# IMPACTS OF A NEW AGRICULTURAL PROCESSING PLANT ON RURAL DEVELOPMENT

Gerald A. Doeksen and James Rathwell

Community leaders of rural areas characterized by low-income and surplus labor seeking ways to promote rural development, frequently encourage new firms to process the primary products of the region. In a rural state such as Oklahoma, which is a large producer and exporter of agricultural products, interest is often focused on industries which process these goods. Impact multipliers are often used to measure income and employment impacts created from processing primary products.

The objective of this paper is to analyze the impact in a rural state from processing available agricultural products on income and employment under two assumptions: (1) that basic agricultural production does not change, (2) that basic agricultural production increases by the amount processed. The paper is presented in three parts. These include: a summary of the Oklahoma social accounting system, a discussion of the alternative simulation runs, and an analysis of the income and employment impacts.

## THE OKLAHOMA SOCIAL ACCOUNTING SYSTEM AND SIMULATION MODEL[1]

Economic activity within the state was classified into 12 endogenous sectors and five exogenous sectors. The Oklahoma social accounting system presents data for these sectors in three main accounts: (1) the interindustry account; (2) the capital account; and (3) the human resource account. Data from the accounts were used in the 51 major equations of the multiple sector recursive model to project economic variables. Many of the 51 major equations are disaggregated intosub-equations; that is, having one sub-equation for each endogenous sector in the Oklahoma economy. Thus, the entire system includes over 300 equations.

The simulation model is formulated around the basic Leontief input-output system. First, equations were derived which estimated changes in final demand. Second, these equations were used to simulate the economy from year to year. The model incorporates growth and development into the analysis through capital investment (capital-output ratios and changes in capital-output ratios), through human resource productivity (labor-output ratios, changes in labor-output ratios, and changes in wage rates), and through current activity (changes in population, government expenditures, and exports). The simulation model was used to project economic variables from 1963 to 1980.

## ALTERNATIVE SIMULATION RUNS

Oklahoma is a large producer and exporter of agricultural products. In 1969, the value of the principal crops and livestock produced in Oklahoma totaled $925,237,000 [4]. The primary agricultural industry was cattle and calf production ($445,722,000) and the second largest commodity, wheat production ($144,296,000) [4].

If these primary agricultural products are carried through additional processing levels before exporting, state income and employment opportunities will increase. The impact of a new agricultural processing

Gerald A. Doeksen is agricultural economist with the Economic Development Division, Economic Research Service, USDA, stationed at Oklahoma State University. James Rathwell is research assistant of agricultural economics at Oklahoma State University.

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[1] For a complete description and presentation of the social accounting system and simulation model see Doeksen [1].

plant (such as a beef slaughtering plant or flour mill) on rural development was analyzed with three simulations run which evaluated two alternative situations.[2]

The first simulation run provides projections of economic variables from 1963 to 1980 given the specified final demand relationships.[3] The second situation assumes a new agricultural processing plant is constructed and operating in 1971. The simulation model, formulated around the input-output system implies that the plant would cause additional primary production of agricultural products as a result of the interaction created by the new plant with other sectors of the economy. The third situation assumes that the new plant will process some of the primary agricultural products currently produced in the state, thus reducing raw product exports. The three simulation runs were used to analyze the impact on income and employment from a new agricultural processing plant: (1) with an increase of production in primary agriculture production, and (2) without an increase of production in primary agricultural products.

## THE EMPIRICAL ANALYSIS

The introduction of a new processing plant was simulated in 1971 to estimate the short run income and employment impacts. The change in income and employment in 1971 estimates the short run impact. Income and employment projection for the three simulation runs will be presented and discussed. Also, impact multipliers resulting from the new plant were evaluated.

### The Impact on Employment

Projected employment by industrial sector and changes in employment from alternative growth assumptions of the agricultural processing sector are presented in Table 1. Column (1) lists the sector employment projections from 1971 if final demand grows as specified in the first situation. Column (2) contains the projected employment in each sector after the new processing plant is operating. Column (4) [Columns (2) - (1)] indicates the total number of jobs created by the new plant. Employment in the livestock and livestock products sector is estimated to increase by 97 man-years, in the crops sector by 146,

Table 1

PROJECTED 1971 EMPLOYMENT AND CHANGES IN EMPLOYMENT BY INDUSTRIAL SECTOR FOR THE THREE SITUATIONS

| Industry Sector | (1) First Situation | (2) Second Situation | (3) Third Situation | (4) Change in Employment due to Second Situation | (5) Change in Employment due to Third Situation |
|---|---|---|---|---|---|
| Livestock and Livestock Products | 40,669 | 40,766 | 40,669 | 97 | – |
| Crops | 77,715 | 77,861 | 77,715 | 146 | – |
| Agricultural Processing | 16,655 | 16,754 | 16,749 | 99 | 94 |
| Petroleum and Coal Products | 7,955 | 7,956 | 7,955 | 1 | – |
| Machinery | 17,594 | 17,595 | 17,594 | 1 | 1 |
| Other Manufacturing | 81,496 | 81,512 | 81,507 | 16 | 11 |
| Mining | 45,562 | 45,565 | 45,563 | 3 | – |
| Transportation, Communication and Public Utilities | 61,816 | 61,832 | 61,825 | 16 | 9 |
| Real Estate, Finance and Insurance | 52,782 | 52,799 | 52,788 | 17 | 6 |
| Services | 168,742 | 168,784 | 168,773 | 42 | 30 |
| Wholesale and Retail | 215,182 | 215,220 | 215,203 | 38 | 22 |
| Construction | 45,582 | 45,583 | 45,582 | 1 | – |
| Total | 831,750 | 832,227 | 831,923 | 477 | 173 |

[2] The agricultural processing sector includes all types of agricultural processing and is indeed an aggregate sector. However, the objective of the paper is to illustrate how assumptions concerning secondary changes in the basic production sectors will affect the impact multipliers. The input-output model assumes basic production increases with an introduction of a new plant, whereas in this paper we illustrate how the multipliers are substantially reduced if basic production does not increase. An aggregate or nonaggregate sector could be used to illustrate this. To the authors' knowledge, this has never been illustrated before.

[3] Seven equations were used to estimate final demand requirements. For the exact specifications of each equation see [3].

and in the agricultural processing sector by 99, with a total of 477 man-years created in the first year from the new plant introduction.

The new agricultural processing plant employment projections without agricultural product changes are listed by industrial sectors in column (3). Sector changes in employment [column (1) - column (3)] under this situation are listed in column (5). Total man-years employed in the basic agricultural sectors would not change, the agricultural processing sector is estimated to increase by 94 man-years, and total employment by 173 man-years.

## The Impact on Income[4]

The short run impact on income under the three situations is depicted in Table 2. Column (1) contains the income estimates by industrial sector for the first situation, while column (2) contains estimates for the second situation. The estimated income change [column (2) - Column (1)] in each sector is presented in column (4). Income is expected to increase by $211,000 in the livestock and livestock products sector, by $318,000 in the crop sector, and by $560,000 in the agricultural processing sector. The total short run annual income increase from the new plant is $1,774,000. Without additional agricultural production (the third situation), total income is expected to increase by only $961,000; a decrease of $831,000 from the second simulation run. Of this total, the largest increase ($535,000) is projected to occur in the agricultural processing sector.

## The Multipliers

The above short run income and employment effects can be converted into multipliers (Table 3). Listed in column (1) are the direct effects from the increased production, or the number of man-years employed and income generated in the agricultural processing sector from the operation of a one million dollar plant. The plant would employ 76 man-years of labor and pay $428,000 either as wages and salaries or proprietor income. Column (2) lists direct and indirect effects, which indicate the repercussions on income and employment in all sectors as a result of the initial change in production.

The direct capital formation effects of each sector are listed in column (3), indicating the number of man-years employed and the income generated from construction of the one million dollar agricultural processing plant. To construct the plant, 65 man-years were required and $357,000 worth of income (wage and salary and proprietor) were generated.

Column (4) shows the short run income and employment production multipliers. These multipliers are the conventional type I input-output multipliers and are computed by dividing the direct effect (column 1) into the direct and indirect effect (column 2). Each multiplier indicates the change in direct and indirect employment or income generated throughout the Oklahoma economy by a one unit change in production employment or income in the

Table 2

PROJECTED 1971 INCOME AND CHANGES IN INCOME
BY INDUSTRIAL SECTOR FOR THE THREE SITUATIONS
(In Constant 1963 Dollars)

| Industry Sector | (1) First Situation | (2) Second Situation | (3) Third Situation | (4) Change in Income due to Second Situation | (5) Change in Income due to Third Situation |
|---|---|---|---|---|---|
| | | | 1,000 dollars | | |
| Livestock and Livestock Products | 88,553 | 88,764 | 88,553 | 211 | -- |
| Crops | 169,217 | 169,535 | 169,217 | 318 | -- |
| Agricultural Processing | 93,915 | 94,475 | 94,450 | 560 | 535 |
| Petroleum and Coal Products | 68,819 | 68,826 | 68,819 | 7 | -- |
| Machinery | 111,258 | 111,262 | 111,322 | 4 | -- |
| Other Manufacturing | 515,727 | 515,831 | 515,897 | 104 | 81 |
| Mining | 330,455 | 330,478 | 330,469 | 23 | 5 |
| Transportation, Communication and Public Utilities | 399,337 | 399,444 | 399,423 | 107 | 67 |
| Real Estate, Finance, and Insurance | 237,445 | 237,520 | 237,502 | 75 | 32 |
| Services | 818,394 | 818,592 | 818,589 | 198 | 142 |
| Wholesale and Retail | 884,604 | 884,760 | 884,726 | 156 | 88 |
| Construction | 261,798 | 261,809 | 261,852 | 11 | 11 |
| Total | $3,979,522 | $3,981,296 | $3,980,818 | $1,774 | $961 |

[4] Income includes wage and salary income and proprietor income. All income data are in constant 1963 dollars.

Table 3

**SHORT RUN IMPACTS AND MULTIPLIERS FROM A NEW AGRICULTURAL PROCESSING PLANT**

| | (1) Direct Effect | (2) Direct and Indirect Effect | (3) Capital Formation Effect | (4) Short Run Production Multiplier |
|---|---|---|---|---|
| **With Increase in Primary Agricultural Production** | | | | |
| Employment | 76 | 477 | 65 | 6.28 |
| Income | 428,000 | 1,774,000 | 357,000 | 4.14 |
| **Without Increase in Primary Agricultural Production** | | | | |
| Employment | 76 | 173 | 65 | 2.27 |
| Income | 428,000 | 961,000 | 357,000 | 2.26 |

agricultural processing sector. Short run employment and income multipliers in the second situation with primary agricultural production permitted to increase are 6.28 and 4.14, respectively. In the third situation with primary agricultural production not permitted to increase, the short run employment multiplier is 2.27 and the income multiplier is 2.26.

## SUMMARY AND IMPLICATIONS

The objective of this paper was to analyze the impact on income and employment from a new agricultural processing plant. The analysis used the Oklahoma social accounting system and simulation model. The first simulation run assumed specified final demand relationships. The second and third simulation runs evaluated two variations (1) a new agricultural processing plant with primary agricultural inputs being produced in addition to present production; and (2) a new plant which processed available agricultural products and did not increase present production levels.

The empirical results under these assumptions are quite different. Under the assumption of increased levels of production short run employment increased by 477 man-years. Short run income was enhanced by $1,774,000. Allowing reductions in exports and no changes in production levels created only 173 man-years of employment and $961,000 of new income. Short run employment multipliers for the expanded agricultural production situation were 6.28. The employment multiplier depicting reduction in exports was 2.27. Short run income multipliers were 4.14 where production was allowed to increase and 2.26 where production was not allowed to expand.

The first implication drawn from this analysis, is that to determine the full impact on income and employment from development of the agricultural processing sector, the effect of additional processing on basic agricultural production must be known. The expected impacts under the extreme conditions of no increased production and an increase in agricultural production equal to the amount processed by the new plant vary greatly. An impression obtained by the authors, in visiting with several marketing personnel, is that the net impact would likely be about midway between these extremes.[5]

Second, care must be taken in interpreting impact multipliers. Income and employment multipliers from input-output studies are generally largest in the processing sectors (such as agricultural processing and petroleum refining). The input-output model assumes increases in processing activities will increase the region's production of raw materials. This analysis shows that the multipliers may be substantially reduced if raw material production remains constant and processing activities draw upon previously unprocessed regional production.

[5] Alternative simulation runs were completed to illustrate how sensitive the magnitude of the multipliers is to changes in basic production. The exact marginal impact on basic production is not known and the authors' objective is to illustrate how important it is in determining the exact impact.

## REFERENCES


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