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A NEW PERSPECTIVE ON THE FARM PROGRAM FOR U.S. TOBACCO

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ABSTRACT

The U.S. farm program for tobacco is often misunderstood and used as an example of regulation that serves vested industry interests at the expense of national income. Many people may be surprised to learn that, in fact, the national benefits from the tobacco program exceed the costs. Quota owners benefit from monopolistic exploitation of both domestic and foreign consumers of U.S. tobacco and the benefits to quota owners are greater than the sum of costs to domestic consumers and the costs arising from production inefficiencies. Moreover, and perhaps more surprising, the total quota is set at a level that maximizes these net national benefits from using production quotas to exploit export markets monopolistically. Rather than serving as an example of government failure, the tobacco program is completely consistent with the government maximizing domestic welfare subject to political and legal constraints.

I. INTRODUCTION

The U.S. tobacco industry has a long regulatory history that began with the establishment of production quotas shortly after the settlement at Jamestown nearly 400 years ago. Supposed cartel behavior by tobacco manufacturing firms has long been the subject of extensive investigation and action.[1] More recently public policy has focussed on the health and safety aspects of tobacco use, and the use of taxation or other regulations to discourage consumption.[2] The regulation of leaf tobacco production and marketing has also been the subject of considerable controversy recently; in part because of the mistaken notion that the U.S. farm program for tobacco is inconsistent with the government's policy to discourage cigarette smoking.[3] This paper focuses exclusively on the regulations that make up this U.S. farm program for tobacco, the so-called tobacco program.

The current U.S. tobacco program had its origins in the Agricultural Adjustment Act of 1938. Like many other commodity programs, the tobacco program involves support prices. Unlike programs for any other U.S. commodities, tobacco has had mandatory supply controls. Initially acreage allotments were used but more recently controls have taken the form of poundage quotas. Over the years there have been several proposals for complete elimination of both support prices and supply controls. These proposals have failed but other changes have been made.

This paper reports the main findings of a comprehensive analysis of several reforms based on the institutional setting and price and quantity data in 1987. First we consider a substantial deregulation of tobacco, a removal of price supports and supply controls. Such a change would result in major changes in the prices and quantities of tobacco and a significant redistribution of income and economic surplus.[4] A result that may be surprising to some is that the United States would

lose — in terms of total surplus measures — $24 million per year. This result raises the further question as to whether the tobacco program could be modified — either through the choice of policy instrument or the level at which the instrument is applied — to increase the benefits to producers, tobacco quota owners, U.S. tobacco consumers, or the United States as an aggregate. To answer this question we consider the effects of a range of alternative policies. In selecting these alternative policies we consider two alternative objective functions: (a) to maximize welfare of a coalition of U.S. producers and quota owners, and (b) to maximize total U.S. welfare, the combined welfare of producers, quota owners and tobacco consumers in the United States. We also consider two types of instrument: (a) a quota as at present that does not allow price discrimination between U.S. and foreign tobacco consumers, and (b) a quota that allows discriminatory pricing.

The major findings may be stated briefly. The current tobacco program raises the price of tobacco leaf by placing a quota on production. Using our "most likely" estimates of elasticities, elimination of the program would cause a 15 percent fall in price and a 30 percent rise in output. Quota owners would lose but consumers would gain. Because the U.S. has significant power in the international tobacco market, the nation as a whole would lose income from moving to a free tobacco market.

Keeping the current policy instruments, we find that the current quota is now above the level that would maximize returns to quota owners and producers; in fact, again using our "most likely" elasticities, it is almost exactly at the level that maximizes total U.S. welfare from a production quota. In other words, within the constraint of the current policy instruments, the total tobacco quota is set about right to maximize total U.S. benefits; it would need to be reduced by about 25 percent to maximize benefits to a coalition of producers and quota owners.

If price discrimination between export and domestic markets were allowed, the United States as a whole could gain a further $28 million per year from monopolistic exploitation of export markets by increasing domestic sales and reducing exports (the "optimal export tax" solution). If such a cartel were operated to maximize the sum of benefits to producers and quota owners, it would reduce domestic sales and increase exports. Relative to the current policy, producers and quota owners would gain but the United States as a whole would lose $210 million per year.

II. A SIMPLE ECONOMIC MODEL OF TOBACCO QUOTAS

Figure 1 shows a conventional representation of the effects of a production quota system. The axes refer to prices and quantities of tobacco at the farm level. In Figure 1, DD' represents the aggregate demand for U.S. tobacco at the farm level, holding all other prices constant. It is the sum of the derived demands for U.S. tobacco for domestic use (D_dD_d') and export (left implicit). SS' represents the long-run industry supply function that would prevail in the absence of the tobacco program, the industry marginal cost function. In the absence of the tobacco program, competition would yield a price, P_1 and output, Q_1.

[Figure 1 about here]

A production quota that restricts total output to Q_2 results in a higher price, P_2. If the quota were freely transferable, it would be allocated among producers so that costs of producing tobacco were minimized: the aggregate marginal cost would still be represented by SS' and the marginal cost of producing the quota quantity would be MC_q. The difference between this marginal cost and the market clearing price (P_2-MC_q) would be quota rent yielding total industry income to quota represented by the area P_2abMC_q = (A+B+C+D).

Under present law, federally determined support prices set a floor to the price for each grade of tobacco. Until recently, the weighted average support price was set by formula, independent of actual conditions in the tobacco market. The quotas are set each year, several months before planting, with the aim that the weighted average support price is slightly below the market clearing price. In practice, support prices are above market clearing prices for some qualities and grades; therefore some tobacco goes into stocks held by the stabilization corporation. In the longer term the authorities cannot control demand through storage and therefore they cannot independently fix both prices and quantities. In the past, the average support price was mostly predetermined so that, to avoid the accumulation of government stocks, quotas had to be adjusted. More recently, with declining total demand for U.S. tobacco, the support prices have departed from the previous formula and there have been substantial reductions in both support prices and quotas.[5]

The analysis below refers to the intermediate to long term (say, 5 year) effects of changes to the tobacco program. In the context of the current "no-net-cost" tobacco program, over this length of run price supports are irrelevant; their only effects are through interseasonal stabilization of prices. Thus we focus on the effects of changes to quotas.

III. THE VARIABLES OF INTEREST AND THE KEY PARAMETERS

We use a simple linear supply and demand model to represent the U.S. tobacco market algebraically and to solve for the quantitative economic effects of policy change. The basic equations of the model are as follows. Equation (1) represents domestic consumption of tobacco (Q_d) as a function of the domestic price (P_d). Equation (2) represents U.S. tobacco exports (Q_e) as a function of the export price of

U.S. tobacco (P_e). Equation (3) represents unregulated U.S. tobacco supply (Q) as a function of the producers' tobacco price net of the quota lease rate (P_p).

(1) $Q_d = \alpha_d - \beta_d P_d$ (domestic demand),

(2) $Q_e = \alpha_e - \beta_e P_e$ (export demand), and

(3) $Q = \alpha_s + \beta_s P_p$ (supply).

The market clearing conditions are defined by equating supply with the sum of domestic and export sales ($Q = Q_d + Q_e$) and defining the relationships between the domestic, export, and producer prices that result from policy. For example, the free market equilibrium is defined by equating the three prices ($P_d = P_e = P_p$) and solving equations (1), (2), and (3) for prices and quantities. The resulting equation for the competitive price is:

(4) $P_d = P_e = P_p = (\alpha_d + \alpha_e - \alpha_s)/(\beta_d + \beta_e + \beta_s)$.

The other magnitudes are recovered by substituting equation (4) into equations (1), (2), and (3).

To quantify the free market equilibrium we require estimates of the parameters of supply and demand. To estimate these parameters we use estimates of elasticities, prices, and quantities applying at the current regulated equilibrium as follows:

(5) $\alpha_d = Q_d(1-\eta_d)$ (domestic demand intercept),

(6) $\beta_d = -\eta_d(Q_d/P_d)$ (absolute value of domestic demand slope),

(7) $\alpha_e = Q_e(1-\eta_e)$ (export demand intercept),

(8) $\beta_e = -\eta_e(Q_e/P_e)$ (absolute value of export demand slope),

(9) $\alpha_s = Q(1-\varepsilon)$ (supply intercept), and

(10) $\beta_s = \varepsilon(Q/P_p)$ (supply slope).

In these equations the quantities, prices and elasticities of supply (ε), domestic demand (η_d), and export demand (η_e) all refer to the values at the current regulated equilibrium. The current quantities supplied and consumed by domestic and export markets are directly observable. The current domestic and export prices are also directly observable; they are equal to the market price (about \$1.50/lb.) corresponding to P_2 in Figure 1. The relevant producers' price (P_p corresponding to MC_q in Figure 1, the unregulated marginal cost of current output) must be deduced using information about the price wedge induced by the quota program. Quota rents are the key data that we use to identify both income and wealth associated with quota ownership and the size of the price wedge. The remaining unknowns are the elasticities of supply and demand. Estimates of these elasticities and the price wedge due to quotas are developed next.

IV. PARAMETER VALUES

Quota Rents and the Price Wedge

Quota may generally be traded by lease or sale only within counties. Because costs of production vary among counties, so does the value of quota. Within any particular county (i), with a total quota Q_i, the annual lease rate for quota $[R_i(Q_i)]$ is defined as the difference between the gross tobacco price common to all counties (P_d), and the county specific marginal costs $[MC_i(Q_i)]$. That is,

$$(11) \quad R_i(Q_i) = P_d - MC_i(Q_i).$$

Inter-county differences in quota lease rates reflect directly such inter-county differences in marginal costs of producing their current quota quantities. In 1987 we estimate the implicit lease rate for all types of tobacco across all counties averaged

about $0.25/lb.[6] On a total quota of 1.5 billion pounds this amounts to a total income to quota ownership of $375 million per year.

With unrestricted movements in the rights to grow and sell tobacco, tobacco production would migrate to the lowest-cost production regions and lease rates would rise correspondingly. There is sufficient capacity for expansion in the lowest-cost counties to produce the current total quota without requiring any significant increase in cost per pound in those counties. In the low-cost tobacco producing counties the lease rate for quota averaged about $0.30/lb. in 1987. Given the capacity for expansion of tobacco production in the low cost counties, this latter lease rate (20 percent of the current gross tobacco price) is relevant as a measure of the wedge between the current price ($1.50/lb.) and the unregulated marginal cost of current output (the implied value is $1.20/lb.). The $0.05/lb. difference between the average lease rate and the lease rate in the low-cost counties is a measure of the costs of regulating to prevent inter-county quota transfers, given elastic supply functions. On 1.5 billion pounds this amounts to $75 million per year.

The Elasticity of Supply

The primary farm resources limiting expansion of the industry without quota would be the availability of prime tobacco land and the availability of relatively efficient producers of tobacco willing to operate farms in the lowest-cost tobacco producing regions. Neither of these inputs is likely to be in short supply even with a significant increase in tobacco output. Tobacco uses only a small percentage of the total available cropland even in the most suitable tobacco regions and significant new acreage could be brought into production in those areas. Also, there is considerable capacity of expertise in those areas due to past reductions in quotas and labor-saving technical changes in tobacco production. Some increase in marginal cost would probably be necessary to compensate producers drawn from other

industries and to reflect entry of some producers less efficient than the most efficient current producers.

The implication of these arguments is that the (unregulated) marginal cost of tobacco is close to constant (at the estimated low-cost county value of $1.20/lb.) over a range of significant increases in tobacco production. Of course, in the short run of a year or two, expansion of tobacco would be limited by availability of specialized equipment or other inputs that are supplied elastically given a few years for adjustment. Uncertainty about regulatory change could also delay some adjustments. After the supply industries had responded and the industry had relocated, however, marginal costs of tobacco would decline to approximately current costs net of quota rental in the lowest-cost regions. Some increase in marginal costs may be expected with increases in output of up to 100 percent of current production. We may take as an approximation an elasticity of between 5 and 10 rather than the infinite supply elasticity implied by constant marginal costs. This view is supported by some econometric evidence.

An estimate of the elasticity of supply for flue-cured tobacco was obtained by regressing the logarithm of real marginal costs (computed as the difference between the gross tobacco price and the quota lease rate) against the logarithm of the quantity of tobacco (effective quota as a percentage of basic quota in 1977). Using data for 43 high lease rate counties for the years 1978-1984 (a total of 344 observations), and including variables to represent potential cost function shifters, the coefficient of the regression of county lease rate against total county quota was estimated as 0.40 with a standard error of 0.026. The implied elasticity of supply is the reciprocal of this parameter, 2.5. This estimate is based on a period when quota was contracting. It is a downward biased estimate of the long-run competitive supply elasticity. The long-run elasticity would allow for more than year-to-year adjustment and intra-county

county movement.[7] Another recent estimate based on a very different approach yielded an estimate of about 7 for the tobacco supply elasticity.[8]

Combining the evidence from prior reasoning with the econometric results supports the view that the intermediate run supply elasticity is highly elastic. In the empirical work we use supply elasticities of 5 and 10, with a most likely value of 5.

The Domestic Elasticity of Demand for U.S. Tobacco

The demand for U.S. tobacco is derived from the use of tobacco by domestic and foreign manufacturers of consumer tobacco products, especially cigarettes. During recent years about half of the domestic flue-cured tobacco crop and three quarters of the burley tobacco crop have been used in the U.S. cigarette industry. The rest has been exported. About 15 percent of the cigarettes made in the United States have been exported as well. At the same time, about thirty percent of the tobacco used by the U.S. cigarette industry has been imported. This co-existence of imports and exports is accounted for by differences in the characteristics of tobacco produced in different places.

The domestic demand elasticity represents the response of U.S. cigarette manufacturers to changes in the domestic price of U.S. tobacco. This response involves substitution of U.S. tobacco for imported tobacco, substitution of U.S. tobacco for other inputs used in domestic cigarette production, and the expansion effect of U.S. tobacco prices on sales of U.S. cigarettes both domestically and overseas.

We have estimated each of these component responses. The detailed approach and results are reported in Sumner and Alston (1986, 1987). In summary, the overall elasticity of domestic manufacturers' demand for U.S. tobacco was estimated as $\eta_d = -1.0$. This reflects an own-price elasticity of domestic demand for U.S. cigarettes of -0.3, an export demand elasticity for U.S. cigarettes of -3, and an output constant own price elasticity of U.S. manufacturers' demand for U.S. tobacco of -1.0.

The overall elasticity estimate (η_d) is dominated by the output constant elasticity which, in turn, is dominated by substitution between U.S. and imported tobacco by U.S. manufacturers in response to changes in the U.S. tobacco price. In the empirical work, values of -0.5 and -1.0 are used for the domestic demand elasticity.

The Elasticity of Export Demand for U.S. Tobacco

The potential for increased tobacco exports in response to lower prices for U.S. leaf has led to vigorous discussion. Exports have recently accounted for about half of the flue-cured crop and about one quarter of the burley crop, 40 percent of total U.S. production of tobacco. Our most likely estimate of the elasticity of demand for U.S. tobacco exports is $\eta_e = -4.0$. This is somewhat above the range implied by Norton's (1981) time series econometric estimates for flue-cured exports. It is lower than the estimates for net exports constructed by Seagraves (1983) using data on market shares and underlying elasticities of foreign supply and demand.[9] In the empirical work export demand elasticities of -2, -4 and -6 are used to test for sensitivity of results to this parameter.[10]

V. CONSEQUENCES OF DEREGULATION

Price, Quantity and Revenue Effects

In equation (4), the competitive tobacco price depends on the parameters of supply and demand. These parameters are defined using the current regulated prices, quantities, and elasticities of supply and demand in equations (5) through (10). The range of data in Table 1 was used to compute a range of competitive prices for U.S. tobacco using equations (4) through (10) and then the results were substituted into equations (1) through (3) to compute competitive quantities. Competitive revenues are easily derived.

[Table 1 about here]

Changes in prices, quantities and revenues due to deregulating tobacco are reported as percentages of the current values in Table 2. The values in Table 2 indicate the likely range of effects of elimination of the tobacco program using a very wide range of values for key parameters.

[Table 2 about here]

The range and most likely effects on prices and quantities are summarized in Table 3. The range of changes in prices is fairly narrow: export and domestic gross prices for U.S. tobacco would fall by between 14 and 18 percent, most likely 14.8 percent; the producers' net price (marginal cost excluding quota rents in the low cost counties) would rise by between 2 and 8 percent, most likely 6.7 percent. On the other hand the range of U.S. tobacco output increases is quite large: from 19 percent up to 51 percent, most likely 32.5 percent. The major source of increased sales is increased exports of between 33 percent and 97 percent, most likely 59.2 percent. Domestic consumption would increase by 7 percent to 18 percent, most likely 14.8 percent. Industry revenue may fall by 2.0 percent or increase by as much as 21 percent; it would most likely increase by 12.9 percent.

[Table 3 about here]

The effect on prices is dominated by the large supply elasticity so that most of the adjustment in the industry must occur in the quantity rather than the price dimension. The range of quantity and revenue effects derives mainly from the range of values for the demand elasticities given a price effect dictated mainly by the supply elasticity.

Economic Welfare Effects of Deregulation

Elimination of the tobacco program would directly affect the economic welfare of a multitude of people involved in the tobacco industry: growers, quota owners and other input suppliers, people involved in transport, wholesaling, processing

tobacco, cigarette manufacturing, wholesaling and retailing, up to final consumers of cigarettes and other tobacco products. Because tobacco and its products are traded internationally, these effects would not be confined to the United States.

In this section we estimate some of these direct effects on economic welfare. To do this we make the conventional arbitrary distinction between consumers' surplus and producers' surplus. We define equilibrium at the wholesale market level so that producers' surplus changes represent the net effects on welfare of suppliers of all inputs used in tobacco up to the wholesale market level. Changes in consumers' surplus, on the other hand, represent the net effects on welfare of final consumers and suppliers of inputs used in the industry beyond the level of the wholesale tobacco market. We divide the producers' surplus into quota rents and producers' quasi-rents; we divide consumers' surplus into domestic (U.S.) and foreign. The standard caveats to the use of these measures apply.[11] These surplus changes are represented diagrammatically in Figure 1.

As an approximation we assume that the producers' quasi-rent on current output is equal to what producers' quasi-rent would be on that output in an unregulated market. By making that assumption, we may measure the change in producers' surplus (excluding quota rent) as that associated with the increase in output from Q_2 to Q_1 along the unregulated supply function, SS', area (C+D+E). We have estimated the current average quota rent as being \$0.25/lb, yielding total income to quota ownership of \$375 million per year. Eliminating the restrictions on quota transfers would yield an increase in in average quota rents of \$75 million per year comprising a cost saving of \$0.05/lb on 1.5 billion lbs. Thus, with unrestricted transfers of quota, total income to quotas would be \$0.30/lb or \$450 million per year.

Elimination of a freely transferable quota would result in a loss of quota income equal to area (A+B+C+D) — which we have estimated as \$450 million per year — and a gain of quasi-rent equal to area (C+D+E), a net loss to producers and

quota owners combined equal to area (A+B-E). Alternatively, simply eliminating the current quota with restrictions on transfers would result in a loss of quota income (and a net loss to quota owners and producers combined) that is lower by the cost of restrictions on quota transfers, $75 million per year.

With a price fall from P_2 to P_1 following deregulation, domestic consumers would gain surplus equal to area (A), and domestic consumers and foreigners combined would gain surplus equal to area (A+B+F). Thus the net gain to foreigners from deregulation is given by area (B+F).

The change in total domestic surplus is computed as the sum of changes in quota owners' surplus (quota rent changes), producers' quasi-rents and consumers' surplus. Elimination of a freely transferable quota would result in a net loss of domestic surplus equal to area (B-E). World surplus effects are computed by adding the effects on foreign surplus. Thus, the net world gain from eliminating a freely transferable quota would be equal to area (E+F).

Using the linear model in conjunction with our most likely estimates of the deregulated prices and quantities from Table 3, we estimated the most likely economic welfare effects of elimination of the tobacco program. Two sets of estimates are shown in Table 4. The first set of estimates assumes deregulation from the present situation. The second set of estimates assumes that deregulation follows from a hypothetical situation where inter-county quota transfers have been deregulated.

[Table 4 about here]

While from a world perspective deregulation would confer a net benefit of $148 million per year (of which $75 million is due to quota transfer restrictions), from a U.S. perspective deregulation would cost $24 million per year ($99 million per year if quotas were freely transferable). This $24 million is the net effect of a consumer

gain of $214 million, a producers' gain of quasi-rents of $136 million, and a loss of $375 million in quota rents.

The U.S. would lose from deregulating tobacco because the tobacco program enables quota owners to extract monopoly rents from consumers of U.S. tobacco, some of whom are foreigners. With the current tobacco program, the gains to quota owners exceed the losses of domestic consumers' surplus and producers' quasi-rents and there is a net gain to the United States in aggregate. These gains would be even greater if quota rents were maximized by allowing free transferability of quota.[12]

VI. OTHER ALTERNATIVES TO THE CURRENT TOBACCO PROGRAM

An "Optimal" Tobacco Program

Clearly, eliminating the U.S. tobacco program would maximize world welfare as normally measured by economists. As shown above, it would not maximize welfare in the United States. This section compares four alternatives to the two policies considered so far (i.e. current quota and free market). These are (1) set the quota to maximize the welfare of domestic tobacco growers and quota owners; (2) set the quota to maximize total domestic U.S. welfare; (3) maximize the welfare of domestic producers and quota owners with production and domestic marketing quotas that allow for price discrimination between the domestic U.S. and export markets; and (4) maximize domestic welfare with export quotas (or taxes) that allow a higher export price but a free market domestically.

In considering these alternatives to the current tobacco program we take as our base case the situation with free inter-county transfers of quota. To compare the alternative policies to the current program (with constraints on transfers) would involve adjusting the estimates of welfare effects to account for the effects of limits on transfers.

Net benefits to quota owners and producers combined would be maximized by a quota set at the monopolist's optimum so that marginal revenue is equal to marginal cost. With linear demand curves this is also the optimal total quantity whether producers price discriminate between export and domestic markets (as happens with the current U.S. peanut program) or allow free arbitrage between the markets (as happens under the present tobacco program).

Using the most likely parameter values from Table 1, combined surplus of producers and quota owners would be maximized by a quota of 1.14 billion pounds. This is 76 percent of the current quota and 57 percent of the competitive quantity. With a quota of 1.14 billion pounds, the tobacco price would be 15 percent higher, and per unit quota rents (the price wedge) would be 40 percent greater than at present. Clearly, the current quota is significantly greater than the quota that would maximize benefits to producers and quota owners. Whatever means is used by the current political system to reach quota decisions, it has failed to constrain quota enough to maximize returns to quota owners and producers as a group.[13]

Suppose, instead, it was desired to set a quota to maximize the combined welfare of producers, quota owners, and domestic consumers of U.S. tobacco, assigning equal weights to the surplus accruing to the different groups. This requires setting the total quantity of U.S. tobacco to optimize the trade off between gains to quota owners and losses to domestic consumers and producers. This is achieved when the marginal quota rent revenue due to a decrease in tobacco output equals the marginal cost of domestic producers' quasi-rent and consumers' surplus. We solved this optimization problem by solving for the price wedge that would maximize this objective function.[14] The solution, in terms of the parameters of supply and demand, is:

$$(14)\quad R^* = (P_d - P_p) = (P_e - P_p) = Q_{e1}/[\beta_d + \beta_e(1+\Phi)]$$

where Q_{e1} is the quantity of exports that would be produced under competition and β_d and β_e are the slopes of domestic and export demand. The final term (Φ) is a function of the slopes of the two demand curves and the supply curve slope (β_s): $\Phi = \beta_s/(\beta_s+\beta_d+\beta_e)$. This term approaches unity as the supply elasticity approaches infinity and approaches zero as the supply elasticity approaches zero (i.e. $0 \leq \Phi \leq 1$).

Using equation (14) as the equilibrium condition along with equations (1), (2) and (3) yields the interesting result that, with our most likely parameter values, the current quota is almost exactly that which would maximize aggregate U.S. welfare. The "optimum" quota would be 1.53 billion pounds compared to the current quota of 1.50 billion pounds.

The quantities and prices that would result from four alternative quota settings, using the most likely parameter values, are shown in Table 5. The four alternative settings are the current quota (1.50 billion pounds) and settings that would maximize surplus for the world in aggregate (the competitive quantity of 1.99 billion pounds), producers and quota owners combined (1.14 billion pounds), or the U.S. in aggregate (1.53 billion pounds). Table 5 also includes the changes in surplus accruing to different interest groups that would arise from changing from a freely transferable quota of 1.50 billion pounds to the three alternative quantities. Radical changes in the total surplus and its distribution would follow a total deregulation or a reduction in the quota to the point where quota owners' and producers' surplus is maximized.

[Table 5 about here]

The current quota policy is hardly optimal from the point of view of the world as a whole or producers and quota owners combined. On the other hand, given the choice of a quota as the policy instrument (and using the most likely parameter values) the current quota is optimal in terms of maximizing the combined surplus

of domestic consumers, quota owners, and producers of U.S. tobacco. We checked the sensitivity of this result to parameters and the results are shown in Table 6. The adjustment to quota required to maximize U.S. surplus is sensitive to the export demand elasticity, but relatively insensitive to the other parameters. With an export demand elasticity of -2, a 7 to 10 percent reduction in quota would maximize surplus; with an export demand elasticity of -6, a 7 to 10 percent increase in quota would be called for. With an export demand elasticity of -4, the most likely value, the quota is set within 1 or 2 percent of the U.S. "optimum."

[Table 6 about here]

Quotas as a Means of Price Discrimination

The only way to further increase the total U.S. surplus in the tobacco market would be to use a different instrument; that is, to optimally price discriminate between domestic and foreign consumers of U.S. tobacco. In effect this would be equivalent to an "optimal export tax" policy in which marginal revenue from export markets is equal to marginal cost and price on the domestic market. Domestic sales would be unrestricted and the domestic price would be equal to marginal cost. Export taxes are unconstitutional in the United States, but there are other means of achieving the same effects which may be both practicable and legal. For instance, an export quota could be introduced. Such a policy could yield an increase in total U.S. surplus of $28 million per year compared to the current policy. Depending on the details of the policy, it might involve significant redistribution of surplus to achieve that increase. It would involve a higher export price and lower exports, and a lower domestic price and greater domestic use of U.S. tobacco than at present.

Alternatively, optimal price discrimination from the point of view of producers and quota owners would involve setting quotas for both domestic and export markets so that marginal revenues from both markets were equal to

marginal cost. This would involve reducing the total quota by 24 percent with a relatively large reduction in supply to the less elastic domestic market.

The economic welfare effects of all of the alternative policies, relative to a freely negotiable quota at the current level of 1.50 billion pounds, are summarized in Table 7. The first three policies, like the present program, allow free arbitrage in U.S. tobacco between domestic and export markets. These policies are (1) competition, (2) a quota set to maximize combined welfare of producers and quota owners, and (3) a quota set to maximize total U.S. welfare. The fourth and fifth policies allow for different prices for U.S. tobacco on domestic and export markets, as could be achieved through separate domestic and export quotas. In policy (4) these two quotas are adjusted to maximize welfare of producers and quota owners. In policy (5)—corresponding to an optimal export tax—the two quotas are set to maximize total U.S. surplus.

[Table 7 about here]

VII. CONCLUSION

The United States is the world's biggest importer and exporter of tobacco with considerable power in the world tobacco market. Total domestic surplus in the U.S. tobacco market would be maximized by applying an "optimal export tax" at a rate of 25 percent of the domestic consumer and producer price given an export demand elasticity of -4.0; but export taxes are unconstitutional in the United States. In a relatively simple static model, an export quota could have the same effect (possibly with different distributional consequences depending upon the disposition of tax revenue relative to quota rents).

The U.S. tobacco program has an effect in the same direction.[15] Through the application of a tobacco quota, the tobacco price is held about 17 percent above its

competitive value and 25 percent above competitive marginal cost on current output. The main differences are that the benefits from monopolistic exploitation of world markets are transferred to quota owners rather than the treasury and domestic tobacco consumers are "taxed" along with foreigners. Also, with the current program that restricts quotas to specific counties, there are efficiency losses of about $75 million per year because the quotas are not freely transferable.

In general, U.S. farm policy seeks to transfer income towards farmers, usually at a cost to aggregate welfare. The tobacco program is unusual—if not unique—in that it achieves transfers to the rural sector (quota owners) while increasing U.S. domestic welfare and at the same time avoiding any significant treasury budget costs. Moreover, and more surprising, the tobacco quota seems to be set at the level that maximizes these net program benefits. While a total deregulation would enhance export income, it would involve a net loss to the U.S. of $24 million per year, potentially $99 million per year. Tobacco smokers would gain from such deregulation, to the tune of about a penny a pack.

It should also be noted that in the context of common international trade negotiations—such as the GATT round currently under way—it is countries or policies that undercut the world market that attract criticism. While "dumping" is objected to by importing countries, to adopt policies that increase prices paid by foreign importers seems to be viewed kindly.[16] In fact policies that increase import prices are often actively supported by the "victims" (as in the U.S. voluntary restraints on imports of Japanese autos or Australian beef). The U.S. tobacco program causes direct transfers from foreigners to U.S. tobacco quota owners. We have shown that this effect is large enough to outweigh the associated efficiency losses to the U.S. economy, even with the inter-county restrictions on quota transfers that have held the geographic distribution of production fixed for half a century.

The result that tobacco quota may be set at the socially optimal level might be surprising at first blush, and some informal discussion of the political economy of the tobacco program is therefore appropriate. Gardner (1987) has recently modelled and measured the effects of various indicators of farmers' political strength on their success in using agricultural programs to obtain income transfers. Using data across 17 U.S. agricultural commodities for almost 70 years he concludes (p. 308) that "... variables associated with the cost to producers of generating political pressure and the social cost...of distribution are both found to be politically important." In the case of tobacco, producers are able to generate political pressure at comparatively low cost and, at the same time, through the tobacco program the net social costs of transferring income in that direction are low.

The quota and associated price supports have been adjusted regularly over the years but there have been only a few instances of clear regime changes. This occurred most recently in the 1980s. The share of U.S. tobacco both in domestic cigarettes and on export markets had fallen, there was increased pressure to minimize taxpayer funding of the program, and there was some pressure from producers who did not own quota to reduce lease rates. The result was a series of program adjustments that allowed the U.S. price to fall, and quota to increase, faster than they would have without the adjustments. These actions followed concerted negotiations and compromise among grower representatives, quota owners, cigarette manufacturers, legislators, and USDA administrators.

Clearly the major interest groups are actively represented in the political arena where policy changes are determined. While national income would be greatest with an export tax on tobacco, such a policy would be opposed violently by industry interests. Rent seeking and legal constraints may account for the use of production controls, instead, as a compromise policy under which national and vested interests lie in a similar direction.

The total quota is determined in a political environment with adjustments made by trial and error based on a "feel" for supply and demand conditions, and the outcome of this process is that the current level of quota is well above that which would maximize benefits to producers and quota owners. Rather, the quota is set about right to maximize national income given that quotas will be used. Thus, the current tobacco program is completely consistent with the objective of maximizing domestic welfare subject to political and legal constraints.

TABLE 1: Basic Data and Parameters used to Simulate Tobacco Policy Changes (1987 Values)

Variable	Symbol	Most Likely Value	Range
U.S. Tobacco Quantity			
Total Quota	Q	1.50 b. lbs	
Domestic Sales	Q_d	0.90 b. lbs	
Exports	Q_e	0.60 b. lbs	
U.S. Tobacco Price			
Producer	P_p	$1.20/lb.	
Domestic Consumer	P_d	$1.50/lb.	
Export	P_e	$1.50/lb.	
Elasticities			
Supply	ε	5	5 or 10
Domestic Demand	η_d	-1	-0.5 or -1.0
Export Demand	η_e	-4	-2, -4 or -6

TABLE 2: Percentage Changes in Prices, Output and Disposal of U.S. Tobacco due to Deregulation.

Elasticities			Percentage Price and Quantity Changes			
Supply	Domestic Demand	Export Demand	Price	Domestic Sales	Exports	Output
(ε)	(η_d)	(η_e)	(P_d=P_e)	(Q_d)	(Q_e)	(Q)
5	-0.5	-2.0	-17.0	8.5	34.0	18.7
		-4.0	-15.3	7.7	61.4	29.1
		-6.0	-14.0	7.0	83.8	37.7
	-1.0	-2.0	-16.3	16.3	32.7	22.9
		-4.0	-14.8	14.8	59.2	32.5*
		-6.0	-13.5	13.5	81.0	50.5
10	-0.5	-2.0	-18.4	9.2	36.8	20.2
		-4.0	-17.4	8.7	69.4	33.0
		-6.0	-16.5	8.2	98.7	44.4
	-1.0	-2.0	-18.0	18.0	36.0	25.2
		-4.0	-17.0	17.0	68.0	37.4
		-6.0	-16.1	16.1	96.8	48.4

Note: Estimates are based on 1987 data. The price refers to the domestic and export prices and not to the producer price which is net of quota rents. The most likely case is denoted *.

TABLE 3: Most Likely Effects of Deregulation on Prices, Quantities and Revenues in the U.S. Tobacco Industry (ε=5,η_d=-1,η_e=-4)

Variable	Units	Base Value	Most Likely Change	Percentage Changes Most Likely (%)	Range (%)
U.S. Tobacco					
Price	$/lb	1.50	-0.22	-14.8	-14 to -18
Marginal Cost	$/lb	1.20	0.08	6.7	2.0 to 7.5
Output	b.lb./yr	1.50	0.49	32.5	19 to 51
Revenue	$b./yr	2.25	0.30	13.2	-2.0 to 21
Exports	b.lb./yr	0.60	0.36	59.2	33 to 97
Domestic Use	b.lb./yr	0.90	0.13	14.8	7 to 18
Imported Tobacco					
Quantity	b.lb./yr	0.35	-0.10	-29.6	
U.S. Use of All Tobacco					
Quantity	b.lb./yr	1.25	0.03	2.4	

Notes: Simulations are based on 1987 data. Changes in imported quantity were computed using a cross price elasticity of demand for imports with respect to the U.S. tobacco price of 2.0 (from Sumner and Alston (1987)) which is compatible with the other demand elasticities. Changes in U.S. use of all tobaccos were computed by summing changes in use of domestic and imported tobacco.

TABLE 4: Economic Welfare Effects from Eliminating U.S. Tobacco Quota

Interest Group	Change in Welfare ($million/year)	
	Non-Transferable	Freely Transferable
U.S. Consumers	214	214
U.S. Producers	136	136
Quota Owners	-375	-450
Total U.S.	-24	-99
Foreigners	173	173
World Total	148	73

Notes: Estimates are based on 1987 data in Table 1. The first column refers to deregulation relative to the current situation where quotas are transferable only within counties; the second column refers to elimination of the current quota after it has been made freely transferable. The difference between the two columns is a gain of $75 million per year from eliminating quota transfer restrictions which shows up as additional benefits in the first column. From the point of view of quota owners and the U.S. in aggregate the cost of eliminating a freely transferable quota is greater by this amount.

TABLE 5: Effects of Alternative Settings of a Freely Transferable Quota

Variable	Current Value	Value With Quota Set to Maximize Surplus of: World (free trade)	Producers & Quota Owners	United States
Prices (cents/lb.)				
Producer	1.20	1.28	1.14	1.20
Domestic	1.50	1.28	1.66	1.49
Export	1.50	1.28	1.66	1.49
Quantities (b.lb./yr)				
Domestic	0.90	1.03	0.80	0.91
Export	0.60	0.96	0.34	0.62
Total	1.50	1.99	1.14	1.53
Surplus Changes Relative to Current Policy ($m/year)				
U.S. Consumers	--	214	-138	11.9
U.S. Producers	--	136	-76	7.0
Quota Owners	--	-450	144	-18.5
U.S. Total	--	-99	-70	0.4
Foreigners	--	173	-76	8.0
World Total	--	73	-146	8.4

Note: Estimates are based on 1987 data. Figures may not add exactly due to rounding.

TABLE 6: Percentage Changes in Total Quota Required to Maximize Total U.S. Surplus with a Range of Parameter Values.

Supply Elasticity (ε)	Domestic Demand Elasticity (η_d)	Export Demand Elasticity (η_e)	Change in Total Tobacco Quota (%)
5	-0.5	-2.0	-9.5
		-4.0	-0.9
		-6.0	6.0
	-1.0	-2.0	-6.7
		-4.0	1.9*
		-6.0	8.8
10	-0.5	-2.0	-9.9
		-4.0	-1.0
		-6.0	6.7
	-1.0	-2.0	-7.1
		-4.0	2.1
		-6.0	9.8

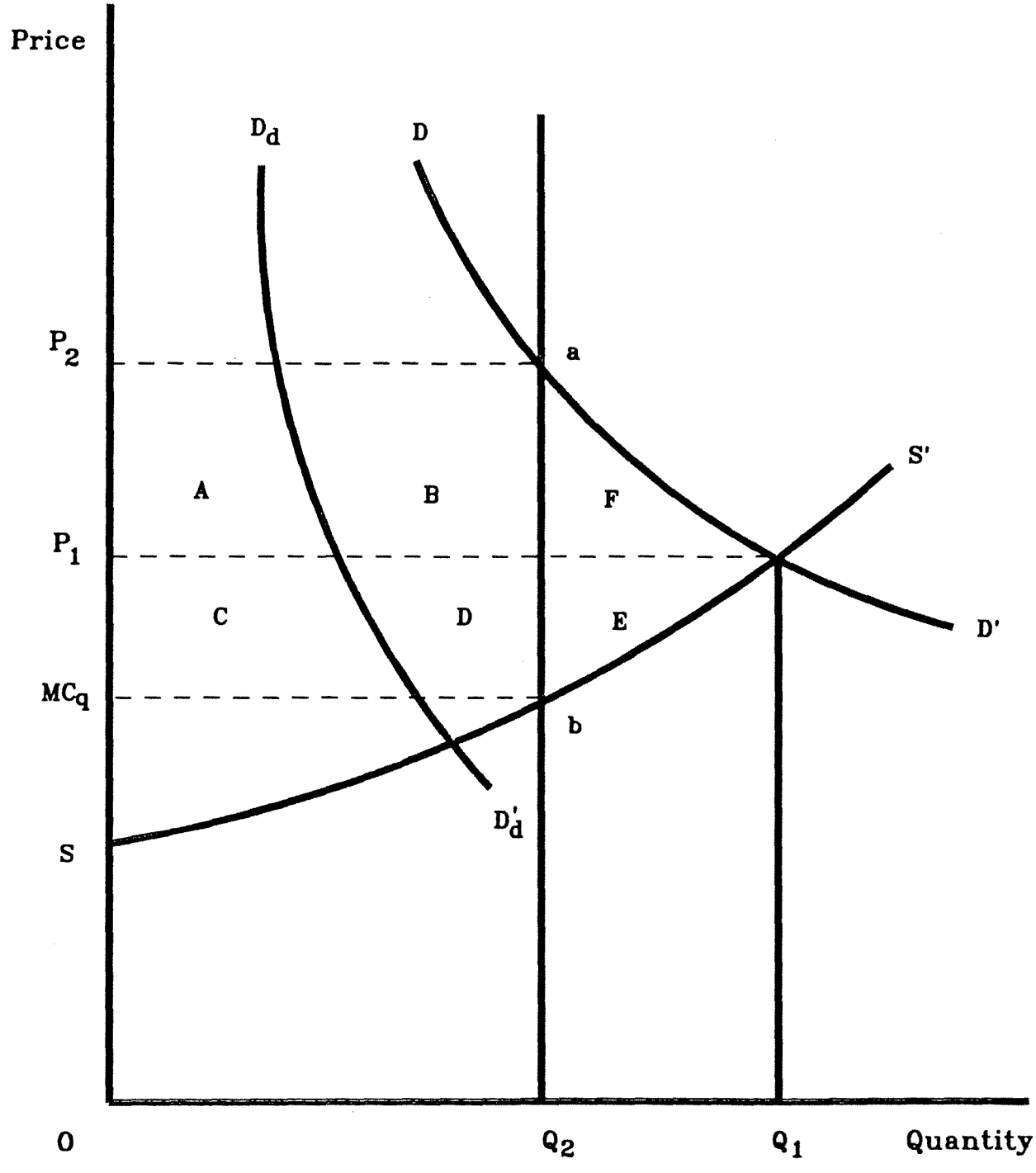
Notes: Estimates are based on 1987 data. The entry denoted * corresponds to our most likely combination of parameters.

TABLE 7: Welfare Effects on Different Interest Groups For a Range of Tobacco Policies Relative to a Freely Transferable Quota of 1.5 b. lbs. ($million/year).

Policy	Effects on Surplus of: Producers & Quota Owners	United States in Aggregate	World Total
Equal Domestic and Export Prices			
1. Competition	-313.8	-99.3	73.2
2. Producers and Quota Owners Maximum Surplus	68.2	-70.0	-146.3
3. U.S. Maximum Surplus	-11.5	0.4	8.4
Price Discrimination			
4. Producers and Quota Owners Maximum Surplus	206.3	-210.1	-215.4
5. U.S. Maximum Surplus	-251.8	28.3	2.7

Note: Estimates are based on 1987 data.

FIGURE 1: Price, Quantity and Economic Surplus Effects of the Tobacco Program



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NOTES

1. Recent discussions include Sumner (1981) and Sullivan (1985). A significant earlier contribution was made by Nicholls (1949, 1951).
2. Recent discussions of these issues include: Ippolito, Murphy, and Sant (1979); Schneider, Klein, and Murphy; (1981), Doron (1979); Lewit, Coate, and Grossman (1981); Warner (1981); Johnson (1984); and Sumner and Wohlgenant (1985).
3. In fact, elimination of the tobacco program would lower the price of tobacco and, as a consequence, the price of cigarettes in the United States would fall and cigarette consumption would rise. Thus the tobacco program reinforces other government policies directed at reducing smoking, but its effects in this direction are quite minor. For details see Sumner and Alston (1986).
4. Besides the basic price, quantity, and economic surplus effects discussed in this paper, the tobacco program influences a number of other important economic variables. For discussion of effects of deregulation on such things as variability, regional incomes, and farm size, see Sumner and Alston (1986).
5. For a description of the program see Sumner and Alston (1986) and U.S. Department of Agriculture Tobacco Situation and Outlook, June 1986. For 1988 crop year, tobacco quotas have been reduced to around 90 percent of expected demand—given the current support prices—in a conscious effort to reduce government stocks.
6. This estimate and that in the following paragraph are based on a survey of North Carolina County tobacco extension agents and on reports from agricultural extension and research groups at the University of Kentucky and Clemson University (in South Carolina).

7. More detail on this estimate and related approaches to estimate the elasticity of tobacco supply is provided by Goodwin, Sumner, and Sparrow (1987) and Sumner and Alston (1986).

8. Fulginiti and Perrin (1987).

9. In a model that emphasizes relatively slow adjustment, Zanias (1987) estimates an elasticity of demand for Greek tobacco exports of -4.6.

10. It is pertinent to note that during the past two or three years, as tobacco prices have fallen, we have seen a turnaround in the long decline in U.S. tobacco exports.

11. In particular, these measures of welfare assume that wholesale market demand curves for tobacco leaf reflect social as well as private values. For tobacco, this assumption may be challenged on the grounds that smokers may either underestimate the costs of smoking to themselves or not account for costs that their smoking imposes on others. It has been suggested, for instance, that there are externalities from smoking in the form of passive smoking and additional costs imposed on the health care system. What is not clear is whether these externalities involve a significant difference between private and social costs of smoking given that they have been corrected for, at least to some extent, by the existing taxes on cigarettes and other regulations over smoking. In any event, a total deregulation would reduce the cost of cigarettes at retail by only about a penny a pack. As a consequence, cigarette sales in the United States would increase by less than half of one percent. It would seem reasonable to assume that there would be a negligible uncompensated externality involved in a consumption change of this magnitude.

12. It might be argued on political grounds that quotas that cannot be transferred across counties are a cost that society (and the tobacco industry) pays to get quotas adopted by a legislature that is geographically based. Under that interpretation the efficiency cost is similar to the cost of lobbying or other political action and is a necessary expenditure to have quotas. In that case a freely transferable quota is not a viable alternative and costs of not having freely transferable quotas are an irrelevance that should be ignored.
13. If quota owners alone were the relevant cartel members the "optimal" quota would be even smaller.
14. See Appendix for details of this solution procedure.
15. Johnson (1965) first pointed out that the U.S. tobacco program worked similarly to an export tax. Also see Johnson and Norton (1983).
16. Council of Economic Advisors (1988, Chapter 4).

APPENDIX A; OPTIMAL QUOTAS

A.1 Introduction

In a recent paper, based in part on Peltzman (1976) and Becker (1983), Gardner (1987) discusses an "optimal" tobacco quota in terms of relative welfare weights assigned to producers and consumers. Gardner notes that equal weights in his model yields the competitive solution and a zero weight for consumers is the monopoly solution. In this Appendix we develop a model in the spirit of Gardner including the welfare of foreigners as an explicit interest group. We show three cases of interest. These are in terms of the welfare weights that yield (i) the monopoly solution, (ii) the competitive solution, and (iii) the optimal quota from a national viewpoint.

A.2 The General Model

Consider the objective function (W):

(A.1) $W = w_p G_p + w_c G_c + w_f G_f$

where the G's represent welfare of producers (p), domestic consumers (c), and foreigners (f), and the w's represent welfare weights which are assumed to be constant. The idea is to choose a quota level (Q) to maximize w. That is, to solve:

(A.2) $dW/dQ = 0 = w_p(dG_p/dQ) + w_c(dG_c/dQ) + w_f(dG_f/dQ)$

The components of (A.1) are defined as follows:

Producer Surplus

(A.3) $G_p = P(Q)\,Q - C(Q)$.

Domestic Consumer Surplus

$$(A.4)\quad G_c = \int_0^{Q_d} P_d(Q_d)Q_d - P_d(Q_d)Q_d.$$

Foreign Surplus

$$(A.5)\quad G_f = \int_0^{Q_e} P_e(Q_e)dQ_e - P_e(Q_e)Q_e.$$

where Q_d is domestic consumption, Q_e is net exports, and total production (Q) is equal to the sum of domestic consumption and net exports, and market clearing is defined by equating the producer price (P) with the domestic consumer price (P_d) and the export price (P_e).

Differentiating equations (A.3), (A.4) and (A.5) with respect to total production (Q) yields:

$$(A.3')\quad dG_p/dQ = P + QdP/dQ - dC(Q)/dQ$$

$$= P[1+(1/\eta)] - MC(Q)$$

$$= P[(P-MC)/P + 1/\eta]$$

$$(A.4')\quad dG_c/dQ = (dG_c/dQ_d)(dQ_d/dP_d)(dP_d/dP)(dP/dQ)$$

$$= -P(Q_d/Q)/\eta = -Pk_d/\eta$$

$$(A.5')\quad dG_f/dQ = (dG_f/dQ_e)(dQ_e/dP_e)(dP_e/dP)(dP/dQ)$$

$$= -P(Q_e/Q)/\eta = -P(1-k_d)/\eta$$

where η_d, η_e, and η are the elasticities of domestic, export and total demand, and k_d is the domestic share of total sales, and MC is marginal cost.

Substituting (A.3'), (A.4'), and (A.5') into (A.2) and dividing throughout by P yields:

(A.6) $0 = w_p[(P-MC)/P + 1/\eta] - w_c[k_d/\eta] - w_f[(1-k_d)/\eta]$, or

$= w_p[(P-MC)/P] + [1/\eta][w_p - w_c k_d - w_f(1-k_d)]$.

Three specific solutions to this general formul are of interest. Maximizing producers' welfare ($w_p=1$; $w_c=w_f=0$) yields the familiar monopoly solution:

(A.7) $(P-MC)/P = -1/\eta$.

Maximizing world welfare ($w_p=w_c=w_f=1$), making use of the fact that $\eta = k_d\eta_d + (1-d_d)\eta_e$, yields the competitive solution:

(A.8) $P = MC$.

To maximize domestic surplus ($w_p=w_c=1$; $w_f=0$) involves setting output to achieve:

(A.9) $(P-MC)/P = -(1/\eta)[1-k_d] = -k_e/\eta$.

These solutions define optimal price wedges in terms of the market shares, elasticities, prices, and marginal costs applying at the optimal solution. This creates some problems when trying to define the optimum based on data defined at some other equilibrium (e.g., the competitive solution). To deal with this problem, next we obtain the equivalent solution for an optimal quota using the linear model defined in the text.

A.3 Specific Solutions for the Linear Case

It is fairly easy to show that the net domestic gain from imposing a quota (Q) is equal to the loss of surplus experienced by foreigners minus the world loss of surplus. Let subscript "1" refer to competitive values, and subscript "2" refer to values in the presence of the quota. Now we define the surplus areas in terms of the wedge (R) between price and marginal cost induced by the quota. The triangle of world surplus loss (WL) is defined as:

(A.10) $WL = -\frac{1}{2}R(Q_2-Q_1) \geq 0$. (area E+F in Figure 1)

The loss of surplus experienced by foreigners (FL) is:

(A.11) $FL = (P_2-P_1)[Q_{e2} + \frac{1}{2}(Q_{e2}-Q_{e1})] \geq 0$. (area B+F in Figure 1)

Therefore, the net domestic gain (G=FL-WL) is equal to:

(A.12) $G = \frac{1}{2}R(Q_2-Q_1) + (P_2-P_1)[Q_{e2} + \frac{1}{2}(Q_{e2}-Q_{e1})]$. (area B-E in Figure 1)

Using the algebra for the liner supply and demand equations (1) to (3) and substituting for the prices as (i) $P_p=P_d=P_e=P_1$ for the competitive case and (ii) $P_d=P_e=P_2$; $P_p=P_2-R$ for the quota case yields:

(A.13) $(P_2-P_1) = \Phi R$; $(Q_{e2}-Q_{e1}) = -\beta_e\Phi R$; $(Q_2-Q_1) = -(\beta_e+\beta_d)\Phi R$;

where $\Phi = \beta_s/(\beta_s+\beta_d+\beta_e)$ and the β's represent the magnitudes of the slopes of supply (s), domestic demand (d), and export demand (e). Substituting equations (A.13) into (A.12) and simplifying terms yields:

(A.14) $G = Q_{e1}\Phi R - \frac{1}{2}(\beta_e+\beta_d)\Phi R^2 - \frac{1}{2}\beta_e\Phi^2R^2.$

Differentiating (A.14) with respect to R yields:

(A.15) $dG/dR = 0 = Q_{e1}\Phi - (\beta_e+\beta_d)\Phi R - \beta_e\Phi^2R$

Therefore, the optimal price wedge is:

(A.16) $R^* = (P\text{-}MC)^* = Q_{e1}/[\beta_d + \beta_e(1+\Phi)].$

Substituting $(P_2\text{-}P_1)[Q_{e2} - \frac{1}{2}(Q_{e2}\text{-}Q_{e1})] = (P_2\text{-}P_1)[Q_{e1} + \frac{1}{2}(Q_{e2}\text{-}Q_{e1})]$ into equation (A.11) and repeating the steps above yields the alternative equivalent result in terms of the "optimal" export quantity:

(A.17) $R^* = (P\text{-}MC)^* = Q_{e2}/[\beta_d + \beta_e]$

It is easily shown that equation (A.17) is equivalent to equation (A.9). Combining equations (A.16) and (A.17) yields the ratio of optimum exports to competitive exports as:

(A.18) $Q_{e2}/Q_{e1} = [\beta_d+\beta_e]/[\beta_d+\beta_e+\Phi\beta_e]$

The relative change in exports is given by:

(A.19) $(Q_{e2}/Q_{e1})\text{-}1 = (Q_{e2}\text{-}Q_{e1})/Q_{e1} = -\Phi\beta_e/\beta_d+\beta_e+\Phi\beta_e]$

In terms of elasticities applying at the competitive equilibrium this can be expressed as:

(A.20) $(Q_{e2}\text{-}Q_{e1})/Q_{e1} = -\Phi k_e\eta_e/[\eta + \Phi k_e\eta_e]; \Phi = \varepsilon/(\varepsilon\text{-}\eta)$

The relative change in price is derived by dividing throughout by the export demand elasticity (making the approximation that the arc elasticity is equal to the elasticity at the initial point):

(A.21) $(P_2-P_1)/P_1 = -\Phi k_e/[\eta + \Phi k_e \eta_e]$

The relative change in quantity is (approximately) equal to the relative change in price multiplied by the total demand elasticity:

(A.22) $(Q_2-Q_1)/Q_1 = -\Phi k_e \eta/[\eta + \Phi k_e \eta_e] = -k_e \eta/[k_e \eta_e + \eta(\varepsilon-\eta)/\varepsilon]$.