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THE INTERACTION OF AGRICULTURAL POLICIES AND HEALTH REGULATION: THE CASE OF TOBACCO

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Abstract

Key Words:

David Zilberman is professor of agricultural and resource economics at the University of California at Berkeley and Richard E. Just is professor and Erik Lichtenberg is assistant professor of agricultural economics at the University of Maryland.

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There has been a growing awareness of the interdependency between agricultural and environmental health regulations and the need to coordinate and develop consistency between environmental and commercial policies concerning agricultural inputs (water, land, and pesticides) and their relationship to commercial policies. Land management and retirement programs, in particular, were designed to meet both environmental and commercial objectives.

Inputs are not the only sources of environmental and health concerns in agriculture. Some agricultural products generate substantial negative externalities which are subject to much concern and regulations. Tobacco is an obvious example; but excessive consumption of agricultural and food products such as wine and beer, sugar, beef, and animal fats may also result in substantial health problems. The environmental and health externalities associated with such agricultural products have not been given much weight in evaluating policies to regulate the marketing of these products. Similarly, regulation of the external effects has paid little attention to the realities of the agricultural markets that produced the externalities in the first place.

This paper will introduce a simple framework to link commercial and environmental health policies affecting an agricultural product which generates consumption externalities. This framework will be used to assess regulations on tobacco and cigarettes and will consider some health costs and benefits associated with commercial policies regulating other products.

I. Conceptual Framework

The conceptual analysis, as well as some of the empirical results of this paper, will analyze the economics of one product—tobacco—which is assumed to be produced by a competitive industry, consumed by domestic consumers, exported, and a source of utility as well as a cause of negative externalities. Obviously, this analysis simplifies many of the multimarket aspects associated with the move up the product chain from tobacco to cigarettes and other tobacco products. Moreover, realistic policy mixtures are likely to regulate simultaneously different markets (as in the case of the

tobacco program and cigarette excise taxes). Nevertheless, one product analysis is useful to an initial understanding of key issues and we will modify some of the results to accommodate multiproduct aspects of the tobacco problem.

First, let us consider a basic partial equilibrium model of output determination. The product demand curve is DD, a marginal cost-supply curve is SS, and a marginal externality cost curve is ME (figure 1). The nonregulated free market will result in an equilibrium output price combination (Q_0, P_0) associated with point A. Subtracting the marginal externality cost from demand will result in the net demand curve, ND. The social optimum is at point C, with output Q_1 and consumer price P_1^S . An antipollution tax of BC is one policy that will attain this optimum. In this case producer price will be V_1, with the area $P_1P_1^S CB$ denoting tax revenue. A standard limiting output to the level Q_1 is another policy that yields optimal resource allocation. It results in consumer and producer prices of P_1; and the area, $P_1P_1^S CB$, under the tax that went to the government is now available to the producers. Of course, implementation of a direct regulation that leads to output level of Q_1 is not simple. One possibility is the introduction of production quotas or licenses. When these quotas are transferable, the quota rent will be equal to $P_1 - P_1^S$.

Both the tax and the standard yield the optimal resource allocation but have different distributional outcomes. These are infinite policy combinations which include an output standard of Q_1 and a tax between zero to $P_1 - P_1^S$ that can attain optimal resource allocation. These policies differ in their distributional implications. Buchanan and Tullock argue that the prevalence of standards (without any taxes) is because this policy is most favored by producers who have much to say (they may "capture" the regulators) about the policies to which they are subjected.

On the surface, it seems that this framework is useful for explaining the regulation of tobacco and cigarettes since current policies restrict the output of tobacco and tobacco products are taxed. However, international trade plays a major role in the tobacco market as well as in the economics of many agricultural products. Thus, the standard partial equilibrium model has to be modified to incorporate international trade considerations.

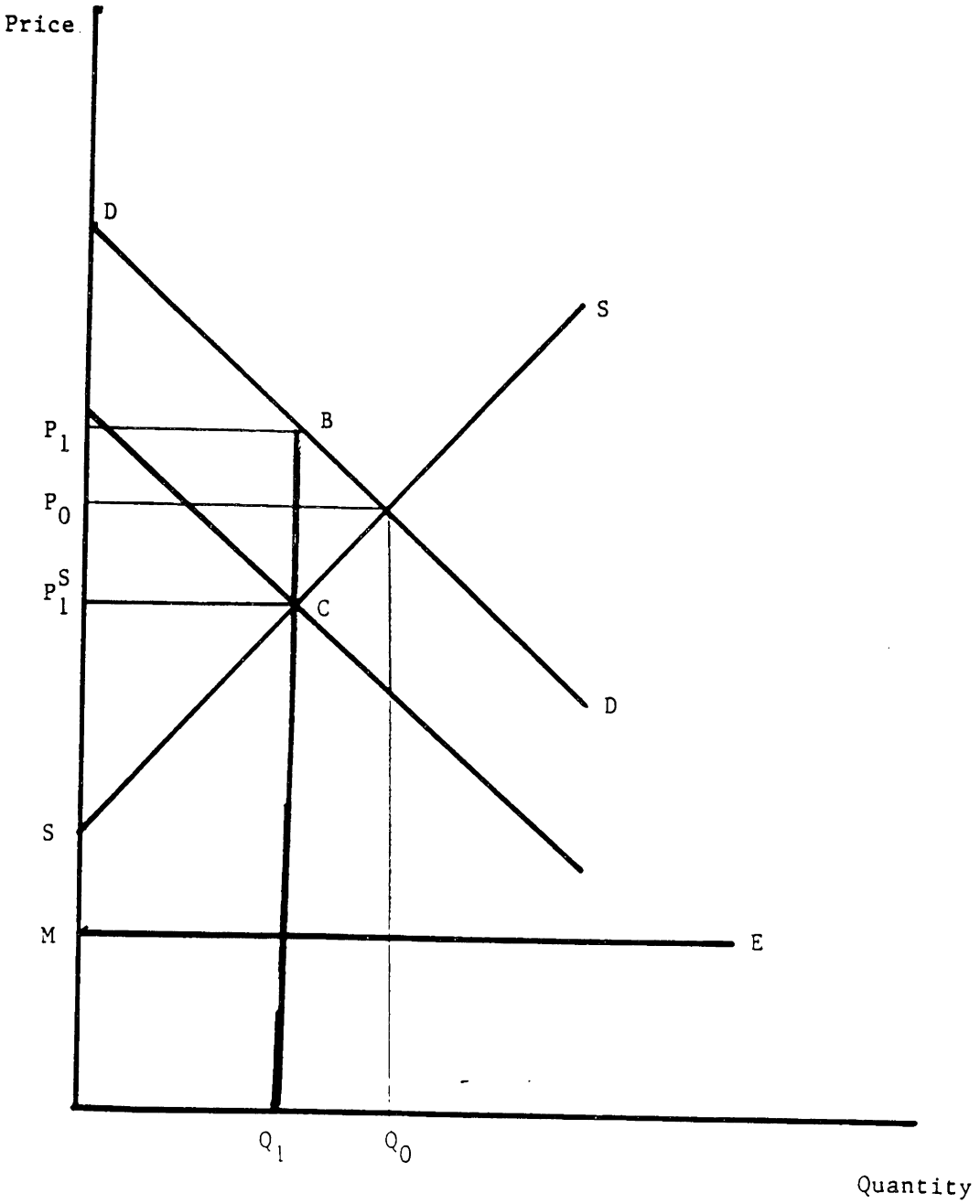

Figure 1. Competitive and Optimal Resource Allocation with Externality-Closed Economy

Since the United States is a net exporter of tobacco, we will analyze the economics of an exported product (figures 2a and 2b). The curve EX (in figure 2a) denotes the excess export demand for the product, and MX denotes the associated marginal revenue curve. As in figure 1, the curve DD denotes domestic demand, the curve SS denotes supply, and the curve ND denotes net domestic demand. Under free trade and no intervention, total output will be denoted by Q_0; output price, P_0; domestic consumption, Y_0; and export, X_0. An optimal policy which preserves free trade while taking into account externality damage in the domestic market will reduce production to Q_1 and domestic production to Y_1 and increase export to X_1. Consumer price will be P_1; if externality control is through a tax of $P_1 - P_1^S$, producer price will be P_1^S. An alternative control will be to restrict domestic consumption to Y_1 and, if it is introduced without a producer tax, price will be P_1. Note that, when the product involved is exported, restricting total production to Q_1 will not yield the optimal resource allocation. Restriction of total output, not accompanied with taxation or control of domestic consumption, will result in "too much" domestic consumption and "too little" export compared to Y_1 and X_1. When the externality causing output is an export product, domestic consumption quota and not production quota can replace tax in attaining the optimal externality level. Since consumption quota is more difficult to implement than production quota, the use of taxes for externality control seems more likely in the case of an exported good.

When export demand is inelastic, the exporting country is tempted to develop trade policy that takes advantage of this situation. Let $TW(Y)$ be a monetary measure of welfare derived domestically from consumption. In essence, $TW(Y)$ is the area under the demand curve and is the sum of consumer surplus and expenditure on the product. The first derivative of $TW(Y)$, $P^D(Y) = \partial TW/\partial Y$ is the inverse demand function denoting domestic consumer price as a function of domestic consumption. Let $R(X) = P^X(X) \cdot X$ denote net export revenue and $P^X(X)$ is the increase of export excess demand for the production. The cost function is $C(Q) = C(X + Y)$, and its derivative $MC(Q) = (\partial C/Q)/\partial Q$ is the marginal cost curve which also serves as the supply curve of the competitive industry. Let domestic externality cost be denoted by $E(Y)$, and the

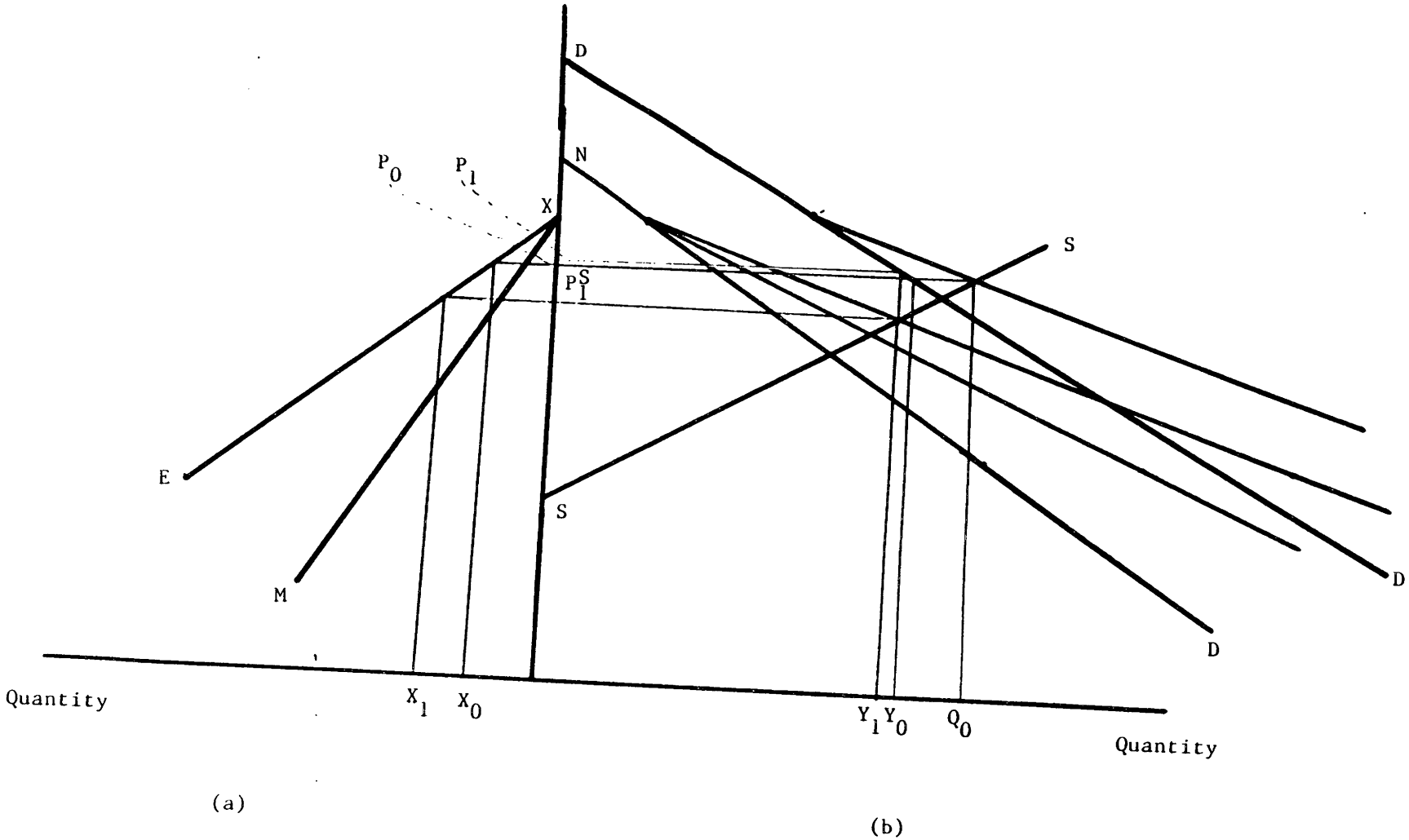

Figure 2. Free-Trade Equilibrium With and Without Externality Control

resulting marginal externality curve is ME. When externalities are ignored, the welfare optimization problem is

$$\max_{Y,X} TW(Y) + R(X) - C(X + Y) \tag{1}$$

and the optimal allocation rules are

$$P^D(Y) = MC(Q)$$

$$MR(X) = MC(Q).$$

This outcome is depicted in figure 3a and 3b. Using the same notation as in figure 2a and 2b and adding the marginal export revenue curve to the domestic demand curve yields the kinked curve DAC'. Its intersection with the supply curve yields total output, Q_2, which results in export and domestic consumption levels of X_2 and Y_2, respectively. In this case domestic price is P_2^D and export price is $P_2^X > P_2^D$. To implement this policy, we have an export tax of $P_2^X - P_2^D$. If implemented, domestic consumption will be Y_2 and export, X_2.

When externality costs are ignored and the supposed optimal export tax is introduced, domestic consumption is greater than under free trade ($Y_2 > Y_1$) and export is smaller. The supposed welfare gain can be decomposed to a reduction in overall cost, an increase in private consumer surplus, and an increase in export revenues. If one incorporates the domestic externality cost into this welfare calculus, it may be found that the free-market solution is superior to an export tax solution since the increase in domestic consumption from Y_2 to Y_1 entails an extra externality cost that may be bigger than the private welfare gain associated with the introduction of the tax.

The use of an export tax is disallowed by the U. S. Constitution and, besides, it is a flagrant violation of the "free-trade" policies the United States is trying to promote and doing this might invite retaliation. A production-control regulation limiting overall output produced does not

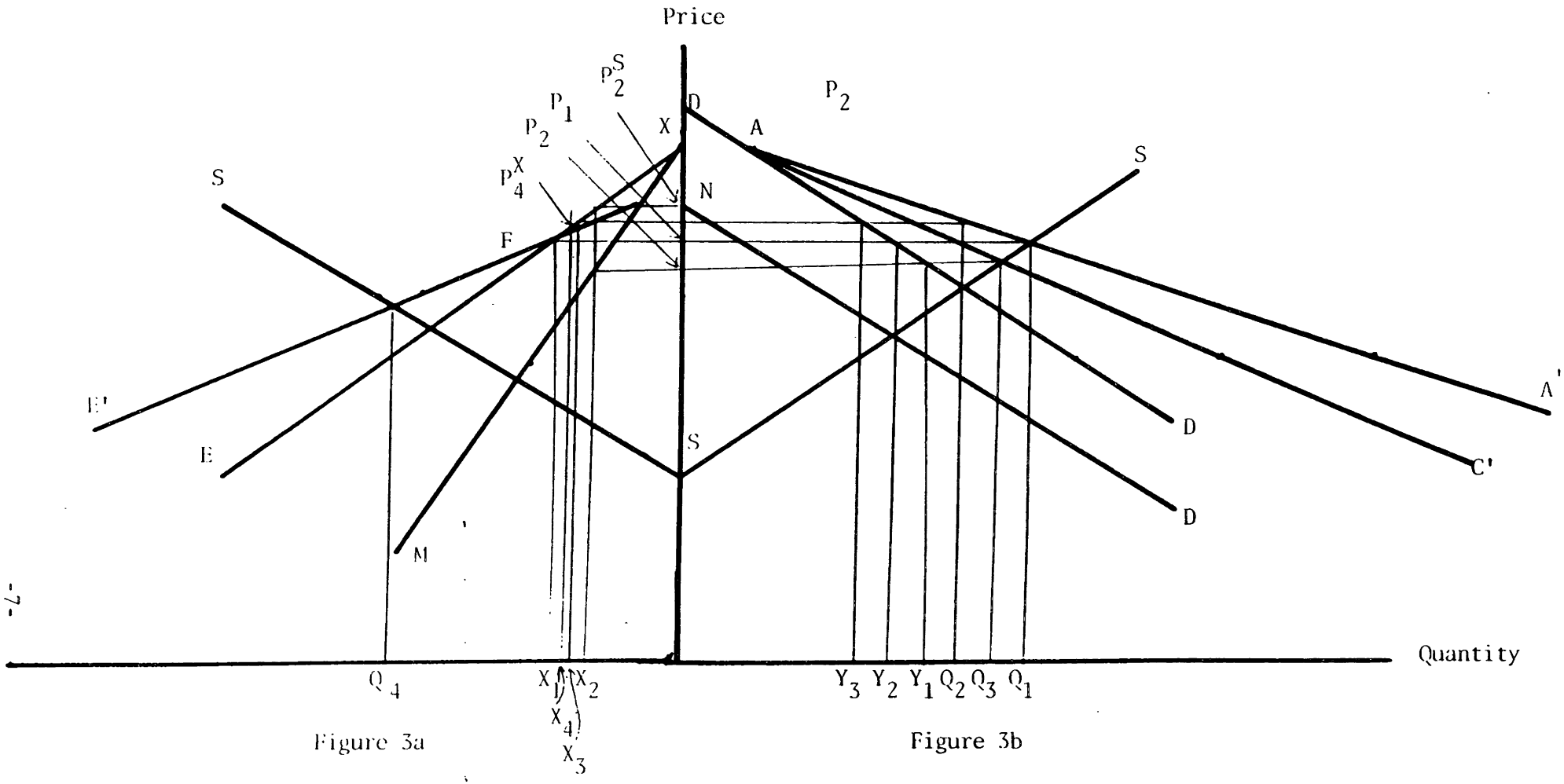

Figure 3a

Figure 3b

Figure 3. Alternative Equilibrium Solutions

yield the "optimal" resource allocation attainable by an export tax, but it seems quite benign to foreigners and can improve the welfare of the exporting country relative to free trade. Sumner and Alston argue convincingly that this logic is behind the establishment of the tobacco production quota in the United States and, therefore, the impacts of such quotas will be analyzed here.

Again, consider the case when externalities are ignored. The government will establish production quotas to maximize the sum of private domestic consumers' surplus and producers' surplus when prices to domestic and foreign consumers are constrained to be equal. Thus, the optimization problem leading to the quota is

$$\max_{X,Y} TW\ (Y) + R(X) - C(X + Y) \tag{2}$$

subject to

$$P^D(Y) - P^X(X) = 0.$$

Let X be the shadow of the free-trade constraint and, by using it, the optimality conditions become

$$P^D(Y) = MC - \lambda \frac{\partial P^D}{\partial Y}, \tag{3}$$

$$MR(X) = P^X(X) + X \frac{\partial P^X}{\partial X} = MC + \lambda \frac{\partial P^D}{\partial X}, \tag{4}$$

and

$$P^D(Y) = P^X(X). \tag{5}$$

From these conditions, one can easily obtain

(6) $$X = \frac{X}{\left(\frac{\partial P^D / \partial Y}{\partial P^X / \partial X}\right) + 1}.$$

This condition suggests that the $\lambda > 0$, and therefore supply price *(MC)* is smaller than domestic consumer and foreign consumer prices but bigger than the marginal revenue of the export.

$$MR(X) < MC < P^X(X) = P^D(Y).$$

Therefore, the production quota (denoted by Q_3) in figure 3a and 3b is between the free-trade production level, Q_1, and the export-tax production level, $Q_2 < Q_3 < Q_1$. The consumer and export price associated with Q_3 is obtained from the aggregate demand curve *DAD'* and is denoted by P^3. This price is bigger than the free-market price and domestic price in the case of export tax, and thus domestic consumption under the quota Y_3 is smaller than both free-trade and export-tax output. More specifically, $Y_3 < Y_1 < Y_2$.

When one introduces externalities to the analysis, the lower domestic output associated with the production quota makes it look even more favorable. The lower domestic output it entails increases the edge this policy has over free trade and, if the externality costs are substantial, the quota policy becomes more desirable from the perspective of the exporting country than the export tax of $P_2^X - P_2^D$.

Now let us consider the externality in the selection of the optimal policy. The social optimization problem becomes

(7) $$\max_{X,Y} TC(Y) - E(Y) + R(X) - C(X, Y).$$

The equilibrium conditions for this case are

(8) $$P^D(Y) - ME = MC$$

and

$$MR(X) = P^X(X) + X\,\frac{\partial P^X}{\partial X} = MC\ . \tag{9}$$

At the first-best solution from the perspective of the exporting country, resources are allocated such that private marginal benefit from domestic consumption equals the sum of marginal production cost and marginal externality cost and marginal revenue of export equals marginal cost. One way to attain this optimal resource allocation is by simultaneous imposition of a domestic consumption tax of ME dollars and export tax of $X(\partial P^X/\partial X)$. However, when optimal domestic consumer price is bigger than the export price, the optimal solution is attainable also by a production quota and consumption tax combination. Figure 3a illustrates this point when we use it to obtain the equilibrium. To this end, we will add net domestic demand to the marginal export curve to form the curve XEE'. Total production in this case is Q_4, and domestic consumption and export are denoted by Y_4 and X_4. Domestic consumer price in this case will be P_4^D and export price, P_4^X. One possible policy combination to attain this outcome is through a domestic consumption tax of $P_4^D - P_4^S$ and an export tax of $P_4^X - P_4^S$. In this case, producer price is P_4^S. An alternative mechanism is through a production quota of Q_4 and a domestic consumption tax of $P_4^D - P_4^X = ME(Y) - P^X X$. $P_n - U_n = ME(Y) - P^X X$. This tax may be substantially smaller than the marginal externality cut. It gets smaller as export demand elasticity declines and optimal export increases. In the rare case when $ME(Y) = P^X X$, the production quota by itself may yield the optimal outcomes from the domestic exporter perspective without any taxes.

The second policy mixture, a production quota and a tax, improves producers' welfare substantially relative to the two tax regimes since their producer price will be P_4^X and producers will obtain quasi-rent of $P_4^X - P_4^S$. Thus, the argument of Buchanan and Tullock can be extended to this case, and it suggests that a mixture of a production quota and consumption tax is more likely to be introduced because of producers' support.

Returning to the tobacco issues, the above results imply the need for coordination in shaping policies that will maximize U. S. welfare, taking into account trade and environmental considerations. In particular, we found that a combination of tobacco taxation (maybe through the taxation of the tobacco content of cigarettes) and tobacco programs are tools that can be combined to attain the best policy from domestic perspective. However, the two policy parameters cannot be established separately but interdependently.

As we will argue later, it seems that currently there is separation between commercial tobacco policies that address trade and other commercial issues and cigarette policies that raise revenue (by taxes) and address health issues by education and control of advertisements. Overall, we may be far away from social optimum. Yet, the existing production quotas (which, according to Alston and Sumner, are aimed to maximize domestic surplus and result in equilibrium quantities Q_4, X_4, and Y_4) are superior to free trade because of the consumption reduction entailed and are likely to be superior to an export tax because of public-health consideration (production quotas result in lower domestic consumption than free trade). Better assessment of these policies requires more empirical discussion of tobacco and cigarette markets and health effects of smoking.

II. The Economic Literatures on Cigarettes and Tobacco: Empirical Estimates and Results

The previous theoretical discussion suggests that effective social policy on tobacco and cigarettes has to incorporate production, trade, and health considerations. It seems that, up to now, policies and decision-making procedures have been developed independently, each policy or procedure specializing in its specific aspect. This is not surprising if one realizes that even economic research that is supposed to lead to new policy ideas has been compartmentalized to several bodies of literature which grow independently without much acknowledgment or interaction with each other.

We can identify two main bodies of literature.

1. *Traditional micro and welfare economic studies of cigarette and tobaccos, dominated by North Carolina's state economists.* This literature estimated cigarette and tobacco demand