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RESOURCES, COMMUNITY, AND ECONOMIC DEVELOPMENT DIVISION

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B-214874

APRIL 17, 1984


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The Honorable E (Kika) de la Garza
Chairman, Committee on Agriculture
House of Representatives

Dear Mr. Chairman:

Subject: Multiplier Effect of the Agricultural Sector on the General Economy (GAO/RCED-84-56)

As requested in your October 4, 1982, letter and subsequent discussions with your office, we reviewed certain aspects of the relationship between the agricultural sector and the rest of the nation's economy. Specifically, you asked us to provide information on

--federal tax revenues generated by federal agricultural program expenditures and

--the agricultural sector's multiplier effect on the general economy.

Regarding federal tax revenues generated by federal agricultural program expenditures, none of the agencies, organizations, or individuals we interviewed were able to provide such information. Accordingly, we are unable to present information on this issue.

Because the definition of the agriculture sector has changed over time and because of differences in analytic procedures, we were unable to determine any specific value for the agriculture multiplier or compare it with multipliers of other sectors. We did, however, obtain (1) information on many of the definitions and techniques analysts use to measure multiplier effects and (2) examples of some of the multiplier and multiplier-type estimates that have been published.

MULTIPLIER EFFECT OF AGRICULTURE

Many modern economics textbooks use the term multiplier as a measure of the relationship between an initial increase in spending in one sector of the economy, such as an increase in personal consumption, private investment, or government purchases, and the total increase in spending and income in the economy that results from that initial increase. Generally, the increase in total

spending will be greater than the initial spending increase because the recipients of the money spent initially will spend some of what they receive. This, in turn, will generate additional rounds of receipts and spending throughout the economy. The greater the share of receipts respent in each round, the greater the receipts earned in the next round and, therefore, the greater the total increase in spending caused by the initial spending increase. Technically, a multiplier is a number used to multiply an initial increase in spending to estimate by how much total spending will increase.

We found that a variety of analysts use many definitions and techniques other than the textbook definition to measure multiplier effects, not only in agriculture but throughout the economy. For example, some analysts often employ input-output analysis, which is a technique for showing the inputs required to produce a particular output, to assess the multiplier impact of various investments on employment in different sectors. Other analysts calculate value added or estimate the increase in transactions and call these multipliers. Accordingly, the different analytical questions being addressed, the variety of ways in which people have calculated multipliers, changes in multiplier values over time, and the variety of ways in which the agricultural sector can be defined make comparisons of multiplier analyses within the agricultural sector as well as with other sectors difficult.

Most analyses of the multiplier effect of spending in agriculture have dealt with particular agricultural products or individual geographic regions and not with the entire agricultural production subsector or the entire food and fiber sector.[1] In only a few cases were we able to find estimates of multipliers for more than a particular product or region. Even in those few cases, the multiplier effects that were computed varied widely in use and definition. Consequently, although multiplier analysis is potentially a useful tool for evaluating the impact of the agricultural sector on the economy, inconsistencies among existing studies and changes in the economy over time prevent us from determining any specific value for the agricultural multiplier and comparing it with multipliers for other sectors.

The diverse number of multiplier-type analyses, however, suggests that understanding how economic growth occurs, the interdependence of different sectors, and the relative impact of an economic sector, geographic region, or investment activity on the rest of the economy are important topics to both business and government. If a consistent set of studies for calculating

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[1]The agricultural production subsector comprises farm-level production. The food and fiber sector encompasses all activities involved in transforming basic input resources such as land, seed, and energy into food and fiber products consumed at home or abroad.

multipliers in various components of the economy were available, then multiplier analysis could be a useful tool to measure the impacts of different economic sectors, regions, and countries on one another.

Enclosure I explains our findings regarding the multiplier effect of agriculture in more detail.

OBJECTIVES, SCOPE, AND METHODOLOGY

The objectives of our review were to obtain information on the multiplier effect of the agricultural sector on the nation's general economy and the amount of federal tax revenues generated as a result of federal agricultural program expenditures. To obtain data on the multiplier effect, we interviewed officials and obtained information from the Washington, D.C., headquarters of three federal agencies: the Economic Research Service, Department of Agriculture; the Bureau of Economic Analysis, Department of Commerce; and the Bureau of Labor Statistics, Department of Labor. We also obtained information from officials of the Council of Economic Advisers and economists, primarily agricultural economists, at the following universities: California, Illinois, Iowa State, Maryland, and Oklahoma State.

We also obtained bibliographies of relevant information on the multiplier effect and reviewed pertinent articles and textbooks. We contacted Wharton Economics Forecasting Associates and Data Resources Inc. because of their experience in measuring the general economy, in analytic techniques, and in agriculture analyses. We contacted the California Department of Food and Agriculture and the California Department of Water Resources because California is a leading agricultural state with experience in analytic assessment of the agricultural sector.

In researching information on the relationship between federal tax revenues and agricultural program expenditures, we contacted the Office of Management and Budget, the Department of the Treasury, the Bureau of the Census, and the Internal Revenue Service.

Because of the complexity of the various analyses, differing analytic frameworks, and the volume of data involved, we did not verify the computations made in the multiplier analyses discussed in this report. Also, as your office requested, we did not obtain agency comments on the report. Except for the above, we made our review in accordance with generally accepted government auditing standards. We conducted our work primarily between February and September 1983 and obtained supplemental information through February 1984.

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We plan no distribution of this report until 2 days from its issue date. At that time, we will send copies to interested parties and make copies available to others upon request.

Sincerely yours,

J. Dexter Peach
Director

Enclosure

ENCLOSURE I

MULTIPLIER EFFECT OF THE AGRICULTURAL SECTOR ON THE GENERAL ECONOMY

WHAT IS THE MULTIPLIER EFFECT?

To assess the likely impact of public policies directed at one sector, it is useful to understand how changes in spending and income in that sector will affect spending and income in other sectors and in the general economy. Economists and other analysts often use a concept known as the multiplier to measure these relationships. Multipliers are used to express the impact of a change in one sector, industry, activity, or region of the economy on the overall economy and on other sectors, industries, activities, or regions. The impacts of these changes, the multiplier effects, can be expressed by different measurements, but they are usually expressed as changes in income, employment, or output relative to changes in spending.

Analysts use different analytic techniques to calculate different multipliers. The technique selected depends on the question being asked, how the answer will be used, and prevailing economic conditions. In addition, the magnitude of the multiplier will be higher in economies or sectors with a substantial amount of unemployed resources than in those with conditions of full employment. This is because idle resources can be made readily available with less net expenses, as opposed to attracting resources that are gainfully employed.

The definition of the multiplier, as popularized by John Maynard Keynes, is a ratio that describes the change in total spending or income to the initial change in spending that brings it about. The reason an initial increase in spending in one sector causes a multiplied increase in total spending is that the initial spending will generate income, some of which is then respent, which leads to successive additional increases in income and spending. Over time, the amount of additional spending and income declines because people do not spend all of the income they receive. The more that is spent at each stage from additional income, the larger the multiplier.

The total effect on spending of the initial spending increase is sometimes thought of as the sum of direct, indirect, and induced effects.

--The direct effect is the initial spending increase.

--The indirect effect is the increased spending to obtain inputs needed to produce what is purchased by the initial spending. This includes spending for inputs that are several stages removed from final output. For example, if an increase in foreign purchases of U.S. grain were the initial increase in spending, the indirect effect of this spending increase would include increased purchases of fertilizer, farm machinery, and other inputs needed to

grow additional grain. It would also include increased purchases of steel to make the additional machinery, increased purchases of coal to make the additional steel, etc.

--The induced effect is the general increase in spending on countless items throughout the economy resulting from the increased income earned by producers of the products and services purchased directly and indirectly. For example, if an increase in tractor tire purchases were the indirect increase in spending, the induced effect of this spending increase would include the new clothing and furniture purchases by employees of the tire manufacturer.

The distinction among direct, indirect, and induced spending is useful because it helps show how an increase in spending in one sector stimulates additional rounds of spending in other parts of the economy. However, the sum of the total spending increase should not be confused with an increase in gross national product (GNP). GNP measures the total value of all goods and services produced for final output during a specified period of time such as one year, whereas the total direct, indirect, and induced spending as represented by the multiplier measures successive rounds of spending.

Increases in indirect spending do not add to GNP because, by definition, indirect spending consists of purchases of intermediate products that are used up in producing final output. Because production nearly always requires the use of intermediate products, the total monetary value of additional transactions that results from an initial spending increase will generally exceed the increase in GNP. Multiplier estimates based on the monetary value of transactions that result from an initial spending increase will, therefore, generally be higher than estimates of the ratio of the addition to GNP to an initial spending increase. This distinction is important when comparing multiplier estimates from different studies because the multiplier can be confused with changes in GNP.

DIFFICULTIES IN USING MULTIPLIERS

In calculating multipliers, analysts often estimate the total increase in spending from an initial increase in one sector without considering whether resources must be diverted from another sector to obtain the initial spending increase. Although this estimation is commonly used for analytical purposes to compare sectors, increases in spending in one sector may be accompanied by offsetting decreases in spending elsewhere. Then, the effect on total spending and income in the economy will be the difference between the multiplied increase due to additional spending in one sector and the multiplied decrease due to a reduction in spending elsewhere.

Another complicating factor in using multiplier analysis is the need to distinguish between (1) real increases in income and spending that represent increases in the value of output and

(2) nominal increases that simply represent higher prices. When an economy is at or close to full employment, increasing spending in a sector may bid up the prices of the products of that sector and the inputs used to make those products. Similarly, when that money is respent, if additional resources are not available at current prices to meet the increased demand for goods and services, prices may rise. Therefore, some or all of the increased spending may simply raise the price level rather than lead to increases in real output.

Yet another complication in using multipliers is the difficulty in measuring the extent to which an initial spending increase uses available unemployed resources or must attract gainfully employed resources to produce a multiplied increase in total spending. The increase in total spending depends on whether substantial unemployed or underutilized resources are available and from where the initial spending increase originates. When analysts study the effects on total spending or income resulting from a shift in spending from one sector to another in a fully employed, efficient economy, they often find that there is little relevance in calculating multipliers. In this situation, aggregate spending or income would show little increase because there is no increase in aggregate demand for goods and services and no opportunity to use unemployed or underutilized resources to increase total output. But other analysts, particularly those in the field of economic development who are studying economies with less than full employment, find that calculating national, regional, or sectorial multipliers is useful in evaluating how best to channel initial investment funds to create economic growth. When an underemployed or underutilized economy can make better use of existing resources or can attract additional spending from outside the economy, a multiplied increase in total spending can occur. Under these conditions, analysts can estimate the multiplied increase in aggregate spending that would occur following an initial increase in demand for goods and services.

INPUT-OUTPUT ANALYSIS AS A MULTIPLIER TECHNIQUE

Input-output analysis is a commonly used technique for identifying how much output from each sector of the economy is used up as intermediate products in producing goods and services for final output. The estimates obtained through input-output analysis are called multipliers, but they differ from the conventional definition of a multiplier. Input-output analysis

> ". . .seeks to determine what can be produced, and the quantity of each intermediate product which must be used up in the production process, given the quantities of available resources and the state of technology."[1]

[1]William J. Baumol, Economic Theory and Operations Analysis, 3rd ed. (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1977), p. 537.

This technique quantifies production processes. Accordingly, it emphasizes increases in production needed in every sector to yield an increase in final output in one sector, rather than the increase in spending in all sectors that results from an initial increase in spending and income in one sector.

The Bureau of Economic Analysis (BEA), Department of Commerce, issues summary input-output tables for the entire U.S. economy. If the restrictive assumptions about production technology that are incorporated in these tables are recognized, the input-output model can be used to calculate by how much output in various sectors must increase to accommodate an increase in demand for the output of one sector. Also, if constant prices are assumed, then the dollar value by which total output will rise if resources are available can be calculated. Of course, any offsetting declines in demand in other sectors should also be considered. In addition, it should be noted that the increase in the dollar value of output calculated this way includes the value of intermediate products and, therefore, will exceed the increase in the value of final output.

THE MULTIPLIER EFFECT OF AGRICULTURE

According to the U.S. Department of Agriculture (USDA), the U.S. agricultural sector has evolved from the diversified farm sector of the 1930's to the industrialized food and fiber sector of today. The size, diversity, and changing definition of the food and fiber sector complicates the calculation of multipliers that reflect its activity. The food and fiber sector encompasses all of the activities--both farm and nonfarm--involved in transforming basic input resouces such as land, seed, and energy into the food and fiber products consumed at home or abroad. The food and fiber sector involves many other subsectors of the economy in addition to the agriculture production subsector. Input suppliers, distributors, processors, retailers, and restaurants constitute part of the nonfarm portion of the food and fiber sector. In some ways, container manufacturers and basic resource industries can also be considered part of the food and fiber sector because they provide ore, coal, transportation, and other resources necessary for distributing food.

USDA estimates that the food and fiber sector makes up 20 percent of the GNP and 22 percent of the U.S. labor force. It also estimates that the agriculture production component of this sector makes up about 3 percent of GNP and 3.5 percent of the U.S. labor force. In 1982 U.S. farmers grossed about $144 billion in cash receipts and spent about $117.4 billion in cash production expenses, most of which was spent on goods and services provided by other industries.

Most estimates of the multiplier effect of investments in agriculture have dealt with specific crops or individual geographic regions. We found only a few multiplier estimates for the agriculture production sector, agriculture-related sectors other than the agriculture production sector, or the total food and fiber sector. These estimates generally considered only

direct and indirect effects. Induced effects were rarely considered. In addition, these estimates did not consider the possibility of reduced spending in other sectors due to an initial diversion of resources to the agricultural sector.

The studies from which these estimates derive differ regarding the questions being addressed, the multiplier concept measured, and the measurement techniques used. Attempts to compare the multipliers calculated in one analysis with those calculated in other analyses may not be appropriate because of these differences. Differences among estimates derived from different studies prevent us from assessing the multipliers on agricultural spending and comparing them with multipliers for spending in other sectors. The remainder of this section discusses several examples of multiplier estimates in the agricultural sector, stated in terms of both dollars and number of jobs created.

Diverse multiplier estimates

USDA's Economic Research Service (then part of the Economics and Statistics Service) published a 1981 study[2] examining the multiplier effect for the entire food and fiber sector. This study, which used 1978 data, indicated that for every new dollar invested in the food and fiber system, economic activity in the general economy increased by $2.13. This estimate is similar to what many economists have estimated for the overall economy. The study's findings on the multiplier effects of the system and its principal parts are as follows:

Sector	Multiplier effect
Agricultural production	2.64
Other food and fiber sectors (e.g., food processors, fast food outlets, grain elevators)	2.05
Entire food and fiber system	2.13

This study did not analyze other sectors of the U.S. economy, and we found no other analysis suitable for comparing agricultural production and the food and fiber system with other sectors.

In contrast to the above study, which dealt with the entire food and fiber sector, most multiplier analyses deal with components of the sector. According to an Economic Research Service agricultural economist, the agricultural multiplier effect, using input-output models, is normally examined on a crop or individual

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[2]John R. Groenewegen and Kenneth C. Clayton, "Agriculture's Role in the Economy of the United States," Economics and Statistics Service, USDA, ESS Staff Report No. ARESS810407, Apr. 1981.

economic activity basis. For example, according to a USDA analysis, which used 1979 data, the direct, indirect, and induced multiplier effect due to a $1 income increase for the dairy sector was $4.52. Because this estimate includes indirect effects, it should include the value of intermediate products used in producing final dairy products as well as final products.

In addition to being mentioned in specific published studies, multiplier effects are often discussed in public forums. For example, at the 1984 Agriculture Outlook Conference sponsored by USDA, the Secretary of Agriculture indicated that "a $1 increase in net farm income can boost non-farm income $4 if it is caused by a growth in demand. Thus, a 20 percent increase in net farm income could boost total GNP by $18 billion, the equivalent of over one million jobs." Department officials were unable to tell us how this estimate was calculated.

We used BEA's 1978 and 1979 input-output tables, which summarize the total direct and indirect output in dollars for all affected sectors due to a $1 increase in demand for the sector being studied, to derive the following multiplier estimates for various agricultural and nonagricultural sectors:

Sector	Input-output multipliers--increase in output measured in dollars created by a $1 increase in demand	
	1978	1979
Livestock and livestock products	$2.91	$2.84
Food and kindred products	2.71	2.72
Other agricultural products	1.90	1.91
Farm and garden machinery	2.20	2.21
Coal mining	1.64	1.69
Ordnance and accessories	1.94	1.85
Motor vehicles and equipment	2.65	2.60

At our request, the Bureau of Labor Statistics (BLS), Department of Labor, computed examples of the direct and indirect employment multiplier effects for the agricultural production and nonfarm agricultural processing sectors of the national economy. These are the number of jobs created per $1 million in increased expenditures in agriculture (1972 base year prices):

ENCLOSURE I

Sector	Employment multipliers--number of jobs created per $1 million
Agricultural production[a]	38.85
Agricultural processing[b]	33.52

[a]Includes dairy and poultry products, meat animals and livestock, cotton, food and feed grains, and miscellaneous agricultural products (BLS input-output sectors 1.01 to 2.07).

[b]Includes the following manufacturing sectors: meat products, dairy products, canned and frozen foods, grain mill products, bakery products, sugar, confectionery products, alcoholic beverages, soft drinks and flavorings, and miscellaneous food products (BLS input-output sectors 14.01 to 14.32).

These estimates are roughly the same as estimates of the job-creating effects of expenditures on travel and tourism and defense that we reported previously,[3] although the methodologies used to obtain them are different.

Using 1981 data, BLS had previously calculated multiplier effects of individual sectors, including those in the following table. These are not directly comparable to the figures BLS calculated for us above because the two calculations use data from different years (1981 and 1972) and define economic sectors somewhat differently. The figures are included here to further demonstrate that multiplier effects can be calculated for a variety of economic activities. Also demonstrated is that comparing data from different analyses can easily be misleading because different definitions will result in different calculations.

Sector	Employment multipliers--number of jobs created per $1 million
Food and feed grains	49.19
Meat products	62.35
Coal mining	62.60
Ordnance	61.70

Although input-output analysis is a common method for measuring the multiplier effect for agricultural activities, other analytic approaches have been used to measure the value of the agricultural sector. For example, as early as the late 1930's and 1940's, Carl Wilkens, editor of the Progressive Farmer, published in Sioux City, Iowa, analyzed the national income

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[3]Estimates of Job Generation in the Travel and Tourism Industry (GAO/PAD-83-54), Sept. 30, 1983.

accounts[4] to determine the yearly ratios between farm cash receipts and current national income for the period 1921-38. Ratios varied between 1.00 and 6.99 for the years during the period. He believed that during the years when the ratio was close to seven, this "seven (7) time turnover in the farm dollars. . ." was a significant ingredient in strengthening the total U.S. economy. Wilkens argued that if $1 spent in the agricultural sector resulted in as much as a $7 turnover or increase in the general economy, the anticipated recession after World War II could be moderated by maintaining the agricultural sector.

According to economists at USDA's Economic Research Service, this "7 time turnover" does not measure the multiplier effect but is an accounting relationship that changes over time and has a questionable cause and effect relationship. It can, however, be viewed as another attempt to measure the effect of the agricultural sector on the economy and is an example of the type of analytic result that some analysts use to describe a multiplier effect. However, this measure does not indicate how much total income will rise in any particular period when there is an increase in spending in the agricultural sector.

Nonfederal uses of the agricultural multiplier effect

The use of multiplier effects has not been limited to the federal government. Input-output analysis and the multiplier effect have also been used to describe economic activity in the agricultural sector at the state and local level. Foreign countries have also used input-output analyses to assess the relative impact of different sectors, including agriculture, on their economies. The following examples illustrate these state, local, and foreign country uses.

--California Department of Water Resources, Measuring Economic Impacts--The Application of Input-Output Analysis to California Water Resource Problems.

This 1980 study used input-output analysis to determine the economic consequences of water management decisions. The multiplier effect of various water uses was computed in terms of gross state product, labor, water, and energy. The multiplier effects included direct, indirect, and induced effects. Agricultural production, the largest water user in California, was studied in detail. Of the five industries contributing the most to the gross state product, three were in the food and fiber sector.

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[4]A composite set of statistics, published by the Federal Reserve, that describe income earned by the total economy in any one year.

ENCLOSURE I

--Kansas Office of Economic Analysis and the Department of Economic Development, The Interindustry Structure of the Kansas Economy.

This 1969 state planning study computed output (direct and indirect) and income (direct, indirect, and induced) multiplier effects for about 70 sectors of the Kansas economy. Food and fiber represented four of the top five sectors in terms of output multiplier effects and one of the top five sectors in terms of income multiplier effects.

--University of California, Cooperative Extension Service, Regional Economic Impacts of Alternative Resource Uses: An Interindustry Analysis of the Fresno Region.

This 1977 study provided the means to evaluate the impacts of land use and resource and development alternatives on Fresno County, California's fourth largest county (in area). This study computed, among other factors, that agriculture had the third largest output multiplier effect on the county's economy.

--F.D. McCarthy and L. Taylor, Macro-Food Policy Planning: A General Equilibrium Model for Pakistan.

This study, published in 1980 in the Review of Economics and Statistics, developed a model describing the effect of food policy changes on Pakistan. (Some developing nations use the multiplier theory for measuring agricultural growth policies that are geared toward increased production of food for domestic consumption or for trade.)

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Various measurement methods have been used to apply the multiplier theory to agriculture. The definition of the economic activity being measured often varies with the question being addressed, the analyst, and the method. The results also vary from analysis to analysis. Sometimes the analysis identifies additional jobs as the result of added investment in a sector. At other times additional income or gross business activity is the measured result.

As indicated by the examples, the values of the different multipliers not only vary with each analysis but can also change from year to year. The variety of ways in which the food and fiber sector can be defined, the variety of methods used to calculate multipliers, and changes in the sector over time make comparisons within the agricultural sector as well as with other sectors difficult. Until more consistency is developed for definitions, methods, and measured values, multiplier analysis for the food and fiber system has limited value for comparing the impact of the agricultural sector with the impact of other sectors.

ENCLOSURE I

The diverse number of multiplier-type analyses suggests that understanding how economic growth occurs, the interdependence of different sectors, and the relative impact of an economic sector, geographic region, or investment activity on the rest of the economy are important topics to business and government alike, particularly for developing economies. If there were a consistent set of studies for calculating multipliers in various components of the economy, then multiplier analysis could be a useful tool to measure the impacts of different economic sectors, regions, and countries on one another.