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DEVELOPING MEASURES OF THE ECONOMIC IMPACT OF AGRICULTURE, AGRI-FOOD, AND THE AGRI-INDUSTRY

Invited paper submitted by the National Agricultural Statistics Service, United States of America*

I. INTRODUCTION

1. This write-up is designed to complement papers highlighting work in specific countries to document the portion of total economic output of a country that relates to agriculture. The major purpose of the paper is to identify procedures and detailed statistical and economic measures needed to create defensible summary statistics to portray importance of agriculture within a National economy.

2. The paper consists of three sections. The first identifies types of measures that are needed. The second points out the need to evaluate measures over time in order to maintain a defensible time series. The third uses data compiled by the United States Economic Research Service to illustrate trends in the absolute and relative economic impact of agriculture in one country.

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3. The first question to be answered is why it is important to develop such measures. There are multiple answers—with many of them relating to societal and political priorities. As a society becomes less agrarian, with fewer participants soley engaged in agricultural production activities, there may be a tendency to see agriculture as nationally less important. If this is the case, research and development funding for improved techniques of production, marketing, and processing agricultural products may dwindle. Programs which are important to producing and processing goods for export, or for making goods more freely available within a country may be curtailed. Stagnation within the agricultural production sector could then lead to difficulties within the many other segments of economic activity responsible for supplying inputs or handling and transporting the agricultural goods which are produced.

4. Before proceeding, it is prudent to clarify that the concept of measuring economic impact of agriculture to the total economic output is the measurement of **value added** by each step of production, transportation, distribution, manufacturing, wholesale sales, retail sales, etc. all the way to the consumption of agricultural related products. To avoid duplication and overestimation of value, it is essential to determine the proper relationship of the value of agricultural goods which pass into other sectors of the economy to the value of the goods which exit each sector. Even within the agricultural sector, measuring the value added concept is important. For example, much of the production of feed grains and other crops is consumed by farm animals. Thus, the grains are an input to livestock production and it is the increased value of the livestock as they are marketed which is the value added entering into the National calculations. It may also be helpful to emphasize that this value added approach differs from estimating the multiplier effect to the economy of the income from a particular activity.

II. DEVELOPING BASIC MEASURES

5. Capturing the necessary facts and estimates to fully measure the economic impact of agriculture and agriculture related activities is a detailed, intricate process. The process usually involves compiling data from multiple sources which may relate to different time periods and may differ in quality. Analysts compiling the information may need to create specific estimating models in order to tease out the proper interrelationships.

6. The starting point for calculating the impact of agriculture and agriculture related activities to the total economy is a set of **quantity measures** for each type of industry within a country. The measures must go beyond industry totals such as all agricultural production, total grocery store sales, total manufacturing, total transportation, etc. The process is enhanced (but not totally solved) if the country has a unified system of detailed standard industrial codes which classify the main activities of each business entity. Again, remember the desired result is the "value added" by each sector. The total value of agricultural production is not added to the total value of agricultural exports and the total value of food sales, etc. Instead, the value of production above the value of all inputs is the desired measure.

7. Countries may have good estimates of total production, at least for the major commodities produced. Those estimates are a vital starting point but it is then important to understand the different **marketing channels** for each commodity, along with volume and

prices for each channel. To use corn as an example, some corn will be used as animal feed on the farms where produced. In that case, payment will not be received for it but corn becomes one input of the animal production. Some corn may be produced exclusively for human food such as for corn meal. When corn is sold from the farm to commercial operations, the corn may be destined for a variety of end uses such as direct exports, animal feed, processing for corn oil or high fructose corn syrup, or ethanol production. The prices received by producers may differ depending upon whether the corn produced has special characteristics. Thus, it is important to have some type of ongoing marketing channel surveys which provide updated information on the total value received by producers as well as starting the process to determine the value added once the crop leaves the farm where produced.

8. To pinpoint the value added relationships within the agricultural sector, information is also needed on **production expenditures**. There are many types of expenditures (livestock purchases, feed, agricultural chemicals, fuels, labor, machinery, and seeds and plants) which are obvious inputs to agricultural production. However, there are many other important expenditure categories such as rent, farm supplies, interest, and farm improvements and construction which are necessary for establishing and maintaining an agricultural production unit. It is best to have continuing measures of each of those major categories in order to measure changes in production practices or significant changes in the costs of specific inputs. For better specificity and improved sector estimates, periodic **cost of production** surveys would be helpful. These types of surveys, which focus on more detailed analyses of the production inputs and costs for specific major commodities, are extremely helpful for detecting new production practices which may be departing from existing model assumptions.

9. Within the agricultural sector, some of the internal value added relationships are obvious. A livestock feedlot buys feeder animals from some producers and feed grains from other producers. They then feed the livestock to mature weights and sell the animals for slaughter. In this simplistic example, the value added is the difference in value from the sale of the mature livestock to that of the feed and the feeder livestock. That is the basic concept, although is it is necessary to also include the cost of labor, medical treatment of the animals, transportation of the animals and feed, and the overhead operational costs of the feedlot in measuring the true value added of selling these livestock. Analysts who are constructing a full value added system must also make a number of assumptions on how to handle issues in which ownership does not change hands. For example, an operation might produce most of the feed used in their livestock feeding. A large, integrated operation might produce baby pigs in one location but transfer them to a different location still owned by the same company for feeding. Economists might make different assumptions on whether to “score” these within-operation transfers at their effective value levels in order to simplify within sector analyses.

10. To visualize the country-wide measurement process, a person should picture agricultural production as a focal point. For agricultural production to occur, many inputs are needed. To use fertilizer as an example, many fertilizers are created (manufactured) by combining various minerals or by chemical processes. The processes needed to obtain the raw materials, plus the transportation to accumulate the right products, would be counted as related to the agri-industry sector, along with the portion of the fertilizer creation that results in farm use products. A similar analogy can be made with machinery. Machinery is fabricated from a wide variety of raw materials such as steel, rubber for tires, wiring and

switches for electronic components, etc. The value added portion of the operations which create all the components would be credited to agri-industry, as well as the value added portion of the machinery itself. It is also important to count the economic activity of the wholesalers, retailers, and transportation services that make these inputs accessible to the agricultural producers.

11. The accounting for the agri-food and agri-industry value added components of gross national product is even more complicated for tracking products from agricultural production than is the accounting for production inputs. Again to use corn as an example, there are large differences in the processes (and the value added impacts) even when corn does not change its form. That is, there are different labor and transportation impacts for corn that is purchased and then exported as whole corn than for corn purchased by a local feed mill to be utilized in creating bulk mixed feed for local feedlots. It is also important to not only understand the main use of corn for processing but also to account for the by products and whether they will also be reused in some other economic activity. For example, if corn is processed for the creation of corn oil, what becomes of the "spent grain" that remains?

III. EVALUATING MEASURES OVER TIME

12. The past section illustrated the complexity of measuring the value added impact of agriculture. It did not describe any specific models that are presently being used but it is probably obvious that economic and statistical units will combine all available detailed data at a point in a time to develop relationships between the amount of economic activity in a sector and the amount of that activity related to agriculture, agri-food, and agri-industry. They will then use those relationships until quality data become available to revise and improve estimating models. One approach that might be used is to conduct periodic (such as every 5 years) economic censuses which can provide information on new processes, new products, and efficiencies within specific industries.

13. Data for updating estimates of value added impacts will come from many different sources. Many of them may come from household and consumer surveys. For example, if the preparers of home meals shift from purchasing meats, vegetables, and grains and purchase more 'prepared' foods, there are drastic changes in the amount of labor and "manufacturing" inputs needed to provide food for home use. Similarly, a small shift in consumer preferences for meals away from home will have a significant impact on the value added agri-food measures.

14. One United States example might illustrate the need to constantly monitor new developments in the utilization of agricultural products. As mentioned earlier, corn is utilized in many different ways. One use, corn for ethanol production, as a fuel additive, has been particularly fast growing over the past 15 years, more than tripling during that time. The growth has been due in large part to government incentives. A large number of ethanol plants have been built, often with farm operators as partial owners or stockholders. The growth has been so substantial that the U.S. World Agricultural Outlook Board now tracks corn for ethanol as a separate use category every month in their *World Agricultural Supply and Demands Estimates* report. The U.S. National Agricultural Statistics Service now uses ethanol plants as a separate stratum in its monthly probability grain prices survey and its

quarterly grain stocks inventory reports. It is also becoming important to develop data on the utilization of the distillers dry grain that is a major by product of the ethanol production. It is a product that has value as a livestock feed and could be exported as well as being utilized in the areas where the ethanol production is occurring.

IV. EXAMPLE VALUE ADDED DATA

15. The major work in the United States on the impact of agriculture, agri-food, and agri-industry on the National economy is done by the Economic Research Service (ERS) of the U.S. Department of Agriculture. ERS staff members have done considerable work on what they call "The Food and Fiber System." Many references and data products can be obtained from the ERS web site (www.ers.usda.gov/) either by going to various briefing rooms or by entering food and fiber system in the ERS search engine. Some of the older references may be available in a read-only format and not downloadable to spread sheets.

16. An example of ERS analyses is shown below as Table 1. This indicates that "farming" accounts for only 0.7 percent of the U.S. Gross Domestic Product but the total Food and Fiber System accounts for 12.3 percent of GDP. Similarly, the farming share of total U.S. employment was 1.4 percent of the U.S. total employment but the Food and Fiber System share was 16.7 percent. The biggest contributors to GDP within the Food and Fiber System were Wholesale and Retailing Distribution (at 3.3 percent of GDP) and the broad category of Services under Total Inputs (at 3.0 percent of GDP).

17. Table 2 below displays some time series data extracted from the former ERS magazine called Rural America. Volume 17, Issue 1 in the Spring of 2001 presented data for each year from 1991 to 2000. Table 2 shows the data for the odd numbered years from that table to illustrate how data relationships may change over time. While the total value added to GDP from the Food and Fiber System increased in every subsequent year in the Table, the percent of GDP decreased from 14.8 percent in 1991 to 12.7 in 1999. This of course indicates that GDP was rising at a greater rate than the Food and Fiber System. One of the big factors during the period was greatly increasing costs for medical care. Total employment in the Food and Fiber System during the 1991-1999 period did not change much and the percent of total employment decreased. However, the Trade and Eating Places employment both increased at least 10 percent during that period. Those increases were offset by decreases in textiles and other manufacturing jobs and efficiencies in farm and food processing industries.

18. It is worthy of note that the comparisons in Table 2 are against GDP data and employment data created by other United States statistical organizations. This illustrates the advantage of having harmonized concepts such as the North American Industry Classification System, even though the United States has a decentralized statistical system.

Table 1. Contribution of the Food and Fiber System to the U.S. Economy, 2001

	Value added to GDP	Share of FFS	Share of GDP	No. of Workers	Share of FFS Employ.	Share of total US Employ.
	Bil. Dollars	Percent	Percent	1,000's	Percent	Percent
Farming	73.8	5.9	0.7	1,922	8.1	1.4
Total inputs:	422.7	34.0	4.2	4,528	19.1	3.2
Mining	17.1	1.4	0.2	59	0.2	--
Forestry, fishing, and ag. serv.	14.5	1.2	0.1	394	1.7	0.3
Manufacturing	84.0	6.8	0.8	1,128	4.8	0.8
Services	307.2	24.7	3.0	2,947	12.4	2.1
Total manufacturing and distribution:	748.4	60.1	7.4	17,295	72.9	12.2
Manufacturing:						
Food processing	168.3	13.5	1.7	1,278	5.4	0.9
Textiles	30.3	2.4	0.3	810	3.4	0.6
Leather	0.1	--	--	1	--	--
Tobacco	16.8	1.3	0.2	26	0.1	--
Distribution:						
Transportation	41.3	3.3	0.4	568	2.4	0.4
Wholesaling and retailing	334.4	26.9	3.3	8,145	34.3	5.7
Foodservice	156.9	12.6	1.6	6,461	27.2	4.6
Total food and fiber system	1,244.6	100.0	12.3	23,740	100.0	16.7

Source: USDA, ERS, William. Edmondson, (wedmonds@ers.usda.gov).

Table 2. Key Statistical Indicators of the United States Food and Fiber Program

Measure/Industry	1991	1993	1995	1997	1999
			Billion dollars		
GDP:					
Farm	69.3	70.2	73.5	82.6	66.9
Food processing	109.7	114.5	116.6	134.2	155.9
Textiles	25.2	27.1	28.4	30.2	34.5
Other manufacturing	105.6	109.8	112.7	109.0	104.6
Services	190.7	216.9	246.6	272.9	316.0
Trade	241.3	260.3	294.2	295.6	314.9
Transportation	30.4	32.2	35.1	35.8	40.5
Eating places	115.0	126.5	141.1	141.7	147.2
Total FFS	887.2	957.6	1,048.2	1,101.9	1,180.6
Percent of U.S. GDP	14.8	14.4	14.2	13.2	12.7
Total U.S. GDP[1]	5,986.2	6,642.3	7,400.5	8,318.4	9,268.6
			Million jobs		
Employment:					
Farm	2.0	1.8	2.0	1.9	1.8
Food processing	1.6	1.5	1.5	1.4	1.4
Textiles	1.1	1.0	1.0	1.0	1.0
Other manufacturing	1.5	1.4	1.4	1.3	1.3
Service	3.3	3.4	3.5	3.5	3.5
Trade	7.3	7.5	7.9	7.9	8.3
Transportation	0.6	0.6	0.6	0.6	0.6
Eating places	6.0	6.3	6.5	6.5	6.6
Total FFS	23.4	23.5	24.5	24.1	24.4
Percent of U.S. employment	18.5	18.2	18.5	17.7	17.5
U.S. civilian labor force[2]	126.3	129.2	132.3	136.3	139.4

[1] U.S. Department of Commerce. Value-added data presented here are consistent with U.S. Department of Commerce, national Income and Products Accounts, accounting conventions.
[2] U.S. Department of Labor, Bureau of Labor Statistics.