.055	43.231	3,043.3
12 Feed Grains	33.230	7.128	7.526	680.4
21 Oil-Bearing Crops	81.532	36.747	39.360	1,675.1
41 Oil & Gas Extraction	59.151	37.217	43.981	254.5
87 Dairy Processing	39.786	9.039	9.558	231.8
99 Bread & Related Products	36.775	14.265	14.912	497.2
103 Other Processed Fats, Feeds	37.499	6.502	6.966	152.0
104 Rice Milling	128.773	19.312	20.668	669.6
109 Sugar Processing	103.130	16.460	18.939	565.3
160 Lumber	127.542	42.031	43.516	1,683.4
187 Paper Products	268.960	92.889	96.007	1,988.3
215 Chemical Products	45.300	13.475	13.915	191.5
235 Petroleum Refining	64.387	5.797	10.520	37.8
448 Motor Frt. & Transp. Warehousing	45.916	28.725	29.663	982.8
449 Water Transportation	31.241	8.180	8.663	305.3
454 Communication	19.548	12.178	13.492	238.8
456 Electric, Gas, & Sanitary Services	79.878	32.339	36.661	474.2
460 Wholesale Trade	104.018	55.444	75.504	1,910.1
462 Retail Trade Not Restaurants	110.077	58.181	69.472	4,018.9
464 Other Finance & Insurance	43.083	19.809	22.649	986.2
469 Real Estate	121.335	59.922	98.004	280.0
472 Personal Services	20.059	15.725	16.136	895.6
478 Repair Services	24.228	11.600	12.543	462.7
479 Business Services	36.689	26.334	27.711	1,323.1
491 Eating & Drinking Places	42.096	12.814	21.862	1,344.9
503 Health Services	68.974	41.704	41.850	2,194.5
Total	2,196.810	854.886	979.411	35,241.0

Note: Industries with output impacts under $17.7 million are not reported. However, totals include unreported industries.

as a direct effect, $595.756 million (27.1%) as an indirect effect, and $630.625 million (28.7%) as an induced effect.[6] Paper products reflected the largest TIO impact at $268.960 million (table 3).

Of the five industries with the largest indirect effects in TIO due to agricultural exports, food grains had a $66.517 million indirect effect and lumber a $47.407 million indirect effect (figure 1). Both of these indirect impacts were explained by the size of the industries and their ties to further processing in Louisiana. For example, the food grains industry required additional processing for its products because rice accounted for most food grains. Rice was generally milled before being shipped overseas. This caused large direct exports in the rice milling industry, which was reflected as an indirect effect for food grains. The petroleum refining and chemical products sectors also had significant indirect TIO impacts due to agricultural exports. Petroleum refining provided fuel to agricultural machinery and to the two export transportation sectors of motor freight transportation and warehousing and water transportation. The chemical products industry is a major producer of fertilizers

[6] The direct shock differed slightly from the survey-based estimates because IMPLAN sector 122, roasted coffee, was not included in the survey data. The original estimate of foreign exports ($5.991 million) for the sector was assumed to be accurate. The rest of the difference was due to the increases in food grain and oilseed product exports.

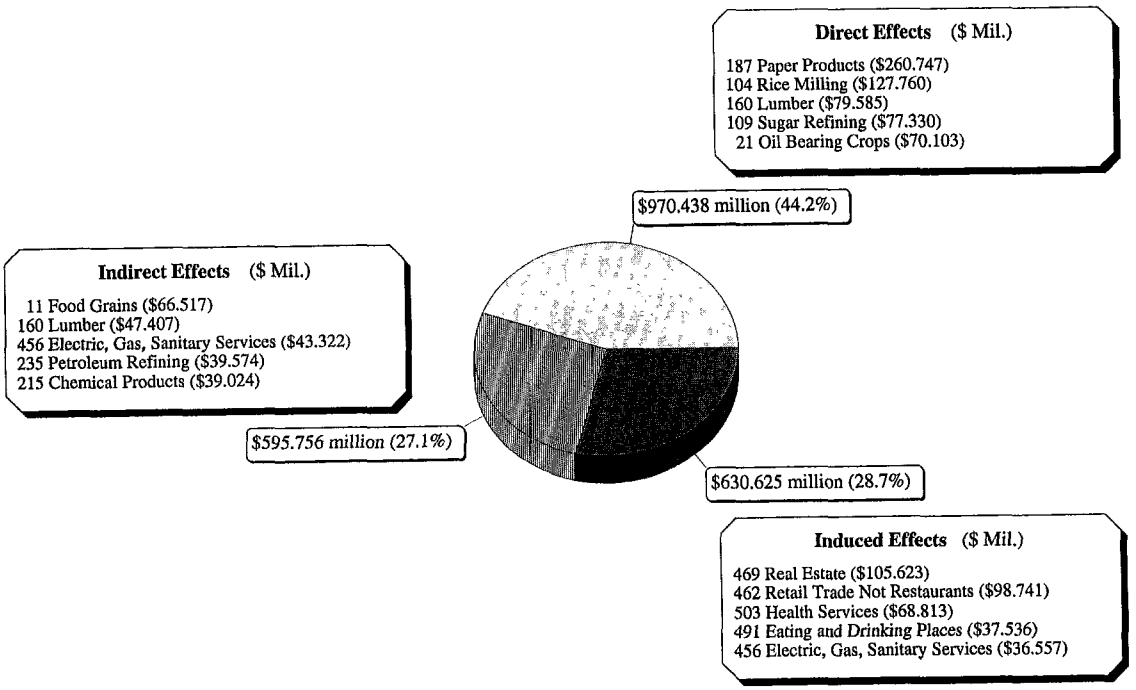


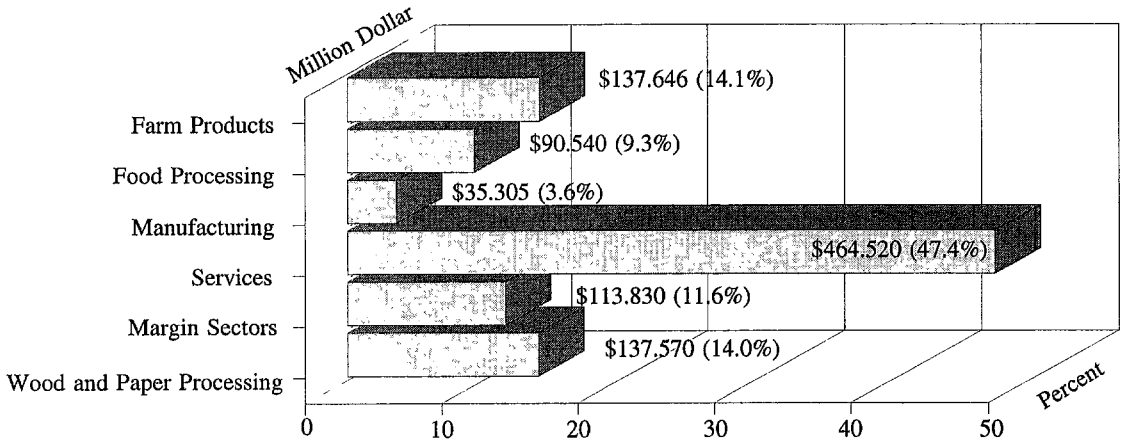
Figure 1. Direct, indirect, and induced effects of agricultural exports on Louisiana TIO estimated with the Louisiana IMPLAN model with updated levels of agricultural exports

and agricultural chemicals such as pesticides and herbicides.

Policy makers in many states have looked to growth in agricultural processing as a way to enhance general economic activity (Barkema, Drabenstott, and Stanley). In Louisiana, growth in agricultural processing has been seen as a way to counteract losses in employment and income in rural areas due to declines in production agriculture and a more general downturn in economic activity due to marked decreases in mining. Such a policy is based on the assumption that increasing the contribution of agriculture to state economic activity would substantially reduce levels of idle resources, particularly in rural communities with few other growth options.

Therefore, general categories of the Louisiana economy were also used to analyze the effects of agricultural exports. This approach enabled a comparison of the contributions to the Louisiana economy of unprocessed and processed agricultural products. Such a distinction is important, because local processing of locally produced raw agricultural products increases jobs and income by adding another layer of value to existing activity generated by the commodity in question (Schluter and Edmondson). To accomplish this analysis, the entire Louisiana economy was separated into six categories: farm products, food processing, wood and paper processing, margin sectors, manufacturing, and services.

The contribution of agricultural exports to Louisiana value added was analyzed for each category (figure 2). The $90.540 million in food processing value added was considerably less than the $137.646 million in farm products. Further, 22.9% of the food products impact was concentrated in rice milling. Rice milling is an important part of the Louisiana economy, but it is not a high-value food product. Other processors with a greater potential for generating state economic activity, such as poultry processors, had a smaller share of the food processing value-added impact. Hence, assuming that markets are available, replacing exports of unprocessed agricultural products with increasing sales of Louisiana food processors to foreign markets would increase the



Notes: Farm Products category includes all unprocessed agricultural commodities and Logging Camps (IMPLAN sector 160). Food Processing category includes all food processing products. Wood and Paper Processing category includes paper products and all lumber products except Logging Camps (sector 160). Margin Sectors category includes Motor Freight Transportation and Warehousing (sector 448), Water Transportation (sector 449), and Wholesale Trade (sector 460). Manufacturing category includes all nonagricultural manufacturing, i.e., all manufacturing except industries belonging to the Agricultural Processing and Wood and Paper Processing categories, and Logging Camps (sector 160). Services category includes consumer, business, and government services except the margin sectors and agricultural services.

Figure 2. Total value added due to agricultural exports by major category of the Louisiana economy estimated with the Louisiana IMPLAN model with updated levels of agricultural exports

contribution of state agriculture to overall economic activity.

The estimated annual average value from 1989 through 1992 of agricultural exports moving through Louisiana ports was $10.952 billion, of which an estimated $9.981 billion (91.1%) originated elsewhere. Agricultural products originating in other states but moving through Louisiana to foreign markets may have considerable influence on the state economy. A scenario was developed to estimate the state impact of agricultural exports produced outside Louisiana. To avoid overestimation, the port sector of the Louisiana economy—which was a component of the water transportation sector in the Louisiana hybrid I-O model—was assumed to be the only industry directly affected by agricultural exports from other parts of the United States.

The direct shock for agricultural exports moving through Louisiana but produced elsewhere was derived by first estimating the tonnage of agricultural products moving through Louisiana ports to overseas markets. Using information provided by the U.S. Army Corps of Engineers, it was estimated that 70,938,214 metric tons of agricultural products were shipped through Louisiana ports annually. The estimated value of agricultural exports originating in Louisiana was 2,346,691 metric tons. This value was subtracted from the total tonnage of agricultural exports shipped through Louisiana ports, resulting in a net value of 68,591,523 metric tons. The 68,591,523 metric tons was then multiplied by the Louisiana port service charge ($4.75 per ton in 1985 dollars). The Louisiana water transportation sector was estimated to receive a direct impact of $325.810 million because of the shipping of non-Louisiana agricultural exports through Louisiana ports.

The total effect on the state economy of non-Louisiana agricultural exports shipped through Louisiana ports was $771.948 million in TIO and 10,096 jobs (table 4). The impact of non-Louisiana exports on state total income was estimated to be $264.854 million. The industry with the largest impact was the directly

Table 4. Effect of Agricultural Exports from Other States Shipped Through Louisiana Ports on Selected Louisiana Industries as Estimated with the Hybrid IMPLAN Model (millions 1985 $)

IMPLAN Industry by Sector Code		Total Output ($ mil.)	Total Income ($ mil.)	Value Added ($ mil.)	No. of Jobs
41	Oil & Gas Extraction	20.085	12.637	14.934	86.4
73	Repair, Maintenance Construction	6.139	2.715	2.877	190.0
200	Printing & Publishing	2.067	0.952	1.073	30.9
215	Chemical Products	2.600	0.774	0.799	11.0
235	Petroleum Refining	28.854	2.598	4.714	17.0
448	Motor Frt. & Transp. Warehousing	5.420	3.391	3.501	116.0
449	Water Transportation	487.873	127.751	135.293	4,768.3
454	Communication	7.518	4.684	5.189	91.9
456	Electric, Gas, & Sanitary Services	16.155	6.540	7.415	95.9
460	Wholesale Trade	11.035	5.882	8.010	202.6
462	Retail Trade Not Restaurants	29.504	15.594	18.620	1,077.2
464	Other Finance & Insurance	13.228	6.082	6.954	302.8
469	Real Estate	39.093	19.306	31.576	90.2
471	Hotels & Lodging Places	2.480	1.334	1.586	124.1
472	Personal Services	5.767	4.521	4.639	257.5
478	Repair Services	10.466	5.011	5.419	199.9
479	Business Services	15.586	11.187	11.772	562.1
488	Legal Services	5.177	3.995	4.003	91.7
491	Eating & Drinking Places	12.154	3.700	6.312	388.3
503	Health Services	19.725	11.927	11.968	627.6
	Total	771.948	264.854	301.467	10,096.4

Note: Industries with output impacts under $2 million are not reported. However, totals include unreported industries.

affected water transportation sector, with a total TIO impact of $487.873 million and an employment impact of 4,768 jobs. Other sectors with large impacts tended to be service industries, such as real estate.

Results from the demand shocks for agricultural exports originating in Louisiana and the demand shock for agricultural exports shipped out of Louisiana but produced elsewhere were summed. The combination provided information on the total impact of agricultural exports shipped through Louisiana, whatever their origin. Agricultural exports were estimated to be responsible for $2.969 billion (2.1%) of state TIO. The contribution to state value added was $1.281 billion (1.7% of total state value added). Agricultural exports generated 45,338 jobs, or 2.2% of the 2,015,084 average number of state jobs from 1989–92. While 45,338 jobs may seem insignificant when compared to over two million jobs, the Louisiana economy annually generated an average of 31,242 net jobs from 1988–92 (U.S. Department of Commerce, Bureau of Economic Analysis). Therefore, total Louisiana employment tied to agricultural exports was approximately equal to the number of jobs generated by the economy over a year and a half.

Summary and Conclusions

A hybrid IMPLAN model of the Louisiana economy was used to estimate the state impact of agricultural exports. Results of the model should be of interest to policy makers and others concerned about the ability of foreign markets to generate regional economic activity.

Model results should also be of interest to IMPLAN users. Provided here is a case study concerning the accuracy of the procedures used in calculating foreign exports in IMPLAN models. Study results suggested that these procedures may have underestimated

foreign exports of Louisiana agricultural products. When the total impact of original versus revised estimates of agricultural exports was evaluated, large differences were observed in the effect of such markets. Based on these model results, IMPLAN users are urged to verify IMPLAN-based estimates of exports with outside information for studies directly concerned with the impacts of exports.

It was also demonstrated that large differences in the estimates of agricultural exports had little effect on the holistic accuracy of model results where general changes in final demand were evaluated. As a result, IMPLAN users should not be too concerned with the accuracy of the estimates of foreign exports, if this variable is not of direct interest. In such cases, researchers may want to verify estimates of foreign exports when export estimates of important regional commodities are large or if knowledge of the regional economy suggests that such estimates may be problematic.

Model results of interest to policy makers indicated that the effect of agricultural exports was felt throughout the Louisiana economy. Based on the assumption that existing levels of idle resources would be substantially reduced, the widespread benefits of agricultural exports to various components of the Louisiana economy provide a partial justification for state efforts aimed at the expansion of agricultural export markets.

The expansion of Louisiana agricultural exports appears to be feasible and desirable. However, the question remains concerning the types of agricultural products to emphasize in promotion efforts. In terms of total contribution to the state economy under current export levels, exports of raw farm products generate more jobs and value added than the exports of processed food products. But the export of agricultural products in processed rather than unprocessed form has greater potential for generating additional economic activity. On a per unit basis, export of a given agricultural commodity in a processed rather than unprocessed form has greater regional impacts because processing adds another layer of economic activity to the impact of goods and services produced at the farm gate. Therefore, beyond increasing the levels of state agricultural exports, policy makers should evaluate a policy of emphasizing the exports of processed agricultural products. A starting point of such a policy should be an assessment of the competitiveness of processed Louisiana agricultural products in foreign markets.

References

Alward, G., E. Siverts, O. Olsen, J. Wagner, O. Senf, and S. Lindall. *Micro IMPLAN Users Manual.* Dept. of Agr. and Appl. Econ., University of Minnesota, St. Paul, 1989.

Bairak, R. "The Impact of International Export of Agricultural Products on the Louisiana Economy." Unpublished master's thesis, Louisiana State University, August 1995.

Balassa, B., and M. Noland. "Changes in U.S. Trade Specialization: Projections to the Year 2000." *J. Policy Modeling* 12,3(1990):587–603.

Baldwin, E., T. Smith, D. Larson, and H. Traylor. "Oats Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1985." Bull. No. 794, Agr. Exp. Sta., University of Illinois, Urbana–Champaign, 1990.

Barkema, A.D., M. Drabenstott, and J. Stanley. "Processing Food in Farm States: An Economic Development Strategy for the 1990s." Federal Reserve Bank of Kansas City, *Economic Review* 75(July/August 1990):5–23.

Belous, R.S., and A.W. Wyckoff. "Trade Has Job Winners, Too." *Across the Board* 24,9(1987): 53–55.

Brucker, S.M., S.E. Hastings, and W.R. Latham. "Regional Input-Output Analysis: A Comparison of Five 'Ready-Made' Model Systems." *Rev. Regional Stud.* 17(1987):1–16.

Burfisher, M., and M. Missiaen. *Developing Countries' High-Value Agricultural Trade: Implications for U.S. Exports.* Agr. Info. Bull. No. 615, USDA/ERS, Washington DC, September 1990.

Eckstein Marine Co. Verbal communication regarding water transportation and charges. Baton Rouge, 1995.

Falgout, C. "Louisiana's Trade with Mexico Up Sharply." *The* [Baton Rouge] *Morning Advocate,* 7 May 1993.

Fruin, J., D. Halbach, and L. Hill. "Corn Movements in the United States: Interregional Flow Patterns and Transportation Requirements in

1985." Bull. No. 793, Agr. Exp. Sta., University of Illinois, Urbana–Champaign, 1990.

Hill, L., M. Patterson, J. Vercimak, S. Fuller, and D. Anderson. "Sorghum Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1985." Bull. No. 791, Agr. Exp. Sta., University of Illinois, Urbana–Champaign, 1990.

Hughes, D. "Measuring the Effect of Louisiana Agriculture on the State Economy Through Multiplier and Impact Analysis." Res. Bull. No. 849, Agr. Exp. Sta., Louisiana State University, Baton Rouge, 1995.

Hughes, D., D. Holland, and P. Wandschneider. "The Impact of Changes in Military Expenditures on the Washington State Economy." *Rev. Regional Stud.* 21,2(1991):311–27.

Jensen, R.C. "The Concept of Accuracy in Regional Input-Output Models." *Internat. Regional Sci. Rev.* 5(1980):139–54.

Jensen, R.C., and G.R. West. "The Effect of Relative Coefficient Size on Input-Output Multipliers." *Environment and Planning A* 12(1980): 659–70.

Larson, D., T. Smith, and E. Baldwin. "Soybean Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1985." Bull. No. 792, Agr. Exp. Sta., University of Illinois, Urbana–Champaign, 1990.

Louisiana Department of Agriculture and Forestry. *Louisiana Agricultural Export Directory.* Office of Marketing, Baton Rouge, 1994.

Louisiana Department of Labor. Unpublished State of Louisiana Employment Data, 1993. Research and Statistical Unit, Baton Rouge, 1994.

Martin, R.P., and D. Holland. "Sources of Output Change in the U.S. Economy." *Growth and Change* 23,4(1992):446–68.

Miller, R.E., and P.D. Blair. *Input-Output Analysis: Foundations and Extensions.* Englewood Cliffs NJ: Prentice-Hall, Inc., 1985.

National Ports and Waterways Institute. "Lake Charles Harbor and Terminal District: A Project Feasibility Evaluation." Louisiana State University, November 1992.

Reed, M., and L. Hill. "Wheat Movements in the United States: Interregional Flow Patterns and Transportation Requirements in 1985." Bull. No. 795, Agr. Exp. Sta., University of Illinois, Urbana-Champaign, 1990.

SAIA Motor Freight Company. Verbal communication regarding truck transportation and charges. Baton Rouge, 1995.

Schluter, G., and W. Edmondson. *USDA's Agricultural Trade Multipliers: A Primer.* Agr. Info. Bull. No. 697, USDA/ERS, Washington DC, April 1994.

Sharp, J.R. "A Closer Look: Economic Impact of Free Trade Between Texas and Mexico." Special Financial Rep., Texas Comptroller of Public Accounts, Austin, November 1991.

Union Pacific Company. Verbal communication regarding railroad transportation and charges. Baton Rouge, 1995.

"The United States." In *Trade Policy Review.* Geneva: GATT Publication Services, April 1992.

U.S. Army Corps of Engineers. *Waterborne Commerce of the United States.* Washington DC, 1989.

U.S. Department of Commerce, Bureau of the Census. "U.S. Exports and Imports of Merchandise" (CD-ROM). USDC/BC, Washington DC, 1994.

U.S. Department of Commerce, Bureau of Economic Analysis. "Regional Economic Information System" (CD-ROM). USDC/BEA, Washington DC, 1994.

Yochum, G., and V. Agarwal. "Economic Impact of a Port on a Regional Economy." *Growth and Change* 18,3(1987):74–87.

Zapata, H., and D. Frank. "Agricultural Statistics and Prices for Louisiana, 1986–1992." AEA Info. Ser. No. 116, Agr. Center, Louisiana State University, Baton Rouge, September 1993.