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Optimum Tariffs in a Distorted Economy: An Application to U.S. Agriculture

By

John C. Beghin
and
Larry S. Karp*

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*John C. Beghin is a research assistant and Larry S. Karp an assistant professor in the Department of Agricultural and Resource Economics at the University of California, Berkeley. Correspondence shoule be addressed to Larry S. Karp at this address:

Department of Agricultural and Resource Economics
University of California-Berkeley
Berkeley, CA 94708

DIVISION OF AGRICULTURE AND NATURAL RESOURCES
UNIVERSITY OF CALIFORNIA

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Optimal distortions for the agricultural sector are calculated taking as given distortions in the nonagricultural sector. The calculations use a general equilibrium model and assume that the sole criterion is economic efficiency. For most agricultural commodities, existing distortions should be decreased; for the cotton and oil bearing sector, however, the existing tariff should be increased.

Key words:

John C. Beghin is a research assistant and Larry S. Karp is an assistant professor of agricultural and resource economics, University of California, Berkeley.

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John C. Beghin and Larry S. Karp

Department of Agricultural and Resource Economics
University of California, Berkeley, California 94720

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Introduction

Empirical evidence is used to determine whether distortions in the nonagricultural sector of the U. S. economy justify, on efficiency criteria, the current level of distortions in the agricultural sector.

Estimates of optimal distortions for the U. S. agricultural sector are provided under the assumption that distortions in other sectors of the economy are fixed. This is a standard problem of choosing second-best policies (the first best being to remove all distortions). It is well known that, given distortions in one sector, it is generally not optimal to simply remove the distortions in the sector over which the policymaker has discretion.

In a simple two-good model, the distortion in one sector can be chosen to exactly offset the fixed distortion so that the economy faces world relative prices. This makes it tempting to compare aggregate distortions in the U. S. manufacturing and agricultural sectors and to argue that, if the former is fixed, economic efficiency would be improved by setting the aggregate agricultural distortions at the same level (see Schuh; also Chambers' comments). This would maintain the domestic relative aggregate price of agricultural to industrial goods at the same level as the world relative aggregate price. This proposal ignores the general equilibrium linkages within and between sectors and can be expected to yield poor results.

A general equilibrium model which disaggregates the agricultural and manufacturing sectors is used to calculate optimal distortions within the former taking as given the distortions within the latter.

The producer distortions, hereafter referred to as tariffs, are defined as the difference between the producer price and the shadow price of a commodity in ad valorem form. Although it is clearly preferable for policymakers to consider altering both agricultural and nonagricultural tariffs simultaneously, this seldom occurs in practice. A notable example was the 1985 Farm Bill. The debate surrounding this Bill concerned how to modify agricultural policy rather than how to modify nonagricultural policy so as to affect the agricultural sector. There are many reasons why actual policy choices may not approximate optimal (i.e., economically efficient) decisions, but it is worth understanding the extent and direction of the discrepancy. This understanding may provide surprising evidence for or against certain policies.

The forthcoming General Agreement on Tariffs and Trade (GATT) discussions illustrate another potential use of the calculations performed here. The United States is especially interested in reducing international distortions in agricultural trade. It is, therefore, important to estimate the effects of particular compromises and to measure how changes in one sector make other compromises more or less palatable. For example, the empirical results indicate that a reduction in the protection of the textile sector has a dramatic effect on the optimal distortion for raw cotton.

The use of computable general equilibrium (CGE) models (See Dervis et al., Ballard et al., and Whalley) provides the most sophisticated method of determining these effects. An alternative developed by Dixit and Newbery is used in this paper. The advantages of this method are its simplicity and more modest demand on data. These features make it possible to develop the empirical model quickly and to perform sensitivity analysis that is relatively transparent. The method lacks the detail of more general CGE models, and there is no suggestion that it provides a substitute for these models.

Dixit and Newbery, Dixit and Norman, and Dixit show that the optimum tariff on the sector in which the policymaker intervenes is a weighted average of the existing tariffs in the other sectors of the economy. Dixit and Newbery use this methodology to find the optimum tariff on imported oil for the Turkish economy. In our study, agriculture is disaggregated into seven sectors, and the model is extended to determine the optimum vector of tariffs.

We used 1982 as a reference year because most of the input-output and final demand data were available for that year. The existing market distortions have been estimated for the same year. The results suggest that lower tariffs should be applied to the dairy, cattle, hog, sugar, tobacco, and fruits and vegetables sectors. More protection (a higher tariff) should be given to oil-bearing crops and cotton. Optimum tariffs for the food and feed grains sectors are close to zero, exposing these two sectors to international competition.

The next section describes the Dixit-Newbery-Norman model. The following section is devoted to the data and the estimation of the existing distortions. The empirical findings are then presented and the sensitivity analysis is discussed. A conclusion follows.

Further details are provided in three appendices which are available upon request. The first appendix contains a more detailed discussion of the Dixit-Newbery methodology, the second appendix describes the computation of prevailing distortions more completely, and the third appendix gives the output of the sensitivity analysis.

The Model

A Ricardo-Viner-Leontief model and duality theory constitute the core of the methodology. The production functions exhibit constant returns to scale, with labor being the only mobile factor, and capital sector specific. The direction of bias induced by the Ricardo-Viner assumption in unclear. Capital includes land which, in some cases, is clearly not sector specific; on the other hand, labor mobility is not perfect. The model is defended as an approximation which makes the empirical analysis tractable.

We initially take world prices to be exogenous but later relax this assumption. There is no formal consideration of retaliation by U. S. trading partners to changes in U. S. policy. However, a range of rest-of-the-world elasticities of excess demand for U. S. products provides an ad hoc way to incorporate different conjectured changes in the rest-of-the-world policies.

Demand is represented by a single consumer having a Cobb-Douglas utility function, u, with an associated expenditure function, e. This assumption of a single consumer is not restrictive since we are concerned with efficiency and not distributional questions. Any change in government revenues can be redistributed in a nondistortionary way through lump-sum transfers. Production is characterized by a revenue function, r. There are m traded goods and 1 nontraded ones. Domestically produced and foreign-traded goods are assumed perfect substitutes (this is in contrast to CGE models, which use an Armington structure).

The accounting identity for this economy is given by

$$e(p + t + c, q + b, u) = r(p + t, q) + (t + c) \cdot e_p + b \cdot e_q - t \cdot r_p - p \cdot g - q \cdot g^n \quad (1)$$

where p is the vector of world prices; t is the vector of tariffs; q is the vector of producer prices for the nontraded goods; c and b are the vectors of consumer taxes applied on traded and nontraded goods, respectively; e_p and e_q are the gradients of the expenditure function with respect to p and q; r_p is the gradient of the revenue function with respect to p; and g and g^n are the vectors of government consumption of traded and nontraded goods. The vector of excess supply of nontraded goods, z, must be equal to zero at equilibrium or

$$z = r_q - e_q - g^n = 0 \tag{2}$$

where r_q is the gradient of the revenue function with respect to q. Differentiating totally (1) and (2), holding b, g, g^n constant, and eliminating dq yields

$$\begin{aligned} B \cdot du = {} & [(t + c) \cdot E_{pp} + (b + h) \cdot E_{qp} - t \cdot R_{pp} - h \cdot R_{qp}] \cdot dt' \\ & + [(t + c) \cdot E_{pp} + (b + h) \cdot E_{qp}] \cdot dc' \end{aligned} \tag{3}$$

where B is a positive scalar; h is the vector of the differences between the producer price and shadow price for nontraded goods; E_{pp} is the Hessian submatrix of the expenditure function corresponding to the traded goods ($d^2e/dpdp'$); and E_{qp} is the Hessian submatrix for the cross derivatives of e with respect to q and p. Similarly, R_{pp} and R_{qp} are the Hessian submatrices of the revenue function ($d^2r/dpdp'$ and $d^2r/dqdp'$). The vector h is

$$h = [(t + c) \cdot E_{pq} + b \cdot E_{qq} - t \cdot R_{pq}] \cdot Z_q^{-1} \tag{4}$$

where Z_q is the matrix dz/dq.

Assume the policymaker can change taxes and tariffs in the first n traded sectors, holding taxes and tariffs constant in the other sectors, and define t* and c* as the vectors of optimum tariffs and taxes (i.e., t = [t*: t(-n)] and c = [c*: c(-n)] where t(-n) and c(-n) give the last m - n elements of t and c, respectively). The optimum t* and c* are given by:

$$(5) \qquad B \cdot du/dt^* = 0 = (t + c) \cdot E_{pn} + (b + h) \cdot E_{qn} - t \cdot R_{pn} - h \cdot R_{qn}$$

and

$$(6) \qquad B \cdot du/dc^* = 0 = (t + c) \cdot E_{pn} + (b + h) \cdot E_{qn}$$

where E_{pn} is $(d^2d/dp_i\ dp_j)$ and R_{pn} is $(d^2r/dp_i\ dp_j)$, for i = 1, ..., m and j = 1, ..., n; E_{qn} is $(d^2e/dq_k\ dp_j)$ and R_{qn} is $(d^2r/dq_k\ dp_j)$, for k = 1, ..., 1 and j = 1, ..., n. Subtract (6) from (5) to obtain the vector of optimum tariffs, t*:

$$(7) \qquad t^* = -[t(-n) \cdot R_{mn} + h \cdot R_{qn}] \cdot R_{nn}^{-1}$$

where R_{mn} is $(d^2r/dp_w\ dp_j)$ for w = n + 1, ..., m, and j = 1, ..., n; and R_{nn} is the square matrix $(d^2r/dp_i\ dp_j)$ for i and j = 1, ..., n. Equation (7) expresses the optimum tariffs as a weighted average of the existing distortions, t(-m) and h, in the remaining sectors.

Substituting (7) into (6) yields:

$$(8) \qquad c^* = -t^* - \{[c(-n) + t(-n)] \cdot E_{mn} + (b + h) \cdot E_{qn}\} \cdot E_{nn}^{-1}$$

where E_{mn} and E_{nn} are the counterparts of R_{mn} and R_{nn} for the expenditure function. According to (8), the optimum consumer tax should be the negative of the optimum tariff minus a correction term accounting for the distortions in the other sectors. In the case of the Cobb-Douglas utility function, it can be shown that the correction term is just a weighted average of the sums of the tariff and consumer tax applied to each of the remaining sectors, weighted by the expenditure shares.

The values of t* and c* can be computed by solving the system of equations (4), (7), and (8). Even given the assumption of the model, these values are only approximations to the optimal levels. The reason is that equations (4), (7), and (8) involve the Hessian of the revenue function, which is evaluated at a point using current data (Dixit and Newbery). This Hessian gives own- and cross-price effects on supply. In calculating the optimal distortions, the Hessian is taken as constant; however, the underlying model implies that the Hessian varies with price. This suggests the following iterative approach: Calculate the optimal distortions as above and then recompute the Hessian evaluated at the new prices; recalculate the optimum distortions using the updated Hessian and proceed to convergence. This method is not practical since calculation of the Hessian at the new set of prices requires additional assumptions which specify how the shadow value of labor and labor demand change as price changes.

As is typically the case with general equilibrium models, costs of adjustment are ignored (see Baldwin et al. for an exception). These costs may be significant--in which case the computed optimum should be regarded as a long-run target and not as a recommendation for an immediate and radical change.

Before proceeding with the data and the results, we repeat several features of the model:

1. Capital is fixed and labor is mobile.
2. Domestic and foreign tradables are perfect substitutes.

3. Strategic considerations (e.g., possible retaliations) are obscured.
4. The computation of optimal distortions involves an approximation.
5. There is no cost of adjustment or other source of dynamics.

It is worth keeping in mind these five features in evaluating the results.

The Data

The estimation of the Hessian of the revenue function requires the knowledge of input-output and value-added data. We used the 41 sectors data set of Adelman and Robinson, aggregated to 38 sectors. The data set gives the input-output table and value-added matrix for the year 1982. We took some value-added data from the U. S. Department of Commerce because some sectors showed a negative capital income for 1982. The share of labor income in the value added of sectors 11 and 28 was estimated using the data of this latter source.

Elasticities of substitution between labor and capital are also needed for the estimation. The estimated elasticities come from Whalley. The Hessian of the expenditure function is calculated using expenditure shares and total expenditure. We used the 1982 final demand data of Adelman and Robinson. Total expenditure is the sum of private consumption and investment. The shares are the ratio of the expenditure for each sector divided by total expenditure.

The vector of consumption taxes is estimated by the vector of "total indirect business taxes" paid by each sector which appears in the value-added data of Adelman and Robinson. These taxes are divided by the value of total output of each sector to obtain an ad valorem equivalent. These tax rates underestimate the true consumption tax rates because they do not include sales taxes. The effect of this underestimation is investigated in the sensitivity analysis.

The tariffs for the agricultural sectors are computed using weighted averages of nominal protection ratios[1] adjusted for transportation cost. The price data come from the U. S. Department of Agriculture (1983, 1985), the World Bank, the Commodity Research Bureau, the U. N. Conference on Trade and Development, Duncan, and Finger and Yeats. The tariffs for the manufacturing sectors are based on Morici and Megna. They estimated ad valorem equivalents of the different producer subsidies in manufacturing for the year 1976. Custom duties for 1982 are also available from the U. S. International Trade Commission. The duties and subsidies, in ad valorem form, are aggregated to approximate the tariffs for the manufacturing sectors.

The difference between producer price and shadow prices are calculated following the Dixit-Norman methodology [see equation (A5) in Dixit and Newbery]. Total output, expenditure shares, shares of labor income in value added, ratios of value added to output, and the sector nomenclature are contained in table 1. The estimated elasticities of substitution, existing tariffs, and existing consumer tax rates are presented in table 2.

The Results

The computed optimum tariffs and consumer taxes for the seven agricultural sectors are shown in table 3. The results suggest that the price support to the "dairy, poultry, and eggs" sector should be decreased from the existing level of 26.02 percent to the optimum tariff of 2.98 percent. Similarly, the tariff on the "meat and livestock" sector should be lowered to 2.77 percent.

TABLE 1 BASIC DATA

		gross output	expendi. share	v.a. per $	labor income in v.a.	labor share of total labor
1	dairy,poultry&eggs	29247.14	0.00199	0.17683	0.33382	0.00094
2	meat&livestock	48071.17	0.00049	0.09409	0.65239	0.00160
3	food grains	10725.30	0.00001	0.33979	0.14841	0.00029
4	feed grains,grass seeds	37934.42	0.00029	0.33097	0.10167	0.00069
5	cotton,oil bearing crops	23295.30	0.00004	0.53715	0.11439	0.00078
6	fruits,veg.,tree nuts	15401.40	0.00357	0.58117	0.29139	0.00142
7	tobacco,sugar,other ag	31389.47	0.00168	0.52759	0.49770	0.00447
8	metal,coal non-met. mining	42860.93	0.00018	0.45652	0.70814	0.00751
9	crude pet.,gas	153350.7	0.00158	0.51121	0.13351	0.00589
10	construction *	399767.0	0.03959	0.38003	0.88270	0.07272
11	munitions	17606.60	0.00046	0.13312	0.73071	0.00093
12	food,bev.tobac.prod.	294192.1	0.06943	0.22231	0.59181	0.02099
13	textiles	44038.21	0.00222	0.25423	0.80076	0.00437
14	apparel	64053.93	0.02070	0.34729	0.79601	0.00960
15	wood,wood pro.	66153.05	0.00793	0.33769	0.78129	0.00946
16	paper,paper pro.,publish.	165340.5	0.00995	0.35912	0.75337	0.02426
17	chemical,chemical pro.	161797.7	0.01129	0.32520	0.62568	0.01735
18	petroleum,pet. prod.	211515.2	0.02279	0.07543	0.54611	0.00472
19	leather,leath. pro.	9762.48	0.00503	0.46575	0.65970	0.00163
20	non-metallic mineral pro.	43982.28	0.00103	0.37615	0.82765	0.00742
21	iron,steel	60803.30	0.00001	0.35153	0.93079	0.01079
22	non-ferrous metals	47642.67	0.00009	0.25359	0.83712	0.00548
23	metal products	106953.4	0.00307	0.39504	0.73301	0.01579
24	farm equip.,motor veh.	125214.4	0.03747	0.25135	0.85591	0.01461
25	machinery	113043.7	0.01422	0.39526	0.73933	0.01912
26	computing,radio TV com. equip	126346.3	0.02177	0.48548	0.87480	0.02910
27	electrical machinery	79856.78	0.01137	0.36477	0.74558	0.01178
28	aircraft,other transportat.	80673.37	0.00834	0.26905	0.77004	0.00906
29	Transportation,communicat. *	309705.6	0.03416	0.54218	0.66168	0.06025
30	electricity,gas,water *	206807.2	0.02504	0.32859	0.32219	0.01187
31	wlsale,retail trade	572881.6	0.15674	0.55836	0.78317	0.13596
32	banking,insurance *	254762.9	0.04702	0.48977	0.80236	0.05428
33	real estate *	464381.7	0.14467	0.64911	0.03862	0.00631
34	hotel,personal serv.,eating *	353153.3	0.09082	0.42822	0.68153	0.05539
35	business services	277962.9	0.01152	0.69838	0.59732	0.06287
36	Health, educ.,soc. services *	336437.8	0.11076	0.55637	0.84135	0.08540
37	fed.,state,local enterprises *	383392.4	0.01110	0.90462	0.99799	0.18763
38	other industry	122023.7	0.02156	0.41434	0.90179	0.02472

* nontraded sectors
The units for gross output are such that the 1982 prices are equal to $1 per unit.

TABLE 2 EXISTING DISTORTIONS AND ELASTICITIES

		elasticity of sub.	existing tariff	exist. cons. tax
1	dairy,poultry&eggs	0.60	26.02	1.41
2	meat&livestock	0.60	35.36	2.04
3	food grains	0.60	0.73	1.94
4	feed grains,grass seeds	0.60	4.14	1.95
5	cotton,oil bearing crops	0.60	10.72	1.49
6	fruits,veg.,tree nuts	0.60	23.93	1.42
7	tobacco,sugar,other ag	0.60	54.04	2.55
8	metal,coal non-met. mining	0.30	-17.27	4.88
9	crude pet.,gas	0.30	-25.12	12.30
10	construction *	0.90	4.54	1.06
11	munitions	0.90	6.03	1.11
12	food,bev.tobac.prod.	0.80	5.57	3.56
13	textiles	0.90	13.82	.97
14	apparel	0.90	32.60	.44
15	wood,wood pro.	0.80	2.54	1.01
16	paper,paper pro.,publish.	0.90	2.33	1.27
17	chemical,chemical pro.	0.30	6.47	1.52
18	petroleum,pet. prod.	0.80	0.45	2.65
19	leather,leath. pro.	0.90	9.77	.49
20	non-metallic mineral pro.	0.90	9.13	2.00
21	iron,steel	0.90	5.82	2.07
22	non-ferrous metals	0.90	1.20	1.71
23	metal products	0.90	5.12	1.03
24	farm equip.,motor veh.	0.80	3.46	1.90
25	machinery	0.60	5.88	1.10
26	computing,radio TV com. equip	0.90	5.46	1.03
27	electrical machinery	0.75	5.09	.69
28	aircraft,other transportat.	1.00	3.69	.72
29	Transportation,communicat. *	1.00	6.83	4.26
30	electricity,gas,water *	1.00	2.99	4.00
31	wlsale,retail trade	1.00	0.0	15.73
32	banking,insurance *	1.00	4.72	3.50
33	real estate *	1.00	-10.32	19.06
34	hotel,personal serv.,eating *	1.00	4.38	3.69
35	business services	1.00	0.0	.77
36	Health, educ.,soc. services *	1.00	4.66	.24
37	fed.,state,local enterprises *	1.00	5.57	.00
38	other industry	1.00	6.80	1.52

* The tariffs for the non-traded sectors are computed at the optimum tariffs and consumption taxes of Table 3

TABLE 3 OPTIMUM TARIFFS AND CONSUMPTION TAXES

sector	optimum tariff	optimum cons. tax
1 dairy,poultry	2.985	5.352
2 meat livestock	2.777	6.060
3 food grains	1.326	7.511
4 feed grains	0.575	3.262
5 cotton,oil bearing crops	49.009	-40.173
6 fruits,veg.	3.311	5.026
7 tobacco,sugar,other.	3.333	5.504

The optimum producer price level of the food and feed grains sector is close to the prevailing level in 1982. The protection of the fifth sector (cotton and oil-bearing crops) should be increased significantly to 49 percent. The opposite conclusions are reached for the last two sectors. For the "fruits and vegetables" sector, the tariff should be reduced to 3.81 percent; the price support to the "tobacco, sugar, and other agriculture" sectors should be lowered to 3.33 percent.

The aggregation scheme in the Adelman and Robinson data does not allow us to determine the optimum protection on a commodity base. There is not any obvious rule to translate the optimum tariff of a subsector into a set of optimum tariffs for each commodity within that subsector. The only rigorous way to proceed would be to use a disaggregated data set commodity by commodity.

Our findings are quite robust to sensitivity analysis. This analysis is centered on (1) the elasticities of substitution, (2) the existing consumer tax rates, (3) the small-country assumption, (4) the share of labor income in value added, and (5) the ratio of value added to output.

For the elasticities of substitution, we consider five scenarios: First, a Cobb-Douglas world is assumed with all elasticities set equal to one; then two extreme cases are examined with all the elasticities of substitution equal to .05 and 5, respectively. We also consider two cases where we take the original vector of elasticities of substitution and change the value of the last 11 sectors. Whalley set these values to 1 because of lack of estimates (see table 2). First, we set the last 11 elasticities to .05 and then we increase them to 5. All the tendencies described above hold through the five simulations. The magnitudes of the optimum tariffs do not vary substantially except for the fifth sector (cotton and oil-bearing crops) for which the optimal tariff drops from 49 percent to 34 percent in the case of the very low elasticities of substitution (.05). The complete results are presented in appendices 3.3, 3.6, 3.9, 3.12, and 3.13 which, along with the other appendixes mentioned below, are available upon request.

The second part of the sensitivity analysis concerns the underestimation of the consumer tax rates. The estimates do not include sales taxes and are biased downward. The tax rates of table 2 are scaled up by 20 and 50 percent to determine the impact of their probable underestimation. The optimum consumption taxes are increased by approximately 1 cent per dollar (20 percent case) and 3 cents per dollar (50 percent case). The optimum tariffs are almost invariant to the changes in the consumer tax rates. We report the results in appendicies 3.1, 3.2, 3.4, 3.5, 3.7, 3.8, 3.10, and 3.11.

The small-country assumption is relaxed for three of the agricultural sectors (food, feed grains, and cotton and oil-bearing crops). We use Dixit, modified to take into account the nontraded sectors, to endogenize prices for these commodities. Several cases are considered. For each scenario, cross-price elasticities are set to zero and all commodities have the same own-price elasticity. First, it is assumed that the elasticities of export demand for the three sectors are very high (-100 for the three sectors), then their values are progressively decreased (-50, -5, -2, and -1). The results do not change substantially for the cases of high elasticities (-100) since the small-country assumption is virtually unchanged for these values. The optimum tariffs are different when we assume that the export demand elasticities are lower (-5, -2, -1). Tariffs decrease significantly and become negative as the world demands for the three sectors become less elastic; that is, it becomes optimal to exercise market power by means of an export tax. In the extreme case of unit elasticity of world demand, the tariffs on food and feed grains and cotton and oil-bearing crops are -98 percent, -99 percent, and -51 percent. The detailed results are in appendicies 3.16 to 3.20.

In a partial equilibrium framework, the optimum export tax is the inverse of the elasticity of export demand for the commodity considered. This result holds in a general equilibrium approach when all existing distortions are assumed equal to zero and when only own-price elasticities of export demand are considered (see appendix 3.22). The U. S. Department of Agriculture (1986) surveys the existing estimates of world demand elasticities for U. S. agricultural exports. According to that study, there is no consensus on the real magnitude of the elasticities. Johnson reports values up to 10.18 for feed grains, 6.72 for wheat, and 5.5 for cotton. However, Bredahl _et al_. compute lower elasticities. We can conclude that the optimum tariffs presented in table 3 are an upper bound for the "true" optimum tariffs for sectors 3, 4, and 5 (unless cross-price effects dominate). Other simulations are performed combining variations in elasticities of export demand and of substitution. These combinations do not bring significant changes (the results are reported in appendices 3.14 and 3.15).

The persistence of a high optimal tariff for the cotton and oil-bearing crops suggests that the high degree of protection of the textile industry determines the optimum tariff on raw cotton via the input-output coefficients. Similarly, the existing tariff on food and beverage affects the optimal tariff on oil-bearing crops suggests e tariff on textile (sector 13) is decreased by 50 percent, the optimal tariff on cotton and oil-bearing crops drops to 17 percent; conversely, when it is increased by 50 percent, the optimum tariff on cotton rises to 80 percent. This conclusion carries through when the world prices of sectors 3, 4, and 5 are endogenous (see appendices 3.29 to 3.34 for detailed results). We perform the same analysis for sector 12 (food and beverage). When the existing tariff on sector 12 is decreased by 50 percent, the optimum tariff on cotton and oil-bearing crops falls to 41 percent; the optimum tariff on feed grains falls to -11 percent (an export tax). That is, a fall in the effective rate of protection of sector 12 caused by a decrease in the tariff on that sector should be partly offset by a decrease in the price of inputs. The tariffs on each of the other agricultural sectors are also decreased but to a lesser extent (appendices 3.23 to 3.28 contain the detailed results). Small changes in the share of labor income in value added do not cause significant changes in the results (see appendix 3.21). This simulation examines the impact of an increase of the share of the mobile factor of production.

An attempt was made to determine the effect on production and trade of changing the current distortions. The Hessian of the revenue function, used to calculate the optimal distortions, was used to construct own- and cross-price elasticities of supply at 1982 prices. These elasticities were used to generate constant elasticity supply curves. The revenue function implied by the model does not lead to constant elasticity supply curves, so the estimates we report are only suggestive. Construction of the actual supply curves implied by the model requires the ability to calculate the Hessian of the revenue function at points other than at the observed prices. As discussed in a previous section, we are unable to do this.

The predicted levels of output, consumption, and net exports--using the constant elasticity of supply curves and the tariffs and taxes given in table 3--are presented in the first three columns of table 4. The fourth column gives the existing (1982) level of net exports. The predictions

TABLE 4 PREDICTED GROSS OUTPUT CONSUMPTION AND NET EXPORT UNDER NEW TARIFFS

		predict. output	predict. consump.	predict. net export	existing net export
1	dairy,poultry&eggs	21962.53	5883.382	-13834.46	5.755
2	meat&livestock	5092.57	1545.214	-40397.89	-471.406
3	food grains	10808.94	19.637	4603.891	5420.757
4	feed grains,grass seeds	37831.63	721.039	17043.66	5771.896
5	cotton,oil bearing crops	24262.09	120.760	4520.979	6142.924
6	fruits,veg.,tree nuts	14432.06	10399.01	-4563.377	-734.723
7	tobacco,sugar,other ag	20577.87	6087.960	-16745.28	-2082.531
8	metal,coal non-met. mining	42890.87	433.858	3413.338	3621.865
9	crude pet.,gas	153338.7	3534.936	-48978.60	-50117.23
10	construction *	399328.3	227764.0	0.016	0.0
11	munitions	17699.39	1160.430	3428.766	3788.338
12	food,bev.tobac.prod.	379831.0	171929.2	70548.15	-1631.046
13	textiles	35792.64	5636.998	-6863.791	-566.050
14	apparel	65168.16	52854.87	-10313.36	-10123.76
15	wood,wood pro.	86331.65	20252.75	13511.29	-1096.472
16	paper,paper pro.,publish.	165512.9	25190.36	-5697.030	-501.500
17	chemical,chemical pro.	162539.0	28532.53	6765.098	6064.629
18	petroleum,pet. prod.	211653.9	56925.25	-7955.418	-6623.216
19	leather,leath. pro.	9770.75	12840.82	-6066.524	-5938.161
20	non-metallic mineral pro.	44025.19	2594.669	-2717.214	-1343.169
21	iron,steel	60605.17	11.469	-9735.712	-9535.274
22	non-ferrous metals	47617.43	237.790	-4436.537	-4494.346
23	metal products	106909.5	7731.743	-1743.050	1943.725
24	farm equip.,motor veh.	124960.2	94291.50	-21536.23	-19925.71
25	machinery	112963.6	36069.75	8784.966	10356.95
26	computing,radio TV com. equip	126263.2	55264.62	-2616.547	-515.754
27	electrical machinery	79338.64	28967.58	1975.563	2866.233
28	aircraft,other transportat.	30377.32	21236.52	9731.806	11271.73
29	Transportation,communicat. *	312019.4	83725.31	0.0	0.0
30	electricity,gas,water *	207594.2	61843.07	0.004	0.0
31	wlsale,retail trade	575367.3	347308.9	16334.97	26860.16
32	banking,insurance *	254028.0	116732.2	0.0	0.0
33	real estate *	466723.5	316272.0	0.0	0.0
34	hotel,personal serv.,eating *	353778.9	225626.9	0.0	0.0
35	business services	278012.5	29306.07	3113.490	6427.182
36	Health, educ.,soc. services *	335148.0	283984.8	0.0	0.0
37	fed.,state,local enterprises *	336024.9	28439.99	0.004	0.0
38	other industry	122254.3	54448.53	-10255.17	-3341.947

* nontraded sectors
The units are such that the 1982 prices are equal to $1 per unit.

indicate that, under the optimal distortions, the United States would change from being a net exporter to being a net importer of dairy, poultry, and eggs. Meat and livestock imports would increase by a factor of almost 10; exports of feed grains would increase by a factor of 3. There would be relatively little change in exports of cotton and oil-bearing crops (despite the increased tariff in that sector), but textile imports would increase by a factor of more than 10. This reflects the fact that an increase in the protection of raw cotton decreases the effective protection of the textile industry. There would be a sixfold increase in the imports of fruits and vegetables and an eightfold increase in tobacco and sugar imports. This would change the United States from an importer to an exporter of food, beverage, and tobacco products. These effects are very intuitive, given the changes in the distortions. There are, in addition, several anomalous results regarding nonagricultural sectors (table 4, rows 15, 16, 23, and 26); it is not uncommon for general equilibrium models to yield such results.

Conclusion

This study was motivated by asking whether existing (1982) distortions in the nonagricultural sectors justify the current (1982) level of distortions in the agricultural sectors. Since there is no theoretical basis for answering this question, we have attempted to provide empirical evidence. This evidence must be interpreted cautiously due to reasons given above. However, the extensive sensitivity analysis suggests that the results provide at least a rough guide. The conclusion is that for four subsectors--which include dairy, poultry and eggs, meat and livestock, fruit and vegetables, and tobacco and sugar--the existing distortions cannot be justified on efficiency criteria.

For two subsectors, which include food and feed grains, the existing distortion, which is quite low, is approximatively optimal.

For one subsector, comprising cotton and oil-bearing crops, the existing distortion should be greatly increased. Both consumers and producers of these commodities should be subsidized. This result is due to the existing protection of the textile and food and beverage industries. Decreases in the tariff on these industries should be translated into a decrease in the optimal level of protection of the raw cotton sector.

The analysis uses economic efficiency as the sole criteria. This is not to suggest that distributional issues are unimportant. Indeed, the estimates of changes in production and trade induced by changes in the distortions suggest that the distributional issues may be significant. This observation is reinforced by the fact that the analysis ignores adjustment costs which increase the burden and decrease the benefits of proposed changes.

Despite these qualifications, there remains the important conclusion that levels of protection of the most highly protected agricultural commodities are not justified by efficiency criteria.

Footnotes

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[1]The nominal protection ratio is equal to the difference between the producer price and the border price of a given commodity, divided by the border price.

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