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### SOCIAL COST OF THE DAIRY PRICE SUPPORT PROGRAM

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# SOCIAL COST OF THE DAIRY PRICE SUPPORT PROGRAM\*

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Decisions to change the level of milk price support or even to continue the program should include some consideration of the associated cost to society. This paper describes a method to estimate the net social cost of the price support program and estimates the change in net social cost resulting from changing the level of support price under the existing program. Net social cost obviously is not the sole criterion for policy decisions but it should be considered along with more conventional criteria such as government program cost, farm income, milk supply and utilization and consumer prices.

Estimating the social cost of the dairy price support program is more complex than it would be for many other agricultural products because of the multiplicity of price regulations.

There are three basic prices determining supply and utilization of milk: the "manufacturing" milk price paid by processors of manufactured milk products; the "fluid bottling" price paid by processors of fluid milk products (usually priced at a fixed differential above the manufacturing use price); and the weighted "all wholesale milk" price received by producers that reflects the proportion of all milk used for both fluid and manufactured products.

Although 75 percent of all milk marketed in the United States is Grade A or eligible for fluid use, only 44 percent of all milk is actually used

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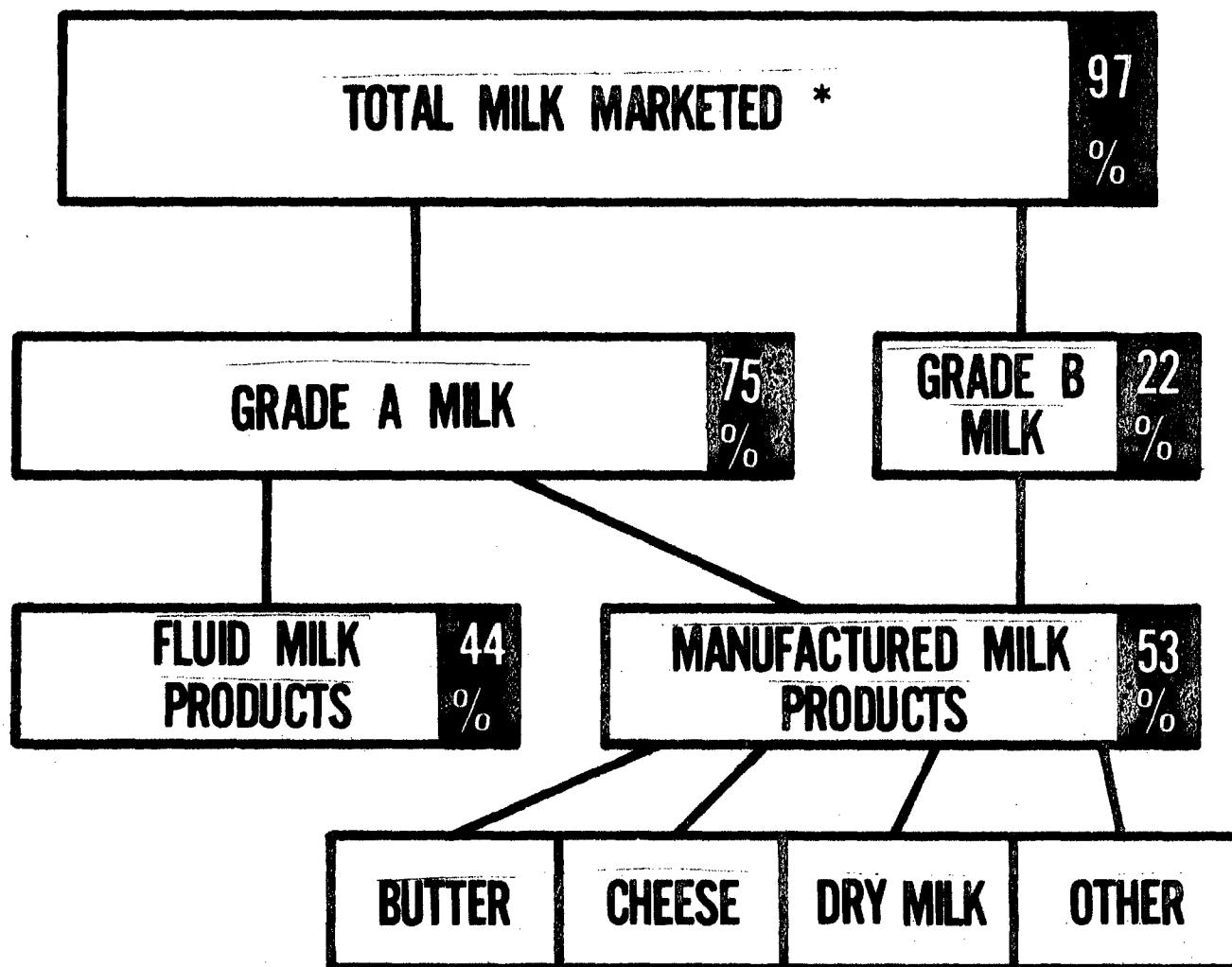
for fluid milk products (see figure 1). The remaining Grade A milk is sold on the manufacturing milk market. This diverted Grade A milk along with all Grade B milk is then the available supply to meet manufactured milk demand. It is the supply and demand of this milk for manufacturing that under the present pricing policies determines the market value of milk. The price paid by processors of fluid milk products is calculated from the manufacturing market price and can be closely approximated by using a \$2.17 differential above the manufacturing price (see Appendix table 1). Also, the all wholesale price received by producers can be closely approximated by using a \$1.00 differential above the manufacturing price (see Appendix table 1).<sup>1/</sup>

These prices tend to move together because they are often tied by formula to manufacturing milk prices and they tend to maintain or hold at fixed differentials. Further analysis suggests that changes in the manufacturing milk price will result in approximately equal changes in the bottling milk price and in the all wholesale milk price received by farmers (see figure 2).

It is the manufacturing milk price that the government must support between 75 and 90 percent of parity. Under the current price support program, the government stands ready to purchase butter, non-fat dry milk powder and cheese at prices sufficient to support the manufacturing milk price at the level established under the support program.

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<sup>1/</sup>However, increasing the manufactured milk price through the support program would raise the fluid eligible price and decrease the proportion of milk used in fluid products, thereby resulting in a relatively smaller increase in the "all wholesale milk" price. The exact relationship between changes in the manufacturing milk price and the all wholesale milk price would depend, in part, on the relative elasticities of demand for fluid eligible and manufacturing milk. The year-to-year changes in prices plotted in figure 2 suggest that a change in manufacturing price will result in about equal changes in fluid eligible and in all wholesale milk prices. This enables us to make some useful simplifying assumptions about price changes which aids in estimating the social cost of the price support program.



\* About 3 percent of the milk supply is used on farms where produced.

Fig. 1. Utilization of total milk marketed in the United States, 1970.

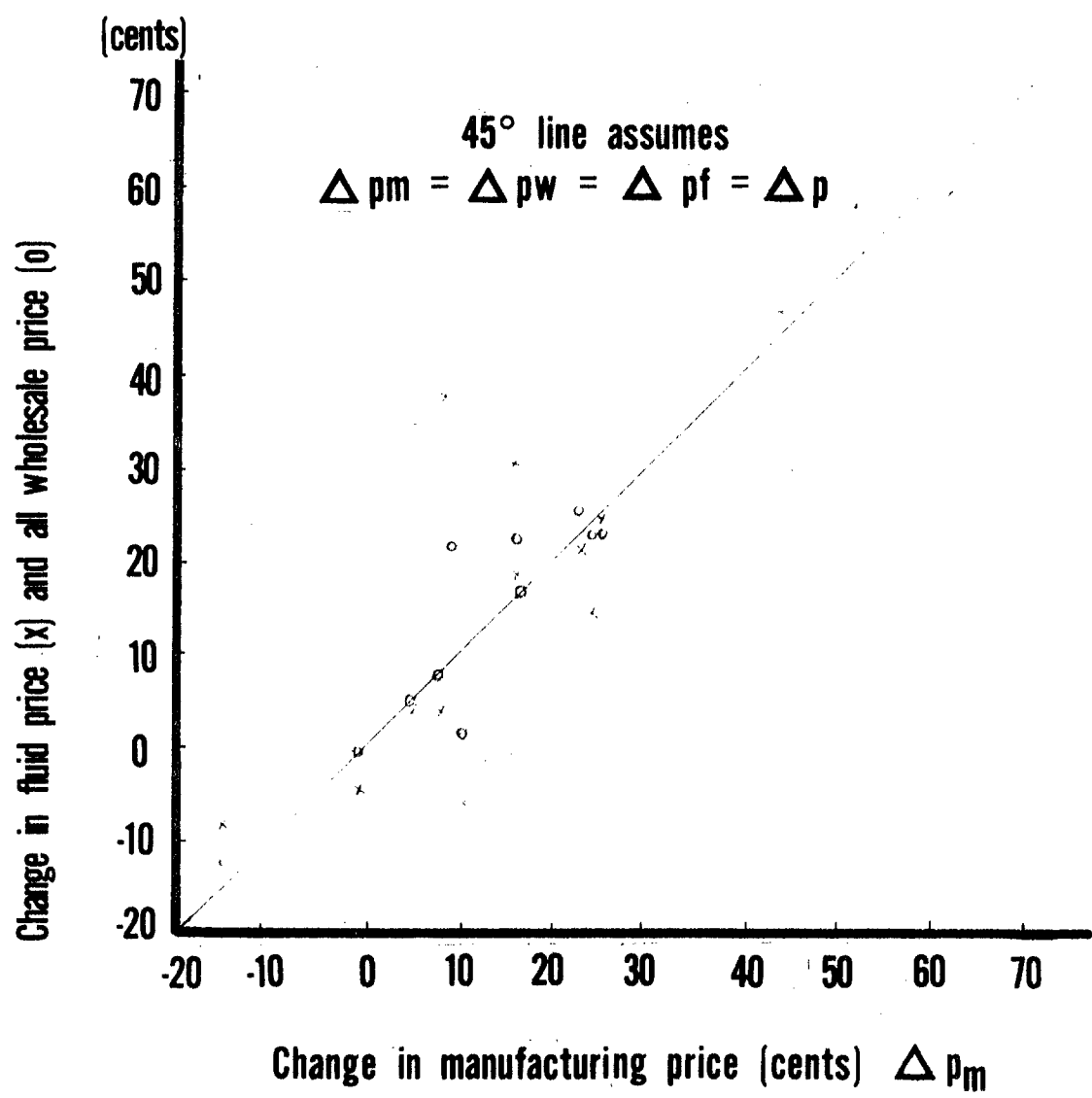


Fig. 2. Relationship between changes in manufacturing milk prices and in fluid bottling and in all wholesale milk prices, 1960 to 1972.

Our method and estimates of social costs do not include considerations of the social benefits and costs of the discriminatory price systems. Rather, they look at the price support program. That is, the federal milk marketing order program and other institutional and classified pricing arrangements and their associated social costs and benefits are assumed to be given.

#### Theoretical Background

Equilibrium price and quantity established in free market, unrestricted by production controls and price supports, maximizes the net social gain, given the initial resource distribution.<sup>2/</sup>

A net social cost is implied whenever the support price for manufacturing milk exceeds the free market price. Consumers must pay higher prices for fluid milk and manufactured dairy products and producers are encouraged to produce more milk than is demanded.

The nature of this social cost of supporting milk prices may be best understood by considering separately and also jointly the consumers and producers of milk.

First consider the consumer. A consumer's preference may be represented on his indifference map. Let this ordinal measure of utility show the consumer's preferences between milk and all other goods (numeraire). The consumer's utility will be at a maximum where the highest indifference curve is tangent to his budget constraint. Here the marginal rate of substitution between milk and all other goods is just equal to slope of the budget constraint. The slope of the budget constraint will equal

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<sup>2/</sup>For a further discussion of this see: Luther G. Tweeten and Fred H. Tyner, "The Utility Concept of Net Social Cost--A Criterion for Public Policy," AER, Econ. Res. Ser., USDA, Vol. XVIII, No. 2, April 1966.

the price of milk since the price of the numeraire is set equal to unity. Assuming that all people have identical preferences and initial endowments, a community indifference map may be constructed, changing only the scale on the two axes. Community utility will be maximum when the highest indifference curve between milk and all other goods is just tangent to the community budget constraint, point A in figure 3. Also, at this point the marginal rate of substitution between milk and all other goods for the community as a whole is just equal to the price of milk. A compensated demand curve for milk can be derived for the community as a whole by changing the price of milk, compensating the community income so that the same level of satisfaction is maintained, and by observing the change in the quantity of milk demanded, e.g., point C in figure 3. The curve will be downward sloping assuming ordinary convex indifference curves.

Now consider the producer. With a fixed amount of resources available to the community, the quantity of all other goods and services will decrease as more resources are used for milk production. The various quantities of milk and all other goods that can be produced in the community may be represented by a production possibility curve. Here the optimal combination of milk and all other goods is attained when the marginal rate of product transformation is equal to the price of milk. Assuming a curved production possibility curve, the community will have to give up more and more of all other goods to obtain larger outputs of milk. The supply curve derived from this possibility curve will have a positive slope since the cost to the community in terms of all other goods increases as larger quantities of milk are produced. The supply curve then reflects the opportunity cost to the community, in terms of all other goods, for additional quantities of milk production. The community indifference map and production possibility curve are combined in figure 3.



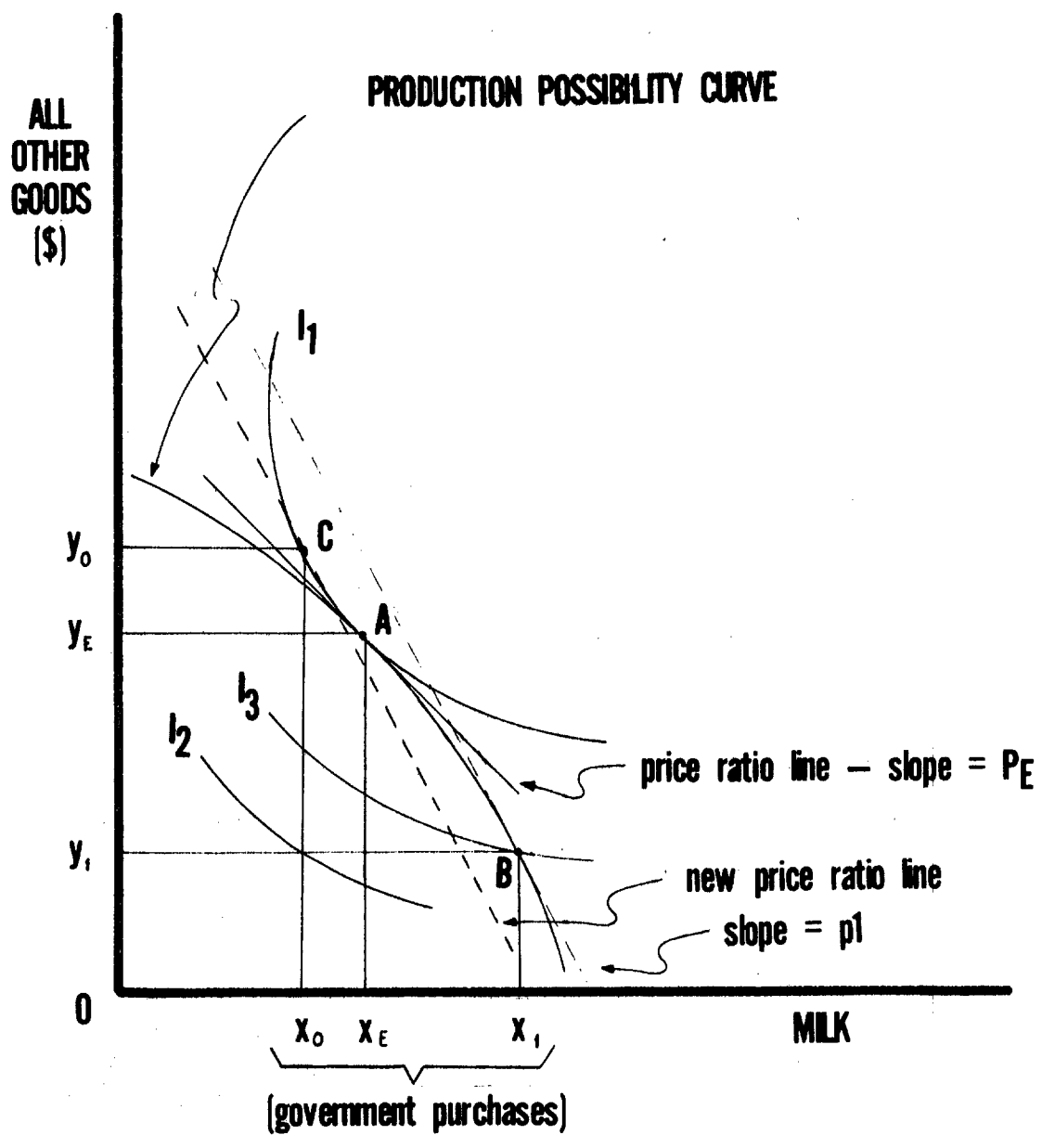


Fig. 3. Production possibility and indifference map for a hypothetical community.

At the free market price the production possibility curve is just tangent to indifference curve  $I_1$  in figure 3. The slope of both the indifference curve  $I_1$ , and the production possibility curve is equal to the price of milk (slope of price line) at point A. Now consider a support price higher than the free market equilibrium price. Dairy producers, attempting to maximize total revenue with available resources, will want to produce on the production possibility curve where the slope of the new price line is just tangent to the production possibility curve. This would be point B in figure 3 and for the entire community  $OX_1$  milk, and  $OY_1$  of all other goods would be produced. The consumers on the other hand would want to consume less milk at the relatively higher milk price to minimize the cost of maintaining the same level of satisfaction.<sup>3/</sup> This is equivalent to consuming, where the slope of the new price line is just tangent to the same indifference curve, point C in figure 3. The entire community would want to consume  $OX_0$  milk and  $OY_0$  for all other goods at the higher milk price.

The difference between what the farmers produce and what the consumers consume at the higher price ( $X_0X_1$ ) is the excess supply purchased by the government. Only  $OX_0$  milk and  $OY_1$  of all other goods are now available to the community, making  $I_2$  the highest indifference curve obtainable if the government donates abroad or "destroys" the milk purchased under the support program.

The corresponding demand and supply curves for fluid and manufacturing milk are presented in figure 4. This figure is a modified version of the more conventional two price plan. The fluid demand curve labeled  $D_f^s$ , and the supply curve labeled  $S^s$  show the amount of milk demanded as fluid and the total milk

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<sup>3/</sup>The change in quantity of milk demanded so that total satisfaction is unchanged in the community due to a higher milk price is equivalent to a compensated demand curve. The compensated demand curve is approximately equal to the own demand curve when the income elasticity of demand for milk is small, i.e., the proportion of total expenditure for milk is small.

supplied, respectively, at each manufacturing milk price. The actual fluid milk price corresponding to any manufacturing price for any quantity can be determined by reading the value directly above  $D_f^S$  on the  $D_f$  curve which is the actual demand curve for fluid milk. This vertical distance between  $D_f^S$  and  $D_f$  is the differential between manufacturing milk and fluid eligible milk prices (\$2.17).

The all wholesale milk price necessary to call forth alternative quantities from farmers and corresponding to any manufacturing price is the price directly above  $S^S$  on the  $S$  curve which is the actual supply curve for all milk. This vertical distance between the  $S^S$  and  $S$  curves is the differential between manufacturing milk and all wholesale milk prices (\$1.00).

The area under the fluid demand curve between 0 and  $X_f$  and under the manufacturing demand curve between 0 and  $X_m$  represents the total value of fluid milk and manufacturing milk to the community in terms of all other goods.<sup>4/</sup> The area under the supply curve between 0 and  $X_s$  represents the cost to society of the resources used to produce milk in terms of all other goods.

Assuming the government donates abroad or destroys its purchases, the social cost of higher support prices would be approximated by the three shaded areas in figure 4. The shaded area under the demand curve for fluid milk and the demand for manufacturing milk would be the loss of consumer surplus while the shaded area under the supply curve would be the cost of the added resources used to produce the additional milk at the higher all wholesale milk price. This area or loss would be approximately equal to:

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<sup>4/</sup> Assumes that both demand curves intersect the vertical price axis.

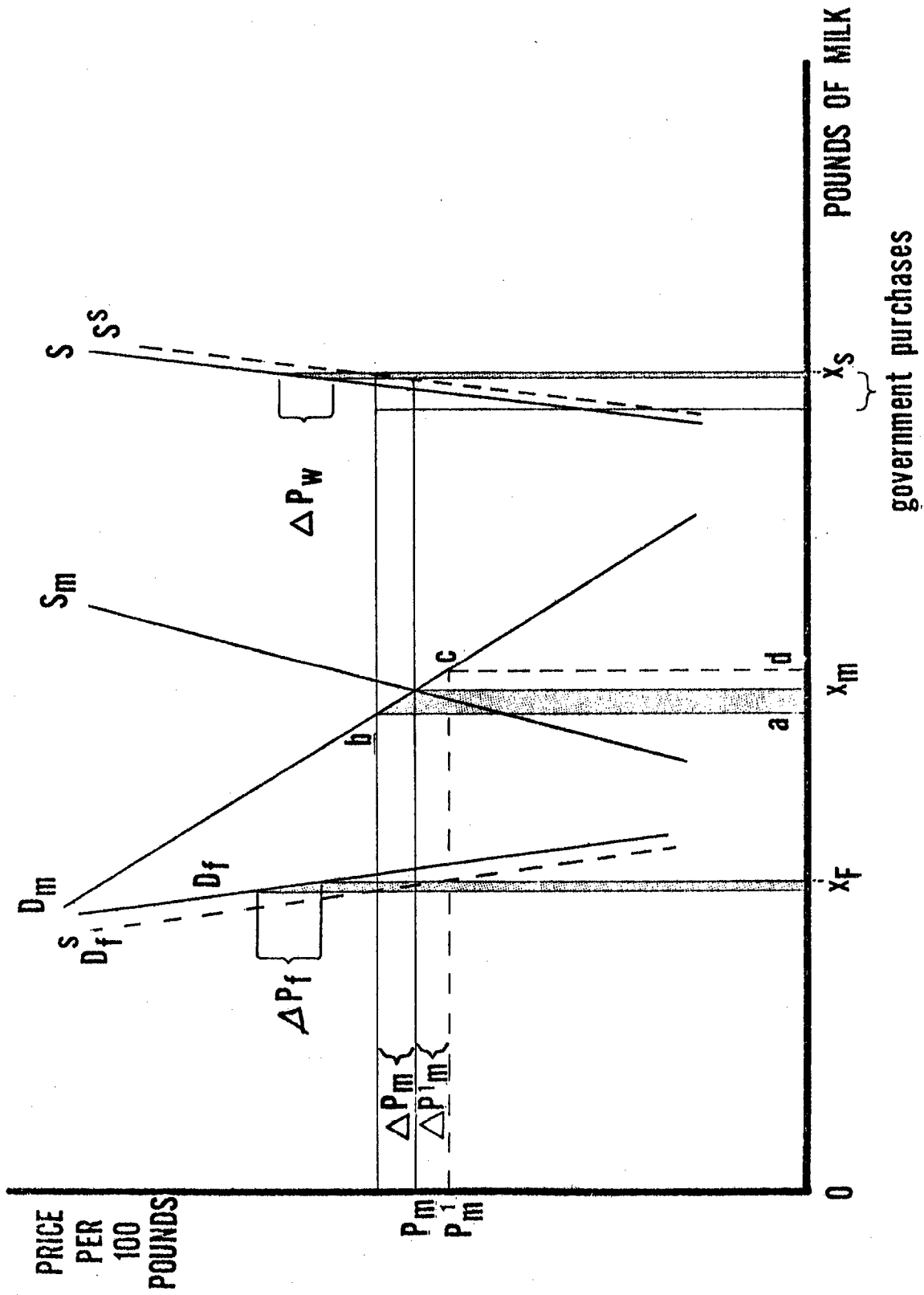


Fig. 4. Impact of increasing support price for manufacturing milk on net social cost.

$$\text{Loss} = + (\Delta q^f P_f + \frac{1}{2} \Delta q^f \Delta P_f) + (\Delta q^m P_m + \frac{1}{2} \Delta q^m \Delta P_m) \\ - (\Delta q^s P_w + \frac{1}{2} \Delta q^s \Delta P_w)$$

where:

- $\Delta q^f$  = change in fluid consumption
- $\Delta q^m$  = change in manufactured milk consumption
- $\Delta q^s$  = change in quantity supplied
- $P_f$  = fluid eligible milk price
- $P_m$  = manufacturing milk price
- $P_w$  = all wholesale milk price.

This social cost can be approximated in terms of elasticity of demand for fluid and manufacturing milk, elasticity of supply, the initial prices and quantities and the change in milk price as follows:

First, approximate the fluid demand ( $\eta_f$ ), manufacturing demand ( $\eta_m$ ), and supply ( $\xi$ ) elasticities with

$$\eta_f = \frac{\Delta q^f P_f}{\Delta P_f q_o^f}$$

$$\eta_m = \frac{\Delta q^m P_m}{\Delta P_m q_o^m}$$

$$\xi = \frac{\Delta q^s P_w}{\Delta P_w q_o^s}$$

where:

- $q_o^f$  = equilibrium or initial quantity of milk sold for fluid use
- $q_o^m$  = equilibrium or initial quantity of milk sold for manufacturing use.

- $q_0^s$  = equilibrium or initial quantity of milk supplied  
 $P_f$  = equilibrium or initial fluid eligible milk price  
           per one hundred pounds  
 $P_m$  = equilibrium or initial manufacturing milk price  
 $P_w$  = equilibrium or initial all wholesale price of milk  
           received by farmers

Assuming constant price differentials the following also hold:

$$P_f = P_m + a$$

$$P_w = P_m + b$$

where:

$a$  = fluid eligible price differential above the manufacturing price

$b$  = all wholesale milk price differential above the manufacturing price, and therefore,

$\Delta P_m = \Delta P_f = \Delta P_w = \Delta P$  = the increase in manufacturing support price.

The social cost can then be expressed as:

$$\begin{aligned}
 L &= + \eta_f \Delta P q_0^f \left[ 1 + \frac{\Delta P}{2(P_m+a)} \right] + \eta_m \Delta P q_0^m \left[ 1 + \frac{\Delta P}{2 P_m} \right] \\
 &\quad - \epsilon \Delta P q_0^s \left[ 1 + \frac{\Delta P}{2(P_m+b)} \right]
 \end{aligned}$$

The more elastic the supply and demand curves the greater the social cost of a support price increase. Also the greater the

increase in support price (or the amount the support price exceeds the free market price) the greater the social cost. In fact the social cost increases at an increasing rate for successively higher support prices above free market equilibrium prices.

#### Reducing the Dead Weight Loss

In reality, much of the government purchases is distributed back to the community through various programs such as the school lunch program and other domestic donations. Assuming all the government purchases were equally distributed back to the U.S. community as manufactured products, the community would be able to achieve indifference curve  $I_3$  through point B in figure 3. However,  $I_3$  is a lower level of satisfaction than is  $I_1$ , which would be attainable under free market conditions.

Any program distributing the government purchase of milk back to the community would reduce the dead weight social cost and allow the community to attain some higher indifference curve between  $I_2$  and  $I_3$  in figure 3. A gift of part of the government surplus to foreign countries would be equivalent to destroying the surplus as far as the United States community is concerned, even though world welfare would clearly be improved.

The social cost would be reduced by the area under the manufacturing curve labeled "a, b, c, d," in figure 4 if government purchases were distributed back to the U.S. community as manufactured products.

The net social cost then would be approximated as follows:

$$\begin{aligned} \text{Net loss} \approx & + (\Delta q^f P_f + \frac{1}{2} \Delta q^f \Delta P_f) - (\Delta q^s P_w + \frac{1}{2} \Delta q^s \Delta P_w) \\ & + (-\Delta q^f + \Delta q^s) P'_m - \frac{1}{2} (-\Delta q^f + \Delta q^s) \Delta P'_m \end{aligned}$$

where:

$P'_m$  = implied price necessary for consumers to purchase as manufacturing products the manufacturing milk diverted from fluid use ( $\Delta q^f$ ) and additional milk supplied ( $\Delta q^s$ ).

$$\Delta P'_m = P'_m - P_m$$

$$P'_m < P_m$$

The net social cost could then be approximated as follows:

$$\begin{aligned} \text{Net loss} \approx & + \eta_f \Delta P_{q_o}^f \left[ 1 + \frac{1}{2} \left( \frac{\Delta P}{P_m + a} \right) \right] - \epsilon \Delta P_{q_o}^s \left[ 1 + \frac{1}{2} \left( \frac{\Delta P}{P_m + b} \right) \right] \\ & - \frac{\eta_f \Delta P_{q_o}^f}{P_m + a} \left[ P'_m + \frac{\Delta P'_m}{2} \right] \\ & + \epsilon \frac{\Delta P_{q_o}^s}{P_m + b} \left[ P'_m + \frac{\Delta P'_m}{2} \right] \end{aligned}$$

where:

$$\Delta P'_m = \frac{-\Delta P P_m}{\eta_m q_o^m} \left[ \eta_f \frac{q_o^f}{P_m + a} - \epsilon \frac{q_o^s}{P_m + b} \right]$$

$$P'_m = P_m + \Delta P'_m$$

$$P'_m < P_m$$



### Empirical Estimates

Two kinds of related policy questions can be considered within the framework presented. First, the annual social cost of the program itself can be estimated by estimating free market prices and quantities and the amount any selected support price exceeds the free market manufacturing milk price. Second, the social cost of increasing the support levels over any current level can be estimated by using current prices and quantities and the intended increase in support price. These questions are part of the same broader problem.

The social costs estimated in this paper assume a demand elasticity for fluid milk of  $-0.35$ , for manufacturing milk of  $-0.5$  and the elasticity of aggregate supply of  $0.15$ .<sup>5/</sup> These estimates are from market data. The elasticity of demand would actually represent the own demand curve for milk rather than a compensated demand curve. The own and compensated demand curves are identical when the income elasticity is zero. Since total expenditure for milk products is a relatively small part of total expenditures, we assume income elasticity is small and no great distortion will result from using the empirically estimated own demand curve.

In early March 1973, the Department of Agriculture announced that the new support price for manufacturing milk would be increased from \$4.93 to \$5.29 the minimum 75 percent of parity as of April 1, 1973. The new support price became effective on March 15, 1973. To estimate the social cost of this decision to raise support price to 90 percent of parity (\$6.35) requires estimates of the free market price and quantities that would otherwise exist in the absence of the program. The manufacturing milk price for 1973 is

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<sup>5/</sup>Estimates reported in an unpublished report to ASCS by Econ. Res. Ser., USDA entitled, "Impacts of Alternative Price Support Levels," January 1973.

expected to be about \$5.50 which would exceed the announced 75 percent of parity support price of \$5.29. Therefore, the social cost would be zero. If the support price had been raised to 85 percent of parity (about \$6.00) the support price would have exceeded the free market price by 50 cents. The estimated annual social cost for 1973 without distributing government purchases back to the community would have been an estimated \$340 million (table 1).<sup>6/</sup> A further increase in the support level to 90 percent of parity (\$6.35) would have increased the social cost in 1973 another \$107 million to a total of \$447 million. The annual social costs of the program itself would, therefore, be those in table 1. The social cost of increasing the support level would be the difference between the totals in table 1. For example, the annual social cost of the program would have been \$340 million if the support price had been set at 85 percent of parity and \$447 million if the support price had been set at 90 percent of parity. The increase in social cost of increasing the support price from 85 to 90 percent of parity is the difference between \$447 and \$340 million or \$107 million (see table 1).

The annual social cost when the increased government purchases due to the higher support price are distributed back to the community as manufactured products is much less at all support levels than without redistribution (see table 1). At 85 percent of parity the estimated annual social cost would decrease from \$340 to \$65 million if all government purchases were distributed back to the community rather than being donated abroad or destroyed. The social cost of a

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<sup>6/</sup> Social cost is based on 1972 production, fluid and manufacturing use.

Table 1. Estimated annual net social cost of alternative price support levels, 1973

	Percent of parity			
	75	80	85	90
Support price <sup>1/</sup> (dollars)	5.29	5.64	6.00	6.35
Estimated free market price (dollars)	5.50	5.50	5.50	5.50
Amount the support price exceeds the free market price (dollars)	- 0 -	.14	.50	.65
Social cost <sup>2/</sup> without distribution back to the community (million dollars)	- 0 -	92	340	447
with distribution back to the community (million dollars)	- 0 -	13	65	94

<sup>1/</sup>Estimated 100 percent of parity price as of April 1, 1973 was \$7.05. This actually turned out to be \$7.01.

<sup>2/</sup>Excludes administrative and storage costs of the program.

combined redistribution and foreign donation policy by the government would be somewhere between the above extremes depending on the proportion redistributed and donated abroad.

#### Summary and Implications

We developed a method to estimate net social cost of the dairy price support program using consumer and producer surplus concepts. The method is intended to be another criterion for policy decisions regarding whether there should be a program or at what level the price support should be set. It is not intended to replace other important criteria such as government program costs, farm income levels, milk supply and utilization, and consumer prices.

Results showed that the social cost of the March 1973 decision to set the support price at the minimum 75 percent of parity was zero. Raising the support prices to 85 percent of parity would have resulted in a net social cost of \$340 million if increased government purchases due to higher support price were donated abroad or destroyed. The net social cost of this same decision could be reduced to \$65 million by redistributing the increased government purchases back to the United States community as manufactured products.

The method developed here has the same weakness as most tools of policy evaluation and formulation. It assumes static demand and supply curves for fluid and manufacturing grade milk. That is, elasticities are constant and there are no shifts in the curves. Shifts in one or more of these curves will lead to different social cost estimates. To the extent that shifts and changes can be forecasted they can be

incorporated into the estimating model. Generally, it is difficult to forecast these changes. Had we made the 1973 social cost estimate without anticipating the shifts in demand and supply that raised manufacturing milk prices above the support level in late 1972 and early 1973, estimates would have been much higher because the free market price probably would have been underestimated.

Appendix Table 1. Selected historical price and quantity data.

		Prices \$1 cwt.										Billion Pounds					
U.S. 1/																	
Manufac. Grade	Milk Used For Bottling 1/	Fluid Milk 1/	All Milk Wholesale 1/	All Milk Diff.	Support 5/ Price	Milk 1/ Prod.	Farm 3/ Use	Milk 3/ Marketed	Used in 2/ Fluid Products	Used in 4/ Manufac. Products	Gov't 1/ Purchase						
$P_m$	$P_f$	$(P_f - P_m)$	$P_w$	$(P_w - P_m)$													
1960	3.25	5.48	2.23	4.21	.96	3.40	123.1		53.0		3.1						
1961	3.36	5.43	2.07	4.22	.86	3.11	125.7		52.6		8.0						
1962	3.20	5.35	2.15	4.09	.89	3.14	126.3		53.3		10.7						
1963	3.21	5.31	2.10	4.10	.89	3.15	125.2		54.3		7.7						
1964	3.26	5.35	2.09	4.15	.89	3.24	127.0		54.9		7.7						
1965	3.34	5.39	2.05	4.23	.89	3.50	124.2	6.0	55.4	118.2	5.7	57.1					
1966	3.97	5.82	1.85	4.81	.84	4.00	119.9	5.4	55.4	114.4	.6	58.4					
1967	4.06	6.20	2.14	5.02	.96	4.00	118.7	5.2	54.0	113.6	7.4	52.2					
1968	4.22	6.50	2.28	5.24	1.02	4.28	117.2	4.7	53.7	112.6	5.2	53.7					
1969	4.45	6.70	2.45	5.49	1.04	4.28	116.1	4.3	52.8	111.8	4.5	54.5					
1970	4.70	6.94	2.24	5.71	1.01	4.66	116.9	4.0	52.0	113.0	5.8	55.2					

Appendix Table 1. (continued) Selected historical price and quantity data.

Prices \$1 cwt.											Billion Pounds	
U.S. <sup>1/</sup>												
Manufac. Grade	Milk Used For Bottling	Fluid Milk	All Milk Wholesale	All Milk Diff.	Support Price	Milk <sup>1/</sup> Prod.	Farm <sup>3/</sup> Use Marketed	Milk <sup>3/</sup> Fluid Products	Used in <sup>2/</sup> Manufac.	Used in <sup>4/</sup> Products	Purchase	
P <sub>m</sub>	P <sub>f</sub>	(P <sub>f</sub> -P <sub>m</sub> )	P <sub>w</sub>	(P <sub>w</sub> -P <sub>m</sub> )								
1971	4.86	7.12	2.26	5.87	1.01	4.93	118.5	3.7	114.8	51.8	55.7	7.3
1972	5.09	7.26	2.17	6.09	1.00	4.93	120.3	3.5	116.7	52.3	59.0	5.4
1973	5.50			6.50		5.29						

<sup>1/</sup> March 1973 Dairy Situation.

<sup>2/</sup> April 1973 Fluid Milk and Cream (sales of fluid milk and cream-milk equiv.) p. 24.

<sup>3/</sup> April 1973 "Milk-Production, Disposition and Income 1970-72," p. 4 (milk utilized includes milk sold to plants and dealers as whole milk and as farm separated cream and milk sold directly to consumers).

<sup>4/</sup> Residual - milk utilized minus government purchase minus used in fluid products.

<sup>5/</sup> For marketing years source May 1973 Dairy Situation.

## REFERENCES

- Currie, J.M., Murphy, J.A. and Schmitz, A., "The Concept of Economic Surplus and Its Use in Economic Analysis," The Economic Journal, December 1971, pp. 741-799.
- Johnson, Paul R., "The Social Cost of the Tobacco Program," Journal of Farm Economics, May 1965, pp. 242-255.
- Mishan, E. J., "A Survey of Welfare Economics, 1939-59," The Economic Journal, June 1960, pp. 197-265.
- Nerlove, Marc., The Dynamics of Supply-Estimation of Farmer's Responses to Prices, The John Hopkins Press, Baltimore, 1958.
- Tweeten, Luther G., and Tyner, Fred H., The Utility Concept of Net Social Cost--A Criterion for Public Policy, AER, ERS, USDA, Vol. XVIII, No. 2, April 1966.
- Wallace, I.D., "Measures of Social Costs of Agricultural Programs," Journal of Farm Economics, May 1962, pp. 580-594.