ECONOMIC SURPLUS AND THE DISTRIBUTIONAL CONSEQUENCES OF DEREGULATING TOBACCO PRODUCTION

S. Sureshwaran, C.S. Thompson, M.S. Henry, and M.I. Loyd

Abstract

Reservations on technical and theoretical grounds in the use of the consumer surplus approach to measure benefits of government programs have often appeared in the literature. Therefore, this paper uses an alternative approach in a case study to estimate the annual economic surplus created in South Carolina from deregulating tobacco production. Impacts of deregulation on cropping patterns and income on representative tobacco farms, and distribution of benefits in the economy are examined. Results of this study indicate that deregulation stimulates the economy and would increase the net value added by $5.8 million in the long run.

Key words: tobacco program, deregulation, linear programming model, input-output model, value added, distributional consequences, economy of South Carolina.

Benefits of commodity programs are measured by deriving changes in consumer and producer surplus and are represented as net increases in real income or economic surplus. The magnitude of the estimated benefits depend on assumptions regarding the contribution of factor productivity to the growth in income [1] (Solow; Sato; Cooke), interpretations of the error term (Bockstael and Strand), specification of functional forms (Ziemer *et al.*), and the nature of the shift (divergent, parallel or convergent) in supply and demand curves (Lindner and Jarrett).

Due to the reservations on technical and theoretical grounds about the use of consumer surplus approach, this paper seeks to use an alternative approach in a case study to estimate annual economic surplus created in South Carolina from deregulating tobacco production. Also, the distributional consequences of deregulation (industry-by-industry) are examined.

Change in value added is used to measure the change in factor productivity and consequently the change in the rate of natural growth in real income in the long run due to deregulation. [2] Value added may overestimate changes in factor productivity since it includes changes in factor intensity. However, for an economy or sector that is labor intensive or for a community with substantial underemployment or unemployment, the rate of growth in real income will increase with an increase in factor intensity until a fixed rate of unemployment is reached (Sato; Cooke). Therefore, there is justification for using change in value added as a measure of annual economic surplus created in South Carolina from deregulating tobacco production.

The remainder of the paper is divided into six sections. In the first, the linear programming model developed to analyze the impacts of deregulation on tobacco farms is discussed. Then the input-output model used to estimate impacts on total value added in South Carolina is presented. In the third section, changes in income and product mix on tobacco farms are compared to the benchmark solution. Changes in value added in the economy are discussed in the fourth section. The fifth section postulates the effects of the current tobacco program on the model's estimate of deregulation. The final section evaluates the empirical results and derives con-

[1] Under neoclassical assumptions, an increase in capital investment unaccompanied by an increase in factor productivity does not increase the long-run rate of growth in income.

[2] Neoclassical growth theory assumes that the economy is in competitive equilibrium such that the marginal value product of a factor is equal in all sectors (Cooke). However, as there are systematic variations in the returns to labor and capital in different sectors, there are other sources of growth. Hence, in this paper, productivity is broadly defined to include changes in total factor productivity, resource allocation, scale economies and reduction in bottlenecks.

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Table 1. The Seven Representative Farms, By Tobacco Acreage and Harvest-Curing Technology[a]

Harvest-curing technology	Tobacco acreage		
	Less than 9.6	9.6 to 30	Over 30
Manual harvesting and conventional barns[b]	X_{111}	X_{211}	None
Manual harvesting and bulk or box barns[b]	X_{112}	X_{212}	X_{312}
Mechanical harvesting and bulk or box barns[c]	None	X_{222}	X_{322}

[a]In X_{ijk}, i refers to tobacco acreage, j refers to harvest technology and k to curing technology.
[b]Manual harvesting includes farms with and without priming aid.
[c]Mechanical harvesters include self-propelled multipass harvesters.

clusions. In the interest of brevity, features of the tobacco program and characteristics of tobacco program and characteristics of tobacco production are not discussed separately but are included where necessary in developing the empirical models.

THE MODEL TO EVALUATE IMPACTS ON TOBACCO FARMS

Model Stratification

Regional responses to policy changes are often estimated as the aggregate of the resource and/or product adjustments on individual representative farms (Jordan). Since research resources are not available to determine the output of every farm, a similar methodology is utilized in this study. [3] However, to minimize aggregation errors, the study area is disaggregated into relatively homogeneous units by explicitly defining representative farms on the basis of inherent differential factor endowments (Miller).

Representative farms are delineated using two levels of stratification: tobacco acreage size-groups and harvest-curing technology (Table 1). Tobacco acreage and harvest-curing technology are among the important factors explaining differences in the decision-making process of tobacco farms. [4] In addition, farms in the seven representative groups appear to be relatively homogeneous with respect to: (1) percentage of land under different enterprises; and (2) other characteristics, such as formal educational levels and off-farm employment of producers. However, some aggregation errors may still persist because of differences in risk aversion attitudes, learning behavior on the part of farmers, external and internal credit rationing, and on-farm resources available for the production of crops (other than tobacco) and livestock. Further disaggregation of the model by subregions may not significantly reduce the errors as tobacco production is concentrated in a few counties in the coastal belt of South Carolina.

The 1984 Tobacco Program Provisions

Since the Agricultural Adjustment Act of 1938, acreage allotments or quotas have been used to restrict tobacco production in order to raise prices (at/or) above the support rate. The national quota is assigned to individual farms according to production history. Through 1982, allotments and quotas could not be sold separate from the farmland but could be leased and transferred from one farm to another within the same county. Since 1982, owners of flue-cured allotments and quotas are permitted to sell these rights separately from the farms to which the allotments are attached to other farms in the same county. Lease and transfer of flue-cured quota has been abolished since 1987.

Because information on quota ownership of individual farms is not available, each representative farm is allocated the quota necessary to produce its market share of production in 1984, *i.e.*, in the benchmark model. To reflect 1984 conditions, income from the lease and transfer of tobacco quota is included in the benchmark model.

To estimate annual economic surplus created in South Carolina from deregulating tobacco production, a single-period linear programming model is used. To treat the phenomenon of capital accumulation more realistically, e.g., quota buying and selling, a dynamic model is required. However, in the static model, it is also possible to conceive the lease rate as the first annual payment for quota bought in 1984. [5]

[3] The linear programming model and some of the results presented in this manuscript are also discussed in Sureshwaran (1989).

[4] The importance of farm size on such problems as costs, risk and uncertainty, and market response are discussed in Heady and in Jordan.

[5] In 1984, the average price quota buyers in South Carolina were reported to have paid was $1.75; the average rate of interest charged on outstanding farm loans in the southeast region of the United States was 9.7 %, and quota sellers were required by the program to allow the buyers up to 5 years to pay for the quota. Using the standard capitalization formula, the estimated annual payment for quota bought in 1984 was $0.457, approximately equal to the lease rate of $0.45 used in the model.

The most direct consequence of deregulation is that tobacco supply rights would become worthless. Lease income in the benchmark model serves as an estimate of the annual loss to quota owners in the deregulated market scenarios. The sales price of quota converted to an annual basis could have been used to account for the loss to quota owners. The results would have been similar.

Decision-Making in a Multi-Product Firm

A tobacco farmer will lease out quota only when the combination of income from the lease and income earned by reallocating the tobacco inputs to other alternatives exceed income from producing tobacco. Therefore, to permit each representative farm to select its optimal enterprise combinations independently, a polystructural linear programming model is used.

The producer is assumed to make decisions which maximize expected net returns (to land, tobacco quota, and unpaid family labor) subject to restrictions on enterprise levels and resource supply. To simulate as closely as possible the actual cropping patterns on tobacco farms in 1984, futures prices and risk costs are used to estimate expected net returns.

If there is no interaction between price and quantity risk, Holthausen shows that the optimal output chosen by a competitive, net revenue maximizing firm is such that marginal cost is equal to the forward price and is independent of the firm's degree of risk aversion and the probability distribution of the variation in price. [6] Therefore, futures prices are used to represent expected prices at the time resources are committed to production (Gardner; McSweeny *et al.*). Since no futures markets for tobacco or feeder pigs exist, season-average prices during 1984 are used as proxies for expected prices. Expected gross returns are estimated from expected prices and season-average yields in South Carolina in 1984.

To represent additional compensation required by farmers for producing crops with large variations in yield, "risk" costs are included (Simmons and Pomareda). Risk cost is estimated as the product of variable cost and the associated coefficient of variation in yield (Adams *et al.*; Epperson *et al.*). [7] For farmers participating in government programs, risk cost is estimated as the product of variable cost and the associated coefficient of variation in Agricultural Stabilization and Conservation Service (ASCS) yield. [8] The model solutions correspond to industry equilibrium under perfect competition in the sense that price is equal to marginal cost (marginal risk cost plus marginal resource cost) for each activity (Hazell and Scandizzo).

Expected net returns to land and labor (family and hired) are equal to expected gross returns minus average "activity" costs. Average "activity" costs are defined as the sum of average risk costs and average resources costs. Average resource costs exclude costs of hired labor because labor hiring activities are specified separately.

Mathematical Model

The following notation is used in formulating the mathematical model:

Y_{ij} = quality of the i-th activity on the j-th farm, i = 1, ..., 9 (tobacco, corn, wheat, soybeans, wheat-soybean rotation, cow-calf, slaughter cattle, feeder pigs, and hogs); j = 1, ..., 7. [9]

Y_{fjt} = hours of off-farm employment by the j-th farm in the t-th time period.

Y_{q1j} = pounds of tobacco quota leased out by the j-th farm.

Y_{q2j} = pounds of tobacco quota leased in by the j-th farm.

Y_{wjt} = hours of labor hired by the j-th farm in t-th time period, t = 1, ..., 3 (January to June, July to September, and October to December).

P_{ij} = expected net returns to land and labor (and quota) for the i-th activity produced by the j-th farm.

P_{fj} = off-farm wage rate for the j-th farm.

[6] To avoid complications due to interaction between price and quantity risk and its effects on production, prices of all products, except tobacco, are assumed not to be affected by output of individual producers in South Carolina. For many farm products, prices are determined in national or international markets and the output of individual producers is uncorrelated with price because each producer is a price taker.

[7] When risk costs are included, benchmark solutions correspond more closely to actual 1984 estimates. The changes in crop mix (greater acreage under soybeans and less under corn when risk costs are included) result from lower variance of soybean yields as compared to that of corn. Similar results were obtained by Kramer, *et al.*

[8] ASCS yield is for Horry County, SC, for the years 1979 through 1983 (South Carolina Crop and Livestock Reporting Service).

[9] Units are acres for crops and number of head for livestock.

P_q = lease rate of $.045 per pound for tobacco quota.

P_w = wage rate for hired labor employed.

A_{lij} = amount of land required by a unit of i-th activity on the j-th farm.

A_{fijt} = amount of family labor required by a unit of i-th activity on the j-th farm in the t-th time period.

A_{qij} = amount of quota required for a unit of tobacco production on the j-th farm.

A_{hij} = amount of institutional constraints on a unit of i-th activity on the j-th farm.

B_{lj} = acres of land available for production by the j-th farm.

B_{fjt} = hours of family labor available on the j-th farm in t-th time period.

B_{qij} = base acres or quota (if any) for the i-th crop activity in the j-th farm.

B_{hij} = institutional constraints (harvest-curing technology, and flexibility constraints) for the i-th activity on the j-th farm. [10]

B_{fj} = hours of off-farm employment permitted for the j-th farm.

B_w = hours of farm labor available in the region.

I_j^* = expected net returns to land, unpaid labor and management by the j-th farm, before the inclusion of lease and transfer provisions of the tobacco program.

The objective function is of the form: [11]

$$(1)\quad \text{Max } \Pi = \sum_{i=1}^{m}\sum_{j=1}^{n} P_{ij} Y_{ij} + \sum_{j=1}^{n}\sum_{t=1}^{s} P_{fj} Y_{fjt} + \sum_{j=1}^{n} P_q Y_{qlj} - \sum_{j=1}^{n} P_q Y_{q2j} - \sum_{j=1}^{n}\sum_{t=1}^{s} P_w Y_{wjt}$$

subject to

$$(2)\quad d\sum_{i=1}^{m} A_{lij} Y_{ij} \le B_{lj}.$$

$$(3)\quad \sum_{i=1}^{m} A_{fijt} Y_{ij} + Y_{fjt} \le B_{fjt}.$$

$$(4)\quad A_{qij} Y_{ij} + Y_{qj} \le B_{qij}.$$

$$(5)\quad A_{hij} Y_{ij} \le B_{hij}.$$

$$(6)\quad \sum_{t=1}^{s} Y_{fjt} \le B_{fj}.$$

$$(7)\quad \sum_{j=1}^{n} Y_{qlj} + \sum_{j=1}^{n} Y_{q2j} = 0.$$

$$(8)\quad \sum_{j=1}^{n}\sum_{t=1}^{s} Y_{wjt} \le B_w.$$

$$(9)\quad \sum_{i=1}^{m} P_{ij} Y_{ij} + \sum_{t=1}^{s} P_{fj} Y_{fjt} - \sum_{t=1}^{s} P_w Y_{wjt} + P_q Y_{qlj} - P_q Y_{q2j} \ge I_j^*.$$

$$(10)\quad Y_{ij}, Y_{qj}, Y_{wjt}, Y_{fjt} \ge 0.$$

Constraints can be interpreted as follows: constraints (2)-(6) require that land, family labor, base acres or tobacco quota, institutional (if any), and off-farm employment limits on the j-th farm not be exceeded; (7) requires that, for all tobacco farms, total tobacco quota leased out equal total tobacco quota leased in; (8) requires that hired-labor limits for the region not be exceeded; (9) permits the j-th farm to lease out tobacco quota only when the combination of income from the lease and income earned by reallocating the tobacco inputs to other alternatives exceed income from producing tobacco; (10) are the usual nonnegativity requirements.

Data

Information for (a) specification of representative farms and associated production activities, and (b) represent farm constraints on land, family labor, off-farm employment, tobacco harvest-curing equipment, base acres and tobacco quota are obtained from a 1984 survey of tobacco quota market participants (Dangerfield). Information on (a) futures and season-average prices, yields and costs of production, and (b) technical coefficients for each production activity are obtained from secondary

[10] Following the methodology adopted by Day, acreage plantings for non-tobacco activities are assumed to be constrained by maximum and minimum restrictions, to allow for a farmer's desire for diversity and reluctance to depart from established production patterns. These flexibility constraints are estimated from land allocation patterns established by all South Carolina farmers from 1976 to 1982 (USDA).

[11] The objective function is the same for all representative farms.

sources (South Carolina Crop and Livestock Reporting Service; Clemson University, Cooperative Extension Service; Jordan).

Model Simulation

The linear programming model is used to analyze a production scenario hypothesized to be a realistic representation of deregulating tobacco production. Prices of all products, except tobacco, are assumed unaffected by deregulation. For tobacco, prices are at best only partly determined by market conditions within the region. Thus, to estimate the impacts of deregulation on tobacco output and prices, estimates of reduction in costs of production and national price elasticities of demand and supply are used.

Sumner and Alston suggest that deregulation of tobacco production would reduce costs of current U.S. tobacco output by 30 percent due to elimination of quota lease rates (annual quota income to the owners), movement of the tobacco industry to the regions where production costs are lowest, and consolidation of marginal production units. If costs are lowered, tobacco output and price changes depend on supply and demand elasticities. Price elasticities of supply and demand used in the literature vary widely (Johnson and Norton; Sumner and Alston; Goodwin *et al.*). An intermediate-run supply elasticity of 1.8 and a long-run supply elasticity of 5 and a share-weighted (domestic and export) demand elasticity of -2 is used in this analysis (Sumner and Alston). Given the reduction in costs of production and the price elasticities of supply and demand, the estimated change in quantity (price) in the intermediate run is about 34 (-17) percent and in the long run is 47 (-23) percent.

Intermediate run is defined as the time period in which the scale of operation cannot be changed, *i.e.*, expansion of tobacco acreage is limited by the existing capacity of harvest-curing technology. The long run is defined as the time period in which all factors of production are variable.

THE MODEL TO EVALUATE IMPACTS ON THE ECONOMY

A 62-sector closed input-output model of the South Carolina economy is used to estimate the impacts of adjustments on tobacco farms on total (direct, indirect, and induced) earned income. [12] Ideally, the linear programming model and the South Carolina input-output model should apply to the current time period. However, this is not feasible because the latest (survey) data available for the linear programming model are for 1984. On the other hand, the latest input-output model is for 1977. During this study, the input-output model could be updated using detailed producer price indices only through 1982. Therefore, the linear programming model solutions (gross value of output of crops and livestock) in 1984 prices are converted to 1982 prices using producer price indices. The underlying assumption is that the 1982 technical coefficient matrix is the best available representation of interindustrial relationships in 1984. The effects of using different base periods for the linear programming model and the input-output model would be relatively unimportant for overall impacts on the economy although potentially some individual sectoral impacts can be badly forecast (Miller and Blair). The qualifier "potentially" is necessary because forecasting errors can be reduced by improving the quality of final demand projections (Miller and Blair). The final demand projections estimated from a linear programming model with 1984 as the base year includes some of the effects of the No-Net-Cost Tobacco Program.

To incorporate the impacts of deregulation on tobacco prices, it is necessary to relax the assumption of constancy in relative prices in basic input-output analysis. The approach followed in this analysis to incorporate exogenous changes in tobacco prices is adopted from an input-output methodology provided by Lee *et al.* [13]

Mathematical Model

The following notation is used in formulating the input-output model:

I = (n x n) identity matrix; n = 62.

A = (n x n) matrix of technical coefficients in 1982 prices.

A' = (n x n) matrix of technical coefficients, adjusted for changes in tobacco prices associated with deregulation.

$A_{62,n}'$ = (n x n) diagonal matrix, with value added coefficients of A' in the principal diagonal.

[12] Following the methodology proposed by DiPietre *et al.*, a regional input-output model for South Carolina is simulated from the national input-output model (U.S. Department of Commerce).

[13] Since prices are determined in national or international markets, the South Carolina prices are assumed as given, *i.e.*, exogenously determined.

$D_{\Delta p}$ = (1 x n) vector of indexed prices, $\left(\frac{P_n^1}{P_n^0} \times P_n\right)$, where P_n^0 is the price of the n-th commodity in 1984, P_n is an index number expressing price of the n-th commodity in 1984 relative to its base (1982) price, and P_n^1 is any other price of the n-th commodity if $P_n^1 \neq P_n^0$ and zero otherwise.[14]

$D_{\Delta f}$ = (n x n) diagonal matrix with changes in final demand down the principal diagonal.

$H_{62,n}$ = (1 x n) vector of value added coefficients of (I - A).

$H_{62,n'}$ = (1 x n) vector of value added coefficients of (I - A').

$T_{2,n}$ = (1 x n) vector of the elements in the tobacco row of (I - A).

$T_{2,n'}$ = (1 x n) vector of the elements in the tobacco row of (I - A').

$E_{\Delta f}^n$ = (n x 1) vector of change in value added in the n-th sector due to changes in the final demand of all sectors.

$E_{\Delta fn}$ = (1 x n) vector of change in value added in the economy due to a change in the final demand of the n-th sector.

s = (n x 1) vector of ones.

1 = (1 x n) vector of ones.

Equations given by Lee *et al.* as adapted for this study to estimate the impacts of deregulation on total value added in the economy of South Carolina can be expressed as follows:

(11) $T_{2,n}' = D_{\Delta p} \times (I - A)$

(12) $H_{62,n}' = H_{62,n} + (T_{2,n} - T_{2,n}')$

(13) $E_{\Delta f}^n = A_{62,n}' \times (I - A')^{-1} \times D_{\Delta f} \times s.$

(14) $E_{\Delta fn} = A_{62,n}' \times (I - A')^{-1} \times D_{\Delta f} \times 1.$

Equations can be interpreted as follows: equation (11) specifies the reduction in costs to sectors that use tobacco as a production input; (12) specifies the increase in the value added coefficient in the sectors that use tobacco as a production input; (13) specifies the change in total value added in the n-th sector due to the changes in final demand associated with deregulation in all sectors; and (14) specifies the change in total value added in the economy due to a change in the final demand of the n-th sector. The column sum of (n x 1) vector $E_{\Delta f}^n$ is equal to the row sum of (1 x n) vector $E_{\Delta fn}$, *i.e.*, net annual change in value added in South Carolina associated with deregulation.

IMPACTS OF DEREGULATION ON TOBACCO FARMS

Benchmark Application

A benchmark application is used to identify and resolve any numerical and/or conceptual errors by comparing programmed solutions with observed 1984 production patterns. It also serves as a vantage point for evaluating the solutions for simulated conditions.

Collectively for all farms in the benchmark model solution, land used for tobacco and wheat production are the same as in the 1984 estimates (Table 2). However, land allocated in the benchmark model for corn is 7 percent higher and in soybeans is 1 percent lower than in the 1984 estimates. Livestock production is higher for the benchmark model. Deviations of benchmark solution values from 1984 estimates are small.

Realized gross and net revenue (gross and net revenue, hereafter) are used to evaluate the financial impacts of deregulation on tobacco farms. Gross revenue is estimated from season-average prices and yields in South Carolina in 1984. Net revenue is defined as gross revenue minus average total resource cost (excluding land and family labor). Gross and net revenue for all tobacco farmers, estimated from activity levels in the benchmark model, are $264 million and $91 million respectively.

Intermediate Run

Approximately 142.2 million pounds of tobacco, 63 thousand acres, are produced at a price of $1.51 per pound. All representative farms, except Farm X_{212} produce more tobacco (Table 3). Given the resource constraints and lower tobacco prices, Farm X_{212} minimizes losses by reducing tobacco production and diverting resources to other enterprises. On all other farms, tobacco production expands at the expense of other products, primarily corn among the crops and feeder-pigs and beef-cows among livestock activities.

Average costs of tobacco production (excluding lease rates) decrease from $1.08 to $1.04 per pound. This is because of consolidation on farms with mechanical harvesters and economies of scale in tobacco production. However, the increase in tobacco output raises total costs of production by $33 million. As gross revenue from tobacco increases

[14] Because deregulation only affects the price of tobacco, P_n^1 is zero for all sectors other than tobacco.

Table 2. Cropping Patterns on Reprentative Tobacco Farms in South Carolina—1984 Benchmark Model Solution and Estimate[a]

Crops/ Livestock	Unit	Representative Farms X111	X112	X211	X212	X222	X312	X332	All Farms (Estimate)
Tobacco	acres	3.6	5.7	15.8	15.3	20.0	55.1	49.0	48,010 (48,010)
Corn	acres	3.6	4.8	43.8	31.9	37.3	53.9	74.7	64,656 (60,575)
Soybeans	acres	6.7	20.4	60.7	103.7	68.1	239.7	215.5	222,028 (224,991)
Wheat	acres	0.0	3.9	0.0	27.4	23.9	71.0	70.6	62,240 (62,231)
Cow-calf	head	5.0	0.0	0.0	7.0	0.0	1.0	5.0	5,762 (4,916)
Beef-cow	head	0.0	1.0	0.0	3.0	0.0	5.0	5.0	5,133 (4,540)
Sows	head	0.0	0.0	1.0	0.0	6.0	1.0	5.0	2,072 (2,673)
Hogs	head	0.0	1.0	17.0	7.0	73.0	7.0	89.0	31,713 (26,110)

[a]The 1984 estimates are presented in parentheses.

Table 3. Cropping Patterns on Representative Tobacco Farms in South Carolina—Intermediate and Long-Run Model Solutions[a]

Crops/ Livestock	Unit	Representative Farms X111	X112	X211	X212	X222	X312	X332	All Farms
Tobacco	acres	8.5 (0.0)	9.8 (0.0)	35.0 (22.8)	9.5 (0.0)	60.0 (60.4)	70.0 (83.0)	60.0 (141.0)	63,471 (67,870)
Corn	acres	2.0 (7.5)	1.8 (10.5)	28.6 (36.2)	37.6 (47.2)	12.3 (12.3)	48.9 (49.5)	70.9 (46.0)	58,220 (66,530)
Soybeans	acres	6.7 (6.8)	19.1 (20.4)	54.1 (58.1)	103.7 (103.7)	60.0 (60.0)	231.4 (216.6)	211.7 (183.2)	215,298 (205,703)
Wheat	acres	0.0 (0.0)	3.9 (3.9)	0.0 (0.0)	27.4 (27.4)	19.8 (19.8)	71.0 (71.0)	70.6 (58.6)	61,691 (59,973)
Cow-calf	head	3.0 (5.0)	0.0 (0.0)	0.0 (0.0)	7.0 (7.0)	0.0 (0.0)	1.0 (1.0)	3.0 (3.0)	5,152 (5,476)
Beef-cow	head	0.0 (0.0)	1.0 (1.0)	0.0 (0.0)	3.0 (3.0)	0.0 (0.0)	3.0 (5.0)	5.0 (3.0)	4,233 (4,847)
Sows	head	0.0 (0.0)	0.0 (0.0)	1.0 (1.0)	0.0 (0.0)	3.0 (3.0)	1.0 (1.0)	5.0 (5.0)	1,667 (1,667)
Hogs	head	0.0 (0.0)	1.0 (1.0)	17.0 (17.0)	7.0 (7.0)	55.0 (41.0)	7.0 (7.0)	89.0 (50.0)	29,283 (21,816)

[a]The long-run model solutions are presented in parentheses.

only by $22 million (due to the reduction in price and elimination of quota lease income), net revenue decreases by $11 million [15] (Table 4). The change n net revenue from tobacco, coupled with the decrease in net revenue from other enterprises, reduces total net revenue by $13 million.

At a disaggregated level, deregulation reduces (increases) total net (gross) revenue for all farms, ex-

[15] If the $48 million loss in quota lease income is excluded, net revenue increases by $37 million.

Table 4. Financial Impacts on Representative Farms—Gross and Net Revenue for Benchmark, Intermediate, and Long-Run Models in 1984 Prices

Farm	Revenue	Bench-mark[a]	Inter mediate-run[b]	Long-run[c]
X_{111}	Gross	19,400	29,854	8,234
	Net	7,776	7,334	4,786
X_{112}	Gross	30,183	38,223	10,759
	Net	12,146	11,190	5,295
X_{211}	Gross	82,726	127,383	86,691
	Net	23,268	19,038	10,749
X_{212}	Gross	91,526	65,297	37,662
	Net	26,612	14,619	8,569
X_{222}	Gross	112,783	237,450	220,364
	Net	41,216	95,091	78,687
X_{312}	Gross	290,450	300,456	321,665
	Net	100,090	75,114	62,849
X_{322}	Gross	285,367	288,036	518,947
	Net	113,551	102,758	161,140

[a]Gross and net revenue in the benchmark model solution for all tobacco farms in South Carolina is $263.9 million and $91.4 million, respectively.
[b]Gross and net revenue in the intermediate run for all tobacco farms in South Carolina is $281.8 million and $78.4 million, respectively.
[c]Gross and net revenue in the long run for all tobacco farms in South Carolina is $284.7 million and $71.3 million, respectively.

cept Farm X_{222} (Farm X_{212}). Farm X_{222}, with excess capacity of mechanical harvesters, is able to expand tobacco acreage and achieve economies of scale.

Long Run

Approximately 156.2 million pounds of tobacco are marketed at a price of $1.39 per pound. Farms X_{111}, X_{112}, and X_{212}, do not produce tobacco, and resources freed are used primarily for corn production. However, tobacco production is increased on the other representative farms.

Although average costs of tobacco production decrease to $1.00 per pound, the increase in total cost is larger than the increase in gross revenue. Therefore, net revenue from tobacco decreases by $17 million. New revenue from other enterprises decreases by $3.1 million. Total net revenue decreases for all farms, except Farm X_{322}. Farm X_{322} has sufficient resources, including technology, to expand tobacco production by a large magnitude.

ECONOMIC BENEFITS AND DISTRIBUTIONAL CONSEQUENCES OF DEREGULATION

Deregulation of tobacco production stimulates the economy of South Carolina, which results in increases in total earned income. Total increase in value added in the economy, due only to the increase in final demand for tobacco, is $4.9 million in the intermediate run and $5.9 million in the long run. However, as additional resources required to produce larger quantities of tobacco are obtained at the expense of other products, the siphoning of these resources represents a cost that must be subtracted from total value added. Net increase in value added in the economy due to the change in the final demand for all products produced on tobacco farms is $4.1 million in the intermediate run and $5.8 million in the long run. These are the benefits of deregulation and are equal to the sum of the area behind the general equilibrium demand curve (in a Leontief sense), and between the two supply curves for all sectors in the economy.

Gainers and losers in deregulation are determined by examining the changes in total valued added on an industry-by-industry basis (Table 5). If tobacco production is deregulated, increases in total value added accruing to farm product sectors will equal $1.4 million in the intermediate run and $1.6 million in the long run. However, gains in these sectors are smaller than gains in the non-farm sectors. Although total value added increases in all non-farm sectors, the biggest gainers are concentrated in the industries that supply inputs, directly or indirectly, to agriculture, i.e., construction, chemical products, rubber products, metal products, machinery, motor freight, wholesale and retail trade, communications, and finance and insurance.

IMPLICATIONS OF RECENT CHANGES IN THE TOBACCO PROGRAM

The Tobacco Improvement Act of 1984 (P.L. 72, Subtitle B, 100-th Congress, April 1986) is in effect a major adjustment toward market equilibrium, with continued gradual deregulation. Quantity and prices would have approached market equilibrium more rapidly if the Secretary of Agriculture had used the low discretionary factor in setting the support price (65 percent of the amount estimated under the current formula) and the high discretionary factor in setting the quota (103 percent of the components that determine national quota). The Secretary used the low discretionary factor in setting the support price for flue-cured tobacco. The 1989 average price paid for South Carolina flue-cured tobacco was $1.43

Table 5. Total Earned Income Gains and Losses by Industry—1982 Prices

Industry	Total Earned Income Gains (Losses)[a]	
	Intermediate-run	Long-run
	----------Dollars----------	
FARM PRODUCT SETORS		
Livestock	(40,151)	(51,992)
Tobacco	1,550,757	1,773,094
Vegetables	2,081	2,973
Forest Products	1,974	3,792
Oil bearing crops	(55,599)	(135,662)
Other agriculture[b]	(78,276)	(21,142)
MAJOR NON-FARM GAINERS[c]		
Construction	154,226	200,066
Chemical products	176,016	236,115
Rubber products	81,270	109,552
Metal products	52,523	123,660
Machinery	62,490	377,385
Electrical machinery	66,043	111,075
Motor freight	74,703	107,789
Communications	79,089	109,697
Wholesale trade	347,938	493,789
Retail trade	337,749	528,488
Finance and insurance,	258,617	345,028
Business services	279,618	389,013
Eating and drinking	102,374	145,250
All other non-farm	668,131	943,948
TOTAL FOR ALL SECTORS	4,121,573	5,791,918

[a]Total earned income losses in parentheses.
[b]Other agriculture includes: cotton, food and feed grains, grass seed, fruits, tree nuts, sugar crops, greenhouse products, etc.
[c]Industries with more than $100,000 increase in total earned income in the long run.

(1984 dollars) per pound, below the model's estimate for the intermediate run. In 1989, South Carolina produced on 48,000 acres, equal to the acreage produced in the 1984 benchmark model. However, this is not a true indication of the effect of partial deregulation or the Tobacco Improvement Act, since the program changes were made in 1986. Tobacco acreage in South Carolina decreased to 37,000 acres in 1986 under the previous program. The increase in acreage from 1986 to 1989 was about 30 percent and is comparable to the model's intermediate-run estimate of 34 percent.

With the changes that have already taken place, deregulation would now have less impact on the allocation of resources and value added in South Carolina than the estimates presented for 1984 conditions. The 1989 tobacco farms will have greater acreage of tobacco and less of other products. Many small farms that produced tobacco in 1984 have ceased production; therefore, these farms in a 1989 benchmark model would have greater acreage of other products especially corn.

This study estimated the impacts of eliminating a highly regulatory program as compared to gradual deregulation adopted in 1986. Given the recent changes, it would have been more relevant to use 1986 or a more recent time period as the base year. Although a follow up study with more current farm survey information and input-output coefficients would be useful, it would be difficult to implement. This is because input-output tables (and farm survey data) available to researchers often reflect data from a much earlier year. The 1977 input-output table was available to researchers only in 1984 and a 1982 table is due for release in 1990.

CONCLUSIONS

An analytical framework for estimating benefits of deregulating tobacco production is developed. Impacts of deregulation on farm income and cropping patterns are estimated using a polystructural linear programming model. Increase in value added is used as a measure of annual economic surplus accruing to South Carolina from deregulating tobacco production. An input-output methodology developed by Lee *et al.*, is adopted to estimate the impacts of changes in tobacco prices and agricultural output on tobacco farms on total value added in South Carolina.

Impacts of deregulation on individual farms are not equal. Producers with mechanical harvesters expand tobacco production to achieve economies of scale and thereby increase their income. Due to economies of scale, the average costs of tobacco production decrease from $1.08 in the benchmark solution to $1.04 in the intermediate run and $1.00 in the long run. Small producers with non-mechanical harvesters, unable to compete in an unregulated market, cease tobacco production. Loss in income to small producers is greater than the gain in income to large producers.

Interpretation of the usual surplus triangles changes with market level. Impacts on total value added due only to changes in tobacco output are larger than the net impacts. This is because increases in tobacco output are at the expense of other products produced on tobacco farms in South Carolina. However, net

impacts of deregulation on total value added in South Carolina are positive. Total value added increases by $4.1 million in the intermediate run and $5.8 million in the long run following deregulation. As deregulation increases total value added, it is reasonable to question whether the current tobacco program is the proper vehicle to transfer income to some segments of the community. However, the primary benefit of the program is the transfer of income to small and medium size farms with non-mechanical harvesters. Impacts of deregulation on the financial viability of tobacco farms are not analyzed in this study.

Impacts of the tobacco program on non-farm sectors of the economy are large, even though these impacts are often unintentional. If tobacco production is deregulated, the increase in total value added for non-farm sectors is larger than the increase in the total value added for farm product sectors.

Linear programming and input-output techniques are limited by their restrictive assumptions (e.g. constancy in relative prices, fixed technical coefficients, etc.). However, some of the assumptions can be relaxed to represent other scenarios, as developed in this paper. With these modifications, the analytical framework developed overcomes some of the limitations of previous approaches.

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