A THEORETICAL FRAMEWORK FOR ANALYZING SOCIAL COSTS OF THE TOBACCO PROGRAM

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Government control of tobacco production through output restrictions and price supports began with the Agricultural Adjustment Act of 1933. The primary goals of the program through the years have been to stabilize tobacco prices and to improve farm income. The tobacco program came under public scrutiny after the U. S. Surgeon General's Report on Smoking and Health in 1964 [11] and the report this year [12]. Critics charge that tobacco production policies of the U. S. Department of Health, Education, and Welfare are inconsistent or even in direct opposition. These issues present a policy dilemma. A theoretical framework is devised for analyzing social costs of the tobacco program and application of the framework to current policy issues is examined.

SOCIAL COSTS

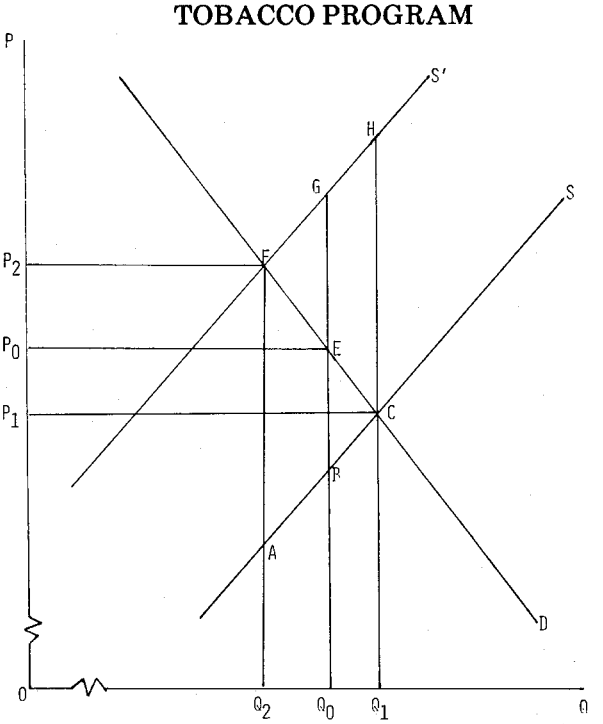
Social costs are defined as (1) loss of consumer and producer surplus and (2) public costs in excess of private costs. Consumer surplus is the difference between the maximum amount consumers would pay and the price they actually pay. Producer surplus is the difference between the price producers receive and the minimum payment they would accept to produce a given quantity. The concepts of consumer and producer surplus have been used as measures of social benefit by economists dating back to Dupuit and Marshall [7, p. 115]. Similarly, losses of consumer and producer surplus represent a social cost. The second definition of social costs distinguishes between public and private costs as the cost to society beyond that internalized in the supply function. When the supply curve reflects only private costs, too much is produced at too low a price. This concept of social cost has been applied particularly to analyses of pollution problems where costs are incurred by the general public through externalities not embodied in the price of the product [5, pp. 1-8; 9, p. 515].

Externalities can be associated with tobacco production and consumption through certain health-related public costs. Medical care from both direct and indirect effects of smoking, research on problems associated with smoking, and education about effects of smoking are external costs borne to some degree by the general public. This difference between public and private costs of tobacco is a social cost.

A THEORETICAL FRAMEWORK

The effect of the government tobacco program of output restriction and price supports on social costs is analyzed within a static, partial-equilibrium framework. The area under the demand curve (D) in Figure 1 reflects the aggregate marginal utility of tobacco, and the supply curve (S) is the aggregate marginal cost curve of the tobacco producers at the farm level.

FIGURE 1. SOCIAL COST ANALYSIS OF TOBACCO PROGRAM



The base point of the framework is present price and output at P_0Q_0. Because output has been restricted through government control, the market equilibrium level is presumed to be P_1Q_1 at a lower price and increased quantity of

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production. The effect of restricting output is a loss in consumer and producer surplus, the well-known welfare triangle (BCE). Johnson [3, pp. 242-255] applied the consumer and producer surplus analysis to the flue-cured tobacco program and concluded that net social costs were small in the short run. The loss of consumer and producer surplus was partially offset by the ability of the U. S. to secure monopoly gains in the foreign market at that time. A limitation of Johnson's analysis is that the utility (or loss of utility) measured by consumer and producer surplus does not extend directly to all members of society.

The second step of the framework extends the analysis beyond tobacco consumers and producers to incorporate social costs in terms of public costs. Curve S' includes both public and private costs of tobacco. The full-cost equilibrium price and level of output are at P_2Q_2. The area of Q_2FHQ_1 represents total resource use in excess of the full-cost equilibrium level if output were actually at the market equilibrium.

Area Q_2ACQ_1 represents private costs and area AFHC represents public costs. Area ACF is the producer-consumer surplus triangle. Reduction of the quantity marketed from Q_1 to Q_2 causes a loss of producer-consumer surplus equal to area ACF. At the same time there is a reduction in public cost of AFHC. The net reduction in public costs is triangle CFH (AFHC less area ACF).[1]

Now consider the effect of restricted output of tobacco under the government program. Output is at Q_0 with a price of P_0, a point that lies between the market equilibrium at point C and the full-cost equilibrium at point F. The effect is to reduce the public cost by area BGHC. Thus, the net effect of the tobacco program with respect to social costs is: the reduction in public costs (BGHC) less the welfare triangle loss of consumer and producer surplus (BCE). The resulting gain to society is the amount represented by area CEGH.

MEASUREMENTS OF SOCIAL COSTS

The social cost areas in Figure 1 can be quantified, given values for Q_0, Q_1, and Q_2 and equations for D, S, and S', by use of integral calculus. The calculations that follow illustrate concepts of the theoretical framework and methods of analysis. The objective is to evaluate the government tobacco program in terms of its effect on social costs. References to social costs of tobacco are partial because they are considered from the base of tobacco producers rather than the entire tobacco industry. Theoretically, additional social costs could be incorporated at each stage of the tobacco manufacturing and marketing process.

All measurements in the analysis are calculated from the 1976 base of P_0Q_0, the price ($1.126 per pound) and level of output (2,134,184 pounds) under the tobacco program [10, p. 98]. From this point, by use of elasticity of demand and the respective percentage change in price, two additional points, the competitive market equilibrium and the full-cost equilibrium, are approximated.[2]

Farm-level elasticities of −.6 and .45 for demand and supply, respectively, are used in these calculations. Empirical estimates of demand elasticities for cigarettes range from −.3 [8, p. 86] to −1.5 [6, p. 703]. Government intervention in the marketplace through the price support program restricts empirically derived estimates of elasticity of demand for tobacco at the farm level. In general, the elasticity of demand for farm products is lower at the farm level than at the retail level [9, p. 188]. Research estimates of the short-run supply elasticity for the total tobacco market are .4 [9, p. 243] to .5 [2, p. 574].

The percentage by which the current tobacco price would fall to the competitive market equilibrium price if output restrictions were removed is approximated on the premise that the quota rental rates reflect this value, given current conditions of technology, prices of inputs, and levels of yield and price uncertainty. From studies on quota rental rates by Keller and Culver [4, p. 18] and Bradford and Thompson [1, p. 275], a value of 25 percent is postulated.

The percentage by which the present price of tobacco would increase if it were set high enough to cover public as well as private costs is given a hypothetical value of 30 percent for purposes of illustration. Social costs per unit of tobacco are assumed to be constant in the interval evaluated. Therefore, S and S' have the same slopes and are parallel (Figure 1).

Calculated points on the D curve represent the competitive market equilibrium on S and the hypothetical full-cost equilibrium on S'.[3] From the estimate of supply elasticity (.45) and the assumption that S and S' have the same slopes, second points on each curve are calculated for the purpose of deriving equations

[1]Resources represented by Q_1 to Q_2 have been freed for alternative uses. The reduction in tobacco output also affects other segments of the economy. The underlying assumption is that these resources will be utilized alternatively.

[2]Elasticity of demand $(\eta) = \frac{\Delta Q}{Q} / \frac{\Delta P}{P}$.

Therefore, $\frac{\Delta Q}{Q} = \eta\left(\frac{\Delta P}{P}\right)$.

[3]These points are: estimated competitive market equilibrium (P_1 = $0.8445, Q_1 = 2,454,310 pounds) and the hypothetical full-cost equilibrium (P_2 = $1.4638, Q_2 = 1,750,030).

for S and S'.[4] From the two points on each curve and the assumption of linear equations in the relevant range, equations for D, S, and S' are derived.[5] By use of these equations and quantities for Q_0, Q_1, and Q_2, the social cost areas in Figure 1 are estimated by integrating the functions over the specified intervals. The equations follow.

(1) Public costs

$$AFHC = \int_{Q_2}^{Q_1} S'\,dQ - \int_{Q_2}^{Q_1} S\,dQ$$
$$= \$716{,}000{,}000$$

(2) Reduction in public costs

$$BGHC = \int_{Q_0}^{Q_1} S'\,dQ - \int_{Q_0}^{Q_1} S\,dQ$$
$$= \$325{,}000{,}000$$

(3) Producer-consumer surplus loss

$$BCE = \int_{Q_0}^{Q_1} D\,dQ - \int_{Q_0}^{Q_1} S\,dQ$$
$$= \$74{,}000{,}000$$

(4) Net reduction in social costs

$$CEGH = \int_{Q_0}^{Q_1} S'\,dQ - \int_{Q_0}^{Q_1} D\,dQ$$
$$= \$251{,}000{,}000$$

The social cost effect of the government tobacco program of output restriction and price supports is thus the reduction in public costs (a gain) less the loss of consumer and producer surplus. If public costs of tobacco are recognized, the effect of the tobacco program is to reduce a portion of the public costs. The relative amount of the reduction depends on the slope of S' in relation to S; that is, are external costs per unit of tobacco increasing, constant, or decreasing? If public costs per unit are increasing, the potential effect of the reduction will be greater than if costs per unit are constant or decreasing.

APPLICATION OF FRAMEWORK TO POLICY ISSUES

The framework provides a means for examining policy issues related to the tobacco program and the social cost effect on producers, consumers, and the total society. The theoretical base could be further developed into a more definitive tool of analysis with the use of empirical estimates of public costs per unit of tobacco consumed and the specified demand and supply functions for tobacco. The analysis could then be extended to evaluation of policy alternatives for allocating external costs through the market system, determining the level of tobacco taxation, and estimating the optimum level of output restriction.

The social cost analysis provides a partial but not a complete framework for evaluating the tobacco program. A complete framework must also include analyses of benefits and effectiveness of the program in meeting goals of farm income and price stability and the effect of the program on distribution of income and resource allocation. Analyses of both economic and social costs and benefits can be useful in resolving diverse interests and formulating future tobacco policy goals.

Government policies with respect to tobacco production and those related to health and smoking are not necessarily in conflict. If the tobacco program of output restriction and price supports does, in fact, meet the farm goals of price stability and increased farm income and, at the same time, reduces health-related public costs of tobacco, the policies are compatible in economic terms. The policies can, however, be further evaluated from sociological and political viewpoints.

The theoretical framework, with appropriate modification and consideration of the relationships, is applicable to analyses of other products in which public costs have not been incorporated in the price of the product. Although tobacco is a unique commodity, the policy alternatives of output restriction, price control, and taxation of the product may be feasible options for internalizing social costs associated with other products. The Marshallian-Dupuit measures of social benefit and the concept of externalities, upon which the framework is based, require assumptions and a level of abstraction from real-world conditions to separate most relevant variables from the many interrelated variables. The conclusions reached through use of the framework are valid only under the familiar *ceteris paribus* conditions. Yet this method of analysis provides one means of analyzing a social problem that is too complex for evaluation in its entirety.

[4]The calculated points are: on S (P = $0.4468, Q = 1,750,030 pounds) and on S' (P = $1.8625, Q = 2,454,310 pounds).

[5]These equations are: D ($P = 3.0026 - 8.793 \times 10^{-7} Q$), S ($P = -0.5414 + 5.647 \times 10^{-7} Q$), and S' ($P = 0.4756 + 5.647 \times 10^{-7} Q$) where P = dollar price per pound and Q = pounds.

REFERENCES

[1] Bradford, Garnett I. and James F. Thompson. "Impact of Eliminating the Tobacco Price-Support Supply-Control Program," *Social and Economic Issues Confronting the Tobacco Industry in the Seventies.* Lexington: University of Kentucky, 1972, pp. 271-293.

[2] Chromarty, W. A. "An Econometric Model of the United States Agriculture," *Journal of the American Statistical Association,* Volume 54, September 1959, pp. 556-574.

[3] Johnson, Paul R. "The Social Cost of the Tobacco Program," *Journal of Farm Economics,* Volume 47, May 1965, pp. 242-255.

[4] Keller, Luther H. and James Culver. "Lease and Transfer of Burley Tobacco Quota Between Farms," *Tennessee Farm and Home Science Progress Report 100,* October-November-December 1976, pp. 15-18.

[5] Langham, Max R. "A Theoretical Framework for Viewing Pollution Problems," *Southern Journal of Agricultural Economics,* Volume 3, December 1971, pp. 1-8.

[6] Maier, Frank H. "Consumer Demand for Cigarettes Estimated from State Data," *Journal of Farm Economics,* Volume 37, November 1955, pp. 690-704.

[7] Mann, Jitendar S. "Techniques to Measure Social Benefits and Costs in Agriculture: A Survey," *Agricultural Economics Research,* Volume 29, October 1977, pp. 115-126.

[8] Sackrin, S. M. "Factors Affecting the Demand for Cigarettes," *Agricultural Economics Research,* Volume 14, July 1962, pp. 81-88.

[9] Tweeten, Luther. *Foundations of Farm Policy.* Lincoln: University of Nebraska Press, 1970, pp. 188, 243, 499-522.

[10] U. S. Department of Agriculture. *Agricultural Statistics.* Washington, D. C., 1977, p. 98.

[11] U. S. Department of Health, Education, and Welfare. *Smoking and Health, Report of the Advisory Committee to the Surgeon General.* Washington, D. C.: USPHS Publication No. 1103, 1964.

[12] U. S. Department of Health, Education, and Welfare. *Smoking and Health, A Report of the Surgeon General.* Washington, D. C., 1979.