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SOCIAL RETURNS TO PUBLIC INFORMATION SERVICES: THE CASE OF STATISTICAL REPORTING OF U.S. FARM COMMODITIES

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The collection and reporting of information bearing upon decision making in both the public and private sectors are considered to be important functions of government. In this study, we attempt to develop a theoretical framework for estimating the social returns to government expenditures on such public information services.

As an illustration of its possible use, the technique is applied to information reported by The Statistical Reporting Service of the U.S. Department of Agriculture (USDA). In this example, we attempt to measure the marginal social returns of reducing the sampling error of crop and livestock statistics reported by the USDA. Although the purpose of statistical reporting is to facilitate decision making in both the public and the private sectors, our methodology applies only to the private sector. Since our estimates of social returns do not include the gains due to a better resource allocation by public agencies, these estimates should represent the lower bounds of the social returns.

I. Theoretical Framework for Estimating Social Returns

In this section we attempt to develop the theory and method of estimating the social returns to statistical reporting. Alfred Marshall's social welfare and social cost concepts provide the basic theoretical framework (Marshall, 1916)[1]. Social welfare is defined as the area under the demand schedule; and social cost, or opportunity cost, is defined as the area under the supply schedule.

Assuming rational profit and utility maximizing behavior by producers, marketing firms and consumers, a sampling error in statistical reporting of the production or the stock of commodities can be expected to lead to a net decrease in social welfare. As we will explain shortly, erroneous information causes producers to make erroneous production decisions and also distorts optimal inventory carryovers. Hence, marginal improvements in the accuracy of these statistics reduce the social cost of misinformation, which in turn can be considered as an increase in net social welfare. By relating the marginal improvements in the net social welfare to the marginal cost of providing more accurate information, we can estimate marginal social benefit-cost ratios for the various levels of accuracy of the information.

We have developed two models for estimating the social returns to the improvements in information: (a) an inventory adjustment model and (b) a production adjustment model.

Inventory Adjustment Model

The inventory adjustment model applies to situations where production cannot be altered significantly in response to output predictions, but where there is an opportunity for inventory holders to adjust stocks. A good example occurs in agriculture in the case of food and feed grains. Once the crops are planted, it is usually not profitable for producers to either significantly expand or contract the output. On the other hand it is relatively easy and inexpensive to store these commodities. In this case any market supply adjustment is possible mainly through adjustment in inventories.

For products of this type, the social cost of misreporting of future production, through such errors as acreage or yield estimates, arises because of distortions in the optimum consumption patterns of the products. Because products of this type are produced during a relatively short period of time within the year, their consumption patterns depend very much on the inventory policy of marketing firms. For example, the expectation of an abnormally small crop in the forthcoming production period and of a higher price can be expected to result in a decreased rate of inventory depletion during the remainder of the current period. This in turn results in increased prices and a decreased rate of consumption during the current period.

This situation is illustrated in figure 1. We assume in this case that production response to a price change can be approximated as being perfectly inelastic during the production period, as denoted by the supply curve SS. The market demand schedule for the commodity is denoted by DD.

Suppose the statistical reporting agency estimates the current period production as OQ' as opposed to the actual or "true" production OQ. Inventory holders, in forming price expectations for the coming period, expect the average price to equal OP'. In other words they would ex-

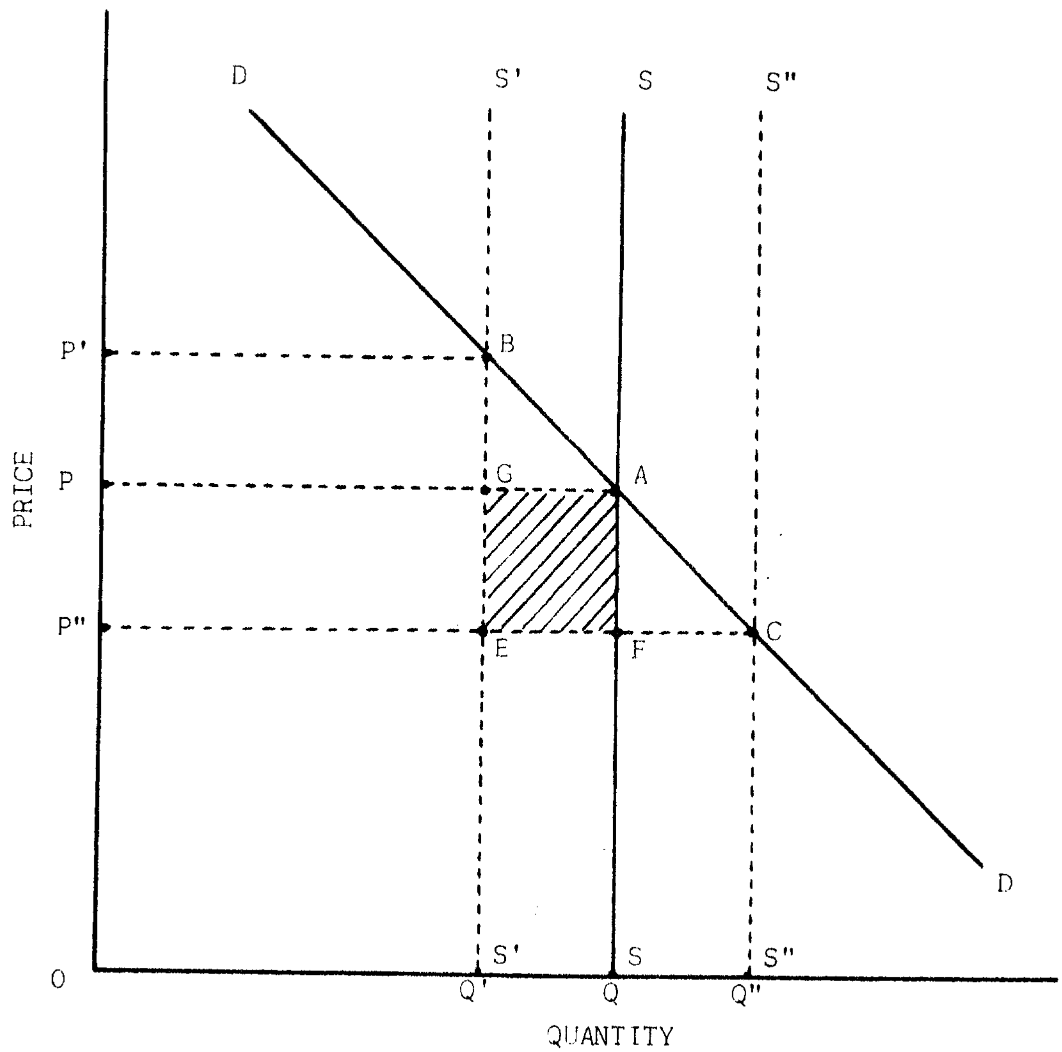

Figure 1. Inventory adjustment model.

pect the future price to be higher by PP' (or BG) than would be the case had no error been involved in the production estimate. Consequently inventory holders find it profitable to decrease their rate of inventory depletion for the remainder of the year, until current price has risen by PP'. Consumption then would contract to OQ', or by the amount Q'Q. In turn, the inventory carry-over into the next production period would be increased by the same amount, Q'Q. As a consequence, the reduction in consumption during the current period would reduce consumer welfare by the area ABQ'Q.

Because of the abnormally large carry-over into the next period, we assume that the next period supply would increase by the amount Q'Q which is equal to QQ" in figure 1. Hence the total quantity placed on the market during the next period would be the "true" production OQ plus the increased carry-over QQ". The result would be a decrease in the average price down to OP" as opposed to price OP which would have prevailed had there been no reporting errors. The decrease in price, however, results in an increase in consumption during the next period by the amount QQ". Thus total consumer welfare is increased during the next period by ACQ"Q. The overall result of reporting errors that gave rise to the decline in current consumption and the increase in future consumption is a net loss in consumer welfare equal to rectangle AGEF (area ABQ'Q minus area ACQ"Q), the shaded area in figure 1, assuming that the demand curve is linear.

The same amount of net welfare loss would have resulted from an erroneous over estimate of production, that is, if OQ" would have been predicted instead of OQ'. Since the errors in statistical reporting (mainly due to sample errors in the example presented in a later section of this paper) can be expected to be random, inventory costs can be expected to average out to zero over a period of years.

Assuming a linear demand curve, the area of rectangle AGEF, which is AG·AF, can be estimated if we have an estimate of the price elasticity of demand (η) of the commodity. Since AF is found by multiplying the error in production reporting QQ" (or QQ') by the absolute value of the slope of the demand curve $(\frac{1}{\eta}\frac{p}{q})$[2], we obtain

$$\text{area AGEF} = e^2\, pq\, \frac{1}{\eta}$$

where q is the "true" quantity of production (OQ); p is the equilibrium price (OP); and e is the error in quantity of production reported as a proportion of the "true" production (OQ' = OQ" = eq).

Production Adjustment Model

Next let us consider the situation where producers have an opportunity to adjust output in response to additional information, as illustrated by the upward-sloping supply schedule (SS) in figure 2. In the context of the example to be presented in a later section of this paper, those commodities for which a continuous adjustment in production is possible include mainly livestock products.

A basic assumption of the production adjustment model is that producers adjust output along their supply schedules in response to changes

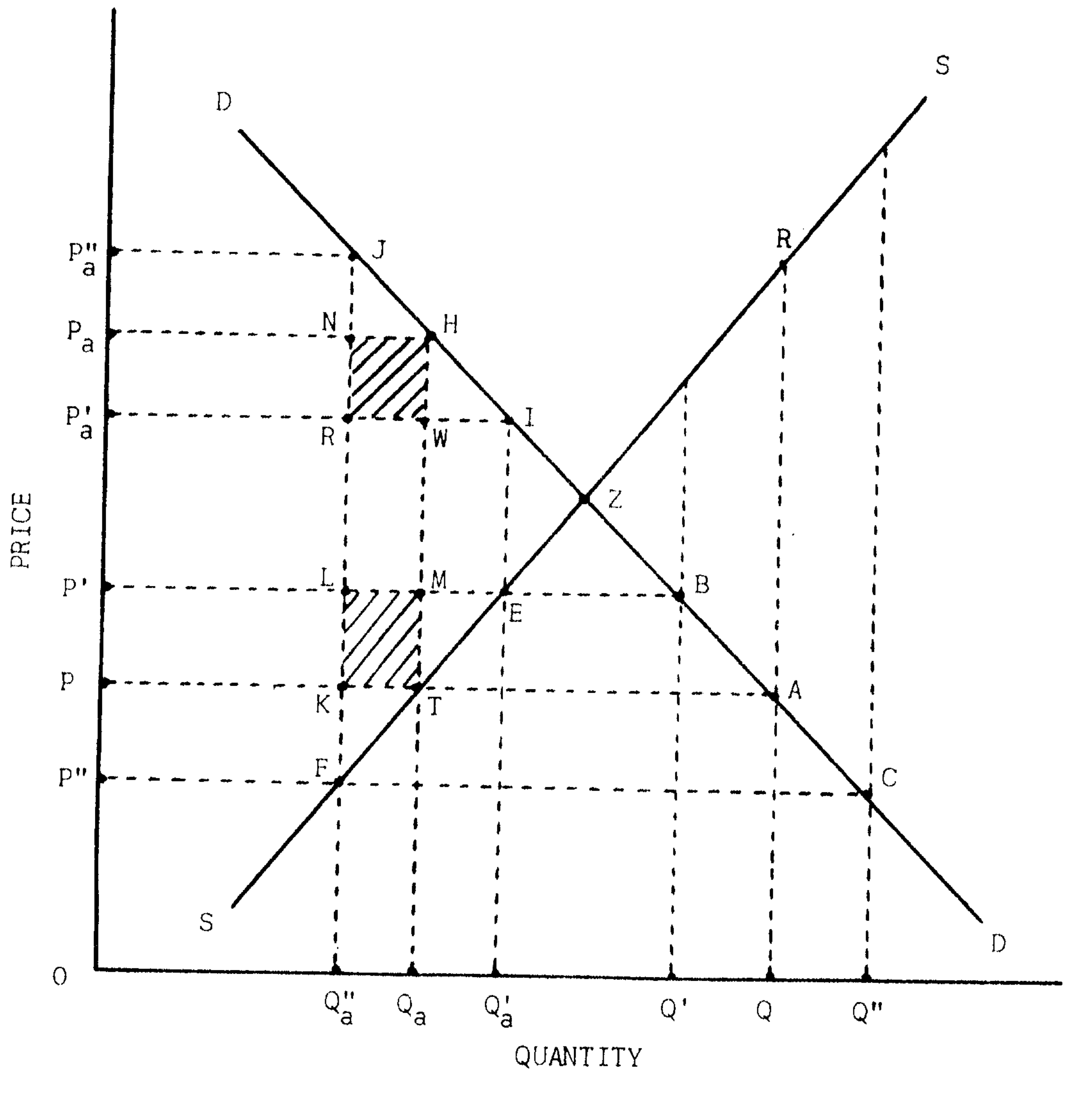

Figure 2. Production adjustment model.

in their price expectations. Furthermore, it is assumed that changes in price expectations came about as a result of new information on expected output provided by statistical reporting agencies. This implies a process of adjustment similar to that of the well-known cobweb model. As a result certain stability conditions became important. We will consider these conditions in more detail in the following section. First let us develop the model.

Suppose, to begin, that producers are unaware that their actual production in the forthcoming period would equal OQ if current production plans materialize. If a sample survey of production could accurately predict OQ and producers have information on the nature of demand for the commodity, the predicted price in the coming period would be OP. Reacting to price OP, producers cut back output and actually place quantity OQ_a on the market, which results in price OP_a in the coming period.

Of course, the below equilibrium output involves a misallocation of resources and therefore leads to a social loss to society. Assuming perfect competition, with no externalities, the marginal cost of output OQ_a is OP, as shown by the supply schedule. However, at quantity OQ_a we see that price P_a will prevail, indicating that society values the marginal unit of this product more highly than it values the products given up to produce it. At the margin this difference is equal to HT on the price axis. Adding to the output of this product would continue to add to net social welfare by progressively smaller amounts, until the equilibrium quantity is reached. Hence, the total net social loss of producing Q_a is equal to triangle ZHT in figure 2.

Suppose, however, that the statistical reporting agency overestimates OQ and predicts OQ" instead, because of a sampling error. On the basis of this information producers expect price OP" and react by actually producing OQ_a". In this case the net social loss would increase to triangle ZJF. However, because sampling errors can be expected to occur at random, there is a 0.5 probability that the statistical reporting agency will underestimate production and predict OQ'. Now the net social loss would decrease (from the initial situation) to triangle ZIE.

It is important to recognize, however, that the expected value of the reduction in social loss due to an underestimate of production will not offset the increase in social loss due to an overestimate. As shown in figure 2, the overestimate of output by OQ" results in an addition to social loss by area HJFT. But an underestimate of production reduces social loss by area IHTE[3/]. The difference between these two areas is equal to the two shaded rectangles in figure 2, area TMLK plus area HNRW. If the probability of either an overestimation or an underestimation is 0.5, the expected value of the net addition to social loss due to the random sampling error, in any given year, is

$$\frac{1}{2} \text{ (area TMLK + area HNRW).}$$

Assuming linear demand and supply curves, the areas of the rectangles TMLK and HNRW can be calculated if we have estimates of the price elasticity of demand (α) and the price elasticity of supply (β) of the commodity in question. The area of rectangle TMLK is equal to TM•TK. Since TM is found by multiplying the error in reporting, QQ' (=QQ"), by the absolute value of the slope of the demand curve ($\frac{1}{\alpha}\frac{p}{q}$) and TK is found by multiplying TM by the inverse of the slope of supply curve ($\beta \frac{q}{p}$), we obtain

$$\text{area TMLK} = e^2pq\frac{\beta}{\alpha^2}$$

where q is the quantity of "true" production; p is the corresponding price on the demand schedule; and e is the quantity error in statistical reporting as a proportion of the "true" quantity (QQ' = QQ" = eq).

The area of rectangle HNRW is equal to HN•HW. The distance HN is equal to TK while HW is found by multiplying HN by the slope of the demand curve ($\frac{1}{\alpha}\frac{p}{q}$). Thus, we obtain

$$\text{area HNRW} = e^2pq\frac{\beta^2}{\alpha^3}.$$

Consequently, the net social cost due to the error in production reporting (sampling error) is given by

$$\frac{1}{2}\ (\text{area TMLK} + \text{area HNRW}) = \frac{1}{2}\ e^2pq\ \left(\frac{\beta}{\alpha^2} + \frac{\beta^2}{\alpha^3}\right)$$

The above formulation applies equally to the case where the actual or "true" production is smaller than the equilibrium production. However, now the social loss occurs because society gives up other goods and services that it values more highly than the commodity in question. Assuming linear demand and supply curves, the magnitude of net social loss due to an error in statistical reporting is the same regardless of whether the actual production is larger or smaller than the equilibrium output.

As a special case, actual output can coincide with the equilibrium quantity. But a statistical reporting error still results in a net social loss in this case; the same formula we derived, $\frac{1}{2} e^2pq \left(\frac{\beta}{\gamma 2} + \frac{\beta^2}{\lambda 3}\right)$, can be used to estimate this loss.

Stability Conditions[4/]

Because the process of adjustment implied by the production adjustment model is of a quasi-cobweb nature, it is important that we investigate the stability of the model. Recall that the cobweb model converges only if the supply curve is steeper (less elastic) than the demand curve at least in the vicinity of the equilibrium point.

If the production adjustment model correctly describes the process of adjustment that occurs in responses output and price information supplied by a statistical reporting agency, then a positive social return is obtained from this information only if the cobweb is stable. This can be seen from figure 2. Suppose for the sake of argument that the statistical reporting agency does not exist and output OQ is produced. The social cost of this disequilibrium situation is given by triangle ZRA. Compare this with the case where a statistical reporting agency is able to predict OQ with 100 percent accuracy. The production adjustment model implies that producers respond by reducing output to OQ_a and as a result the social cost is equal to triangle ZHT. Notice, however, that triangle ZHT, the social cost with perfectly accurate information, is less than triangle ZRA, the social cost with no information, only if the supply curve is steeper than the demand curve. If the converse is true, then information provided by a statistical reporting agency results in a net loss to society. This is one case where "it pays to be ignorant".

Whether or not society is better or worse off with statistical reporting agencies of the type discussed in conjunction with the production adjustment model appears to depend, therefore, upon whether or not the model is convergent. This, of course, will depend upon the commodity in question. In the case of the U.S. Agricultural Commodities, to which we apply the model in the following section, we have evidence that leads us to believe that the model is convergent. According to Cromarty's and Brandow's estimates of supply and demand elasticities for livestock products (table 2), it appears that the demand elasticities are substantially larger than their corresponding supply elasticities. In addition, we do not observe an increasing amount of price instability in the markets for these products particularly in the post World War II era. In fact, just the opposite appears to be the case, although this may be explained in part at least by a more stable economy during this time. At any rate the evidence clearly supports the hypothesis that the Statistical Reporting Service of the U.S. Department of Agriculture provides a positive rather than a negative social return.

We should point out, however, that statistical reporting errors increase social cost irrespective of the market stability condition, and that the formula developed in conjunction with production adjustment model applies in either case. That is, the two shaded rectangles in figure 2, denoting the expected increase in net social loss due to random sampling errors, continue to exist regardless of the relative size of triangles ZRA and ZHT. Of course, in the unstable case where triangle ZRA is smaller, the relevant question pertains to the existence of the statistical reporting agency rather than to the size of its sampling errors.

Let us now turn our attention to the measurement of the marginal costs and returns of achieving greater sampling accuracy in the statistical reporting of U.S. Agricultural Commodities. By comparing these costs and returns we will be able to estimate the marginal benefit-cost ratios to public investment in this activity.

II. Costs and Returns of Statistical Reporting of Agricultural Production

Sample Survey Costs for Alternative Degrees of Accuracy

For the purpose of reporting and predicting agricultural production, The Statistical Reporting Service of the USDA conducts a nationwide sample survey covering approximately 150 agricultural commodities. The costs of obtaining specified levels of accuracy in the sample survey are estimated by the Research and Development Branch of The Statistical Reporting Service. These cost estimates for degrees of accuracy ranging from a zero to a three percent sampling error for the major farm commodities are presented in table 1[5/]. Also presented in table 1 are the corresponding sampling errors for each of the individual commodities included in this group.

The Statistical Reporting Service is now shifting its methodology of sampling from an area technique to multiple frame techniques (using lists in conjunction with the area), in order to attain higher accuracy. At present the enumerative and objective yield surveys, using the area technique, are being conducted with a goal of attaining an average sampling error of 2 percent; the cost of these surveys is 4.13 million dollars.

Table 1. The costs of sample survey required for the specified levels of typical sampling error in major U.S. farm commodities, and the corresponding sampling errors in individual commodities.

Survey cost		Typical sampling error in major commodities[a]	Sampling error in individual commodities[b] (100e)										
Area sample	Multiple frame sample		Wheat	Rye	Rice	Corn	Oats	Barley	Potatoes	Soybeans	Peanuts	Tobacco	Cotton
million dollars		- - % - -	- - - - - - - - - - - - - - - - -					%	- - - - - - - - - - - - - - - - - -				
3.40	3.40	3.0	3.2	9.0	15.8	2.1	3.1	5.4	18.5	3.4	9.5	5.1	4.8
3.76[c]	3.76[c]	2.5	2.6	7.5	12.6	1.8	2.6	4.5	15.5	2.8	8.0	4.3	4.0
4.13	4.13	2.0	2.1	5.9	9.9	1.4	2.1	3.5	12.6	2.2	6.3	3.4	3.1
5.80	5.60	1.5	1.6	4.5	7.8	1.1	1.7	2.7	9.5	1.7	5.0	2.6	2.4
7.90	7.60	1.0	1.1	3.0	5.5	0.8	1.2	1.9	6.6	1.2	3.6	1.8	1.7
17.10	13.00	0.5	0.7	2.0	3.5	0.5	0.7	1.3	4.2	0.8	2.2	1.2	1.1
62.00	44.20	0.0	0.2	0.6	0.8	0.0	0.2	0.5	1.0	0.3	0.8	0.5	0.4

a Major commodities refer to items that are produced on most farms in the U.S.

b Sampling errors in the production characteristics of individual items corresponding to the specified levels of typical sampling error in major U.S. farm commodities.

c Linear interpolation

Source: Data prepared by The Statistical Reporting Service, U.S. Department of Agriculture.

Table 1. (continued)

Survey cost		Typical sampling error in major commodities[a]	Sampling error in individual commodities[b] (100e)					
Area sample	Multiple frame sample		Cattle	Hogs	Sheep and lambs	Poultry	Egg	Milk
million dollars		- - % - -	- - - - - - - - - - - - - % - - - - - - - - - - - - - - - - - -					
3.40	3.40	3.0	2.3	4.4	13.1	9.2	9.2	5.4
3.76	3.76	2.5	1.9	3.8	11.0	7.8	7.5	4.5
4.13	4.13	2.0	1.3	2.9	8.9	6.2	5.8	3.5
5.80	5.60	1.5	1.0	2.2	6.8	4.8	4.5	2.7
7.90	7.60	1.0	0.7	1.6	4.5	3.3	3.1	1.9
17.10	13.00	0.5	0.5	1.0	3.0	2.0	1.9	1.3
62.00	44.20	0.0	0.0	0.4	0.7	0.5	0.6	0.4

Table 2. Estimates of social returns to reducing sampling error in the survey for statistical reporting: 17 U. S. farm commodities, 1966-68 averages.

	Inventory adjustment model[a]										
	Wheat	Rye	Rice	Corn	Oats	Barley	Potatoes	Soybeans	Peanuts	Tobacco	Cotton
Price elasticity of demand (α)	0.02	0.04	0.04	0.03	0.01	0.01	0.1	0.3	0.2	0.5	0.1
Price elasticity of supply (β)											
	- - - - - - - - - - - - million dollars - - - - - - - - - - - -										
Farm value of production (pq)	2075	26	464	4882	540	380	598	2534	285	1255	1053
Social loss corresponding to typical sampling error:											
100e = 3.0%	106.2	5.3	289.6	71.8	51.9	110.8	204.7	9.8	12.9	6.5	24.3
2.5	70.1	3.7	184.2	52.7	36.5	77.0	143.7	6.6	9.1	4.6	16.8
2.0	45.8	2.3	113.7	31.9	23.8	46.6	94.9	4.1	5.7	2.9	10.1
1.5	26.6	1.3	70.6	19.7	15.6	27.7	54.0	2.4	3.6	1.7	6.1
1.0	12.6	0.6	35.1	10.4	7.8	13.7	26.0	1.2	1.8	0.8	3.0
0.5	5.1	0.3	14.2	4.1	2.6	6.4	10.5	0.5	0.7	0.4	1.3
0.0	0.4	0.0	0.7	0.0	0.2	1.0	0.6	0.1	0.1	0.1	0.2
Marginal social returns corresponding to:											
100e = 3.0 to 2.5%	36.1	1.6	105.4	19.1	15.4	33.8	61.0	3.2	3.8	1.9	7.5
2.5 to 2.0	24.3	1.4	70.5	20.8	12.7	30.4	48.8	2.5	3.4	1.7	6.7
2.0 to 1.5	19.2	1.0	43.1	12.2	8.2	18.9	40.9	1.7	2.1	1.2	4.0
1.5 to 1.0	14.0	0.7	35.5	9.3	7.8	14.0	28.0	1.2	1.8	0.9	3.1
1.0 to 0.5	7.5	0.3	20.9	6.3	5.2	7.3	15.5	0.7	1.1	0.4	1.7
0.5 to 0.0	4.7	0.3	13.5	4.1	2.4	5.4	9.9	0.4	0.6	0.3	1.1

Table 2. (continued)

	Production adjustment model[b]					
	Cattle	Hogs	Sheep and lambs	Poultry	Eggs	Milk
Price elasticity of demand (α)	0.8	0.7	1.8	1.6	0.6	0.6
Price elasticity of supply (β)	0.04	0.1	0.1	0.7	0.3	0.2
	- - - - - -	- - - -	million dollars	- - - -	- - - -	- - - -
Farm value of production (pq)	8180	4064	246	1758	1981	5745
Social loss corresponding to typical sampling error:						
100e = 3.0%	0.2	1.0	0.7	2.9	11.7	6.2
2.5	0.1	0.7	0.5	2.1	7.0	4.3
2.0	0.0	0.4	0.3	1.3	4.2	2.6
1.5	0.0	0.2	0.2	0.8	2.5	1.5
1.0	0.0	0.1	0.1	0.4	0.9	0.8
0.5	0.0	0	0.0	0.1	0.4	0.4
0.0	0.0	0	0.0	0	0	0
Marginal social returns corresponding to:						
100e = 3.0 to 2.5%	0.1	0.3	0.2	0.8	4.7	1.9
2.5 to 2.0	0.1	0.3	0.2	0.8	2.8	1.7
2.0 to 1.5	0.0	0.2	0.1	0.5	1.7	0.7
1.5 to 1.0	0.0	0.1	0.1	0.4	1.6	0.5
1.0 to 0.5	0.0	0.1	0.1	0.3	0.5	0.4
0.5 to 0.0	0.0	0	0.0	0.1	0.4	0.3

Notes to Table 2.

a Social loss = $e^2pq \frac{1}{\alpha}$

b Social loss = $\frac{1}{2} e^2pq \left(\frac{\beta}{\alpha^2} + \frac{\beta^2}{\alpha^3}\right)$

Sources:

Price elasticity of demand for crops: Commodities except soybeans, tobacco, and cotton from Brandow (1961), p. 59; soybeans from Houck and Mann (1968), p. 20; tobacco from Lyon and Simon (1968), p. 893. Median figure in the estimates of price elasticity for cigarettes; cotton from Donald, Lowenstein, and Simon (1963), p. 61.

Price elasticities of demand for livestock products: Cromarty (1959), p. 573, except sheep and lambs (from Brandow) and eggs (assumed same as in milk).

Price elasticity of supply: Cromarty (1959), p. 573, except sheep and lambs (assumed same as in hogs).

Farm value of production: USDA (1969).

This cost would be similar for the multiple frame sampling scheme down to the 2 percent error level. This 2 percent error objective is based on the fact that the cost of a survey begins to rise rapidly almost with a kink at the 2 percent level of error. For sampling errors of less than 2 percent the multiple frame technique is more efficient.

A relevant question at this point is whether the marginal cost of attaining greater statistical accuracy represents a socially profitable investment. We can shed some light on this question by comparing the marginal cost of greater accuracy with its accompanying marginal net social return as calculated by the techniques developed in the previous sections.

Estimation of Marginal Net Social Returns

In agricultural production it is possible to utilize both the inventory adjustment and the production adjustment models for the various kinds of products. Sampling errors in crop reporting data can be evaluated by the inventory adjustment model. In this case there is little chance to adjust production once the crops have been planted. However, there is ample opportunity for inventory holders to adjust the rate of inventory depletion in response to information on acreages planted and on predicted yields. On the other hand, livestock and livestock products appear to be well suited to the production adjustment model. Here continuous adjustments in production can be made in response to information reported by the government.

Of course, we might expect some products to have applicability to both models. There are, for example, significant inventories of livestock products in cold storage which could be analyzed by the inventory adjustment model. There are, on the other hand, possibilities of production adjustments in crops, particularly if we consider interregional adjustments. For example, errors in the statistical reporting of the winter wheat acreage in Kansas and Oklahoma may influence decisions to plant spring wheat in Montana and North Dakota. The fact that we apply only one of the adjustment models to each major commodity would seem to imply, therefore, that our estimates of the social returns to improvements in sampling accuracy represent a lower bounds of the true returns.

Data for farm value of production (pq) were obtained from Agricultural Statistics (USDA). The time period 1966-68 roughly corresponds to the years for which the costs of the sample survey in table 1 were estimated. Price elasticities of demand and supply (α and β) were collected from various publications (see sources under table 2)[6].

In the upper portion of table 2 we present the social losses corresponding to degrees of sampling errors, as opposed to a zero error. The actual "e" values for each commodity are taken from table 1. For example, in the inventory adjustment model, the "e" value (in percent) for wheat is 3.2 at the 3.0 percent group level sampling error.

The marginal net social returns figures resulting from a reduction in sampling error are presented in the lower portion of table 2. These figures are obtained by subtracting the social cost of a given sampling error from its next higher level. For example, the marginal net social returns for wheat in the inventory adjustment model, because of reducing the typical sampling error from 3.0 to 2.5 percent, is 36.1 million dollars. This figure is obtained by subtracting the social loss of a 2.5 percent error, 70.1 million dollars, from the social loss of a 3.0 percent error, 106.2 million dollars.

The Benefit-Cost Ratios

Based on the estimates of the costs of the sample surveys reported in table 1 and of the marginal social returns, we calculated the benefit-cost ratios for public investment in increasing accuracy or reducing sampling error in the survey of agricultural production as being conducted by The Statistical Reporting Service, USDA. The results are presented in table 3.

Marginal costs of the survey for reduction in the typical sampling errors are calculated from the data in table 1. Marginal social returns corresponding to the reduction in the typical sampling errors are aggregated from the estimates of marginal social returns for individual commodities in table 2.

In spite of the possibility of underestimation of social returns, the benefit-cost ratios calculated by dividing the marginal social returns by marginal social costs are extremely large. For example, our estimates reveal that each extra dollar invested in increasing the accuracy of statistics from the 2.5 to the 2.0 level of error returns more than 600 dollars worth of benefit to society. And increasing the level of accuracy from 2.0 to 1.5 percent error produces 90 to 100 dollars of benefit for each extra dollar invested.

To a certain extent the reliability of our estimates of the marginal social returns and benefit-cost ratios depends on the accuracy of the

Table 3. Estimates of marginal social benefit-cost ratios corresponding to reduction in typical sampling error in the survey for statistical reporting of farm commodities, the United States.

	Marginal survey cost[a]		Marginal social returns[b]			Marginal benefit-cost ratio	
Change in typical sampling error	Area sampling (1)	Multiple frame sampling (2)	Inventory adjustment (3)	Production adjustment (4)	Total (5)	(5)/(1)	(5)/(2)
- - - - % - - - -	- million dollars - - - -						
from 3.0 to 2.5	0.36	0.36	288.8	8.0	296.8	824	824
2.5 to 2.0	0.37	0.37	223.2	5.9	229.1	619	619
2.0 to 1.5	1.67	1.47	152.5	3.6	156.1	93	106
1.5 to 1.0	2.10	2.00	116.3	2.9	119.2	57	60
1.0 to 0.5	9.20	5.40	66.9	1.4	68.3	7.4	13
0.5 to 0.0	44.9	27.1	42.7	0.9	43.6	1.0	1.6

a Increases in the cost of sample survey corresponding to changes in the typical sampling error; data from Table 1.

b Aggregates of marginal social returns; data from Table 2.

price elasticities of demand and supply that we have utilized. Over-estimation of the marginal social returns or the benefit-cost ratios would result from either an underestimate of demand elasticities (α's), an overestimate of the supply elasticities (β's), or both. In the interest of obtaining lower bounds to the various B-C ratios we utilized progressively larger demand elasticities and progressively smaller supply elasticities in making our calculations. The results are presented in table 4.

As expected, the B-C ratios decline using progressively larger α's and smaller β's. However, even when the 500 percent larger α's and 500 percent smaller β's are applied, an extra dollar invested in increasing the accuracy of statistical reporting of the products considered returns over 100 dollars worth of benefit to society at the 2.5 to 2.0 percent range of accuracy and nearly 20 dollars of benefit at the 2.0 to 1.5 percent range.

Although the present estimation is very rough and is intended more to illustrate the methodology, it seems apparent that the benefit from the investment in increasing accuracy for agricultural production statistics exceeds its cost by a wide margin. It appears, therefore, that in terms of social welfare maximization criteria it pays to increase public expenditure to obtain greater accuracy of information concerning agricultural production.

Table 4. Marginal social benefit-cost ratios corresponding to an increase in the price elasticities of demand (α) and a decrease in the price elasticities of supply (β).

Changes in typical sampling error (%)	2.5 to 2.0	2.0 to 1.5	
Sample survey method	Area or multiple	Area	Multiple
Marginal benefit-cost ratios using *α's increased and β's decreased by			
0%	619	93	106
10	560	85	96
30	470	71	81
50	434	62	70
100	304	46	52
300	151	23	26
500	103	16	18

* See original α's and β's in Table 2.

III. Summary and Conclusions

In this study a methodology was developed to estimate the social returns to investment in the collection and reporting of information. The methodology was applied to the case of reporting of agricultural production statistics by the USDA. We found that the social returns exceed the cost of data collection over an extremely wide margin even after adjusting for possible overestimation of the B-C ratios arising from possible errors in the demand and supply elasticities.

In addition to the adjustments just referred to there are a number of other reasons why our results should represent the lower bounds of estimates of the social returns: (a) all commodities covered by the same sample survey are not included in the benefit calculations; (b) the benefits arising from the better inventory adjustments of livestock products and from the better production adjustments of crops are not included in our calculations; and (c) the benefits from the better planning and resource allocations by government agencies are not included in our calculations. The gap between the social benefits and the costs would further widen if we were to include these benefits.

Our results suggest that there is an underinvestment in the provision of public information services, at least with respect to statistical reporting in agricultural production. However, this study does not necessarily imply that the government should reduce the output of other public service activities in order to improve information services. The study by Griliches in which the social returns to hybrid corn research were estimated indicates that the benefit-cost ratio for the research is in the order of 70 (Griliches, 1958). Peterson's study of poultry research indicates that the ratio is in the order of 20 (Peterson, 1967). Thus our results indicate that the social returns to a dollar invested in statistical information service is comparable to the returns in such high pay-off investments as agricultural research.

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Footnotes

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1/ See Marshall (1916, pp. 124-133, 140, and 810-812.) Our approach is along the tradition of public goods. For a classical theoretical study see Hotelling (1938). For an empirical study see Griliches (1958).

2/ α is the absolute value of the price elasticity of demand.

3/ This does not imply that the statistical reporting agency can always reduce social loss by biasing their estimates on the low side. If actual output happened to be less than equilibrium output, the underestimate error increases social loss instead of reducing it.

4/ We are indebted to George Borts for calling our attention to this problem.

5/ The data given in table 1 were developed "on a state-by-state basis and were built up to the national level" (a personal communication of Dr. W. E. Kibler, Research and Development Branch, Standard and Research Division, The Statistical Reporting Service, May 8, 1970).

6/ We attempted to collect the estimates of price elasticities from the studies widely recognized among the profession. It is somewhat difficult to judge the reliability of these elasticities and the possible direction of bias. Further examination or re-estimation of these elasticities would be necessary for advancing this study in the future.