Employment, Welfare and Distributional Effects of a Unilateral Change in Sugar Trade Policy

by

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Abstract

Efficiency and distributional impacts of the removal of sugar trade protection in presence of factor price rigidities and factor immobilities are analyzed. Protection removal should be considered, but in the absence of full knowledge of society's system of ethical beliefs and the present concern with "Fair Trade", a definitive conclusion is not possible.

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Changes in international prices brought about by the removal of tariffs and quotas in face of factor price rigidities and factor immobilities result in unemployment and loss of output to the nation as factors of production migrate from import competing industries. Analysis has emphasised the benefits of free trade in terms of reduced prices to consumers and the costs of reduced factor rents but not considered the cost of lost production during the transitional period - the transitional cost, by assuming that factors of production adjust instantaneously.

Mutti (in an approach that had its beginnings in Baldwin and Mutti) measured the benefits and costs to the nation of a unilateral reduction in tariffs in each of five manufacturing industries. The benefits were the reduction of the deadweight losses that had occurred with the initial imposition of the tariffs and the costs were the transitional costs.

The sugar industry, because of its long history of trade protection (Barry, et.al.), warrants study. Although the Sugar Act was allowed to lapse in 1974, tariffs and quotas are still being used to protect the domestic industry. Because production in the agricultural sector, in contrast to the industrial sector, occurs in sparsely settled rural areas and involves large land areas the analysis of the sugar industry must include a cost not included in Mutti's works: the transitional cost of impacted sugar lands.

Policy assessment must include distributional as well as efficiency considerations. The latter has its basis in utilitarian ethics. However reliance on another ethical system, such as contractionalism (Rawls), could lead to different policy recommendations. In the parlance of our profession, the weights of the social welfare function may be such that protection removal is not desirable. The impacts of the benefits and costs

of changes in trade protection such as those among industries (Balassa) as well as that between consumers and producers need to be measured as part of the transitional cost approach.

Several efforts have been made to examine the impact of tariffs and quotas on the nation's sugar industry (Bates, Snape, Mintz, D.L. Johnson, Choudhury, Flores, Gemmill,1976; Gemmill,1977; Jesse, Zepp, Jesse and Zepp, Hironwong) but none have measured the full range of impacts possible with the transitional cost approach.

Theoretical Considerations

The analyzation of the impact in the small country case is presented in Figure 1. The imposition of an ad valorem tariff, t, on sugar raises the domestic price from Pe to P(1+t). This reduces the demand for sugar from Qd to Qd', increases the total domestic production from Qs to Qs', and decreases the quantity imported from M to M'. A decrease in consumer's surplus (a+b+c+d), and increase in rents to factors of production (a), an introductin of a production inefficiency (b), an increase in government revenue (c), and an introduction of a consumption inefficiency (d) result. The deadweight loss used in the transitional cost approach is b+d, the net of the welfare gains and losses. A decrease in a tariff reverses the above effects.

Because the equivalency between quotas and tariffs can be demonstrated, the discussion will continue in terms of trade protection, which includes both tariffs and quotas.

The large country case is demonstrated in Figure 2 where panel (2) represents the United States and (1) the world excess demand and supply. The United States' imposition of trade protection reduces the world sugar price from Pe to Pw and the United States post-protection sugar price to P'(1+t), not P(1+t) as in the small country case. This reduces the impact of trade protection and the effects of protection removal.

Dynamic Benefits and the Distribution of Welfare Impacts

The formula for estimating the benefits of protection removal is

$$B = \int_0^{\infty} B_o e^{-(r-g)T} dT \qquad (1)$$

where B is the benefit, Bo the static benefit for one year (b + d), r the discount rate, g the rate of growth of imports, and T is time (Mutti).

Expressing areas b and d as functions of their respective elasticities, the relative change in price as t/(1+t) (Mutti), and specific tariffs as ad valorem equivalents, the static benefit is then

$$B = \tfrac{1}{2}(t/(1+t)P[(ed)(Qd) + (es)(Qs)] \qquad (2)$$

where t is the tariff or its quota equivalent and ed, es, Qd and Qs are the elasticities and quantities of demand and supply. The terms on the right hand side of the equation are d and b respectively.

Costs

Transitional costs arise because of the short-run industry specificity of capital and the rigidity of factor prices that occur after resource displacement, both of which inhibit the mobility of the factors of production (Mayer, Mussa). The latter occurs because human resources do not lower their asking wage in the short-run. In Mutti's adaptation of Mussa's diagrammatic analysis, Figure 3, the initial wage is established by the equality of the VMPL for both industries. The VMP of sugar shifts inward [VMPLs(Pos) to VMPLs(P's)] and the wage rate decreases to W2. However the initial factor price rigidity results in L1L0 amount of unemployment. Full employment and transitional costs of labor cease, as human resources accept lower wages.

The transitional costs at any point in time is the area W2(L1L0)T where subscript T refers to time. The social cost for specific capital and land

is analagous. The formula for calculating the transitional cost is

$$C = \int_{o}^{u} dwue^{-rT}dT \qquad (3)$$

where d is the resource displacement (W2(L1LO) above) w is the static cost of time unemployed and u is the duration of unemployment (Mutti). The quantity of labor displaced is

$$dL = es(t/(1+t))PQ(L/PQ) \qquad (4)$$

where L/PQ is the employment coefficient (hereafter aoj). Post-displacement earnings foregone during periods of initial and subsequent periods of unemployment are the human resource transitional costs (Bale).

METHOD

The t, elasticities, and price and quantities without protection are estimated for equations (2) and (4). The ad valorem equivalent, t, is expressed as a ratio between the change in the domestic raw sugar price, Pusa, and the sugar price. However the difference between Pusa and Pw does not measure only the impact of protection (and its removal) on Pusa. Because of the terms-of-trade effect, the total difference is a consequence both of an increase in Pusa (a decrease in the case of protection removal) and a decrease (increase) in Pw. The terms-of-trade effect is derived from Gemmill's simulation of the world sugar market Because of year-to-year fluctuations in these prices, changes were based on mean real values of Pusa and Pw since 1974. Of the total change in Gemmill's simulation, .387 was a result of a decline in Pusa and .613 was a result of an increase in Pw.

Gemmill's weighted mean supply elasticities of 1.74 for beet and 1.57 for cane and Jesse and Zepp's price elasticity of domestic demand, -.055, were used. The quantities demanded and supplied without protection, Qs and Qd, were estimated using the following formula (using Qs as an example): Qs = Qs'-[Qs'(%dQs)/100] where %dQs equals es(%dP), Qs' is the production

under trade protection and a positive sign is used to estimate Qd. These figures also were based on post-74 mean values (I and II of Table 1).

Two assumptions are used. The first is that under free trade, imports of refined sugar will replace domestically refined sugar because it is cheaper to refine sugar outside of the United States (Snapes). The second is that transitional costs are negligible for sugar beet production because substitute crops exist for sugar beets when output prices warrant it. Transitional costs of sugar beet refineries are included because some impacted refineries would exit permanently from the industry.

Interindustry tables were used to estimate the direct and indirect impacts. Because this author did not have access to the national interindustry computer tapes and employment coefficients, the estimation of transitional costs was limited to those firms whose total requiremnts were at least .01. Employment coefficients were derived from appropriate Department of Commmerce Census.

The post-displacement monthly earnings were used as the basis for the transitional cost of labor. The procedure for deriving the post-displacement earnings followed that of Jenkins and Montmarquette. The following equation was used to estimate the monthly pay on the first post-sugar displacement job using the personal income distribution characteristics of the displaced sugar workers as the explanatory variables:

$$RPAYFJ = f(AGELO, SEN, SCHOOL, GRADE, ETHNIC, U)$$

where f is the functional form of the regression, RPAYFJ is the real pay in the first post-displacement employment, AGELO is age at the time of the layoff, SEN is seniority in years, SCHOOL is the years of education, GRADE is the last position (Grade) with the sugar company, SEX is 1 if male and 0 if female, ETHNIC is ethnic background, and U is the rate of unemployment at the time of displacement.

A perusal of various sources did not reveal any material on private or transitional costs for the sugar industry or for industries directly and indirectly affected. Thus the experience of Hawaii's sugar workers, both field and mill workers, was used to approximate the costs for both sugar and other industries. The applicability of this approach depends on the representativeness of the Hawaii experience for the domestic economy and the domestic sugar industry in terms of personal income distribution characteristics of impacted workers and alternative employment opportunites. If this approach is not truely representative, it is at least suggestive of the consequences in terms of the transitional costs of impacted human resources.

Two assumed periods of unemployment of land was used: six months and one year.

The transitional costs of capital were not included. However the opportunity cost of capital in agriculture is low (Johnson and Quance).

Discount rates of 5 percent, 10 percent, and 20 percent were used provide a sensitivity analysis.

The transitional costs of human resources were based on a survey of 210 people who had been employed with the Kohala Sugar Company located in the North Kohala area of the island of Hawaii.

Analysis and Results

The average difference in the real prices for the post-Sugar Act era was $73.47 so the reduction in Pusa, based on Gemmill's simulation, as the result of protection removal would be $27.66 per ton. The value of t is 7.0. The static deadweight loss was $8,972,763 (III of Table 1).

A projection of sugar demand showed little or no growth in demand (Carman and Thor) so g was dropped from equation 1. The present values of the benefits are demonstrated in Table 1 and range from approximately $45 million at 20% to $179 million at 5%.

The weighted U.S. sugar growing employment coefficient (aoj in the dL equation) was 27.6241. The land coefficient was 38.52. The total decline in the value of refined sugar was approximately $222 million. The employment and acreage impacts are also derived but not presented here

The results of the estimation of the pay in the first post-layoff job, RPAYFJ, are presented in Table 4. SEX was dropped from the equation because of insufficient numbers. AGELO had a negative sign as expected; however it was not significant. SCHOOL and GRADE had the anticipated signs, but only GRADE was significant. SEN had a negative sign, opposite of that expected; but it was insignificant. EHAW was the only ethnic variable that was significant. The unemployment rate had an inverse and significant influence on RPAYFJ, as was anticipated.

Because of the high correlation between AGELO and SEN, the equation was reestimated: the first by retaining AGELO and excluding SEN (column 2) and vice versa (column 3). The equation was also resstimated using polynomials, but none of the coefficients were significant.

Because the above indicated that AGELO may have been a factor in the formulation of alternate earnings, the sample was disaggregated on the basis of age. The mean values for the various income distribution characterists in each group were substituted into the estimated equation to derive the value of RPAYFJ for each group. The three groups were: those under 45 years of age, those between 45 and 54 years of age, and those in the 55 to 64 age group (Jenkins and Montmarquette). The transitional costs per worker were 642, $410, and $245 at 5 percent, 10 percent, and 20 percent respectively.

The transitional cost of former sugar lands for the United States based on the rental value of land in alternate use in Hawaii. Contact with pertinent personnel revealed the rental value for Kohala sugar lands, rented for cattle grazing, was $40.00 per acre per year.

Both the benefit-cost ratios and differences are presented in Table 5. Again the transitional cost of capital has not been included . The differences are presented as a sensitiveity analysis becuase they indicate the values that the transitional costs of capital must exceed for the benefit-cost ratio to be less than one. The ratios range from a high of 16.4 and a low of 6.5 in the case of ex-sugar lands being idled six months and from a high of 10.7 to a low of 3.8 if they are idled one year. The differences range form a high of $168,534 to a low of $33,033,533. The distribution of welfare effects are presented in Table 6. The consumer surplus was $288,256,123, the producer surplus $170,754,683, and the difference between the two, $117,501,440. Interindustry impacts are also estimated, but not presented here.

Conclusions

The results of the analysis indicate that in the presence of factor immobilities and factor price rigidities the benefits of protection removal for the domestic sugar industry, in the form of the regain of the deadweight loss, exceed the transitional costs. Thus a return to free trade in sugar is very likely to raise the level of general welfare.

Therefore the removal of protection for the United States sugar industry should be strongly considered.

Given the limitations of the study a definitive statement cannot be made. The major limitation is the exclusion of the opportunity cost of capital. Most of the impact falls on the sugar industry - sugar growing and processing. Johnson and Quance indicate that the opportunity cost of capital in an agricultural industry such as sugar may not be high and thus may not be high enough to offset the presented benefit-cost ratios. Future research could overcome this and other limitations in the analysis.

A definitive answer also depends on society's evaluation of the distributional impact, i.e. welfare weights.

Additionally, in light of the recent emphasis on "Fair Trade" any proposed changes in protection for sugar should be made in conjunction with overall trade policy.

Final note: The author has modified this approach to measure the efficiency as well as the distributional impacts to the state of Hawaii, a major producing area and a state where the effects of closings of sugar operations has important consequences for its rural areas. Figure A is the basis for this modification. Panel (1) is the U.S. mainland market, (2) the total U.S. sugar market, and (3) the state of Hawaii which exports to the U.S. mainland. The author also has analyzed the distribution of the impacts on sugar workers using the personal income distribution characteristics as explanatory variables.

END

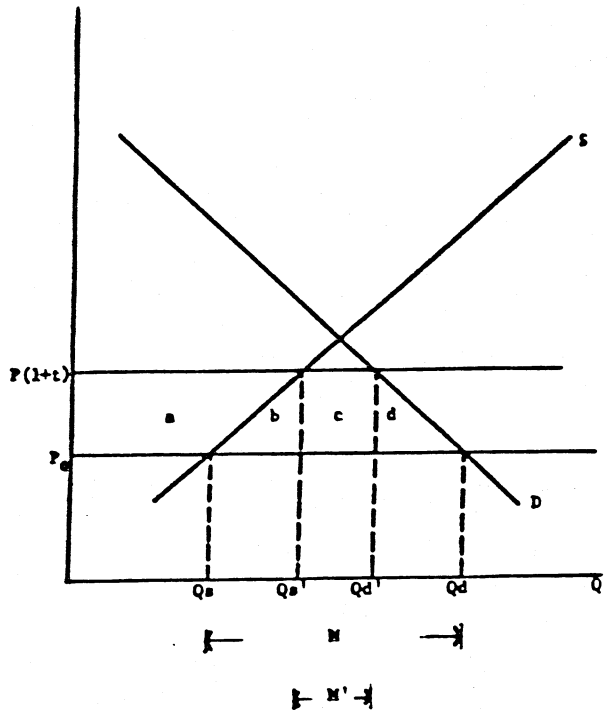

Figure 1: Effect of Tariff Protection and the U.S. Sugar Market and the Distribution of Welfare Impacts

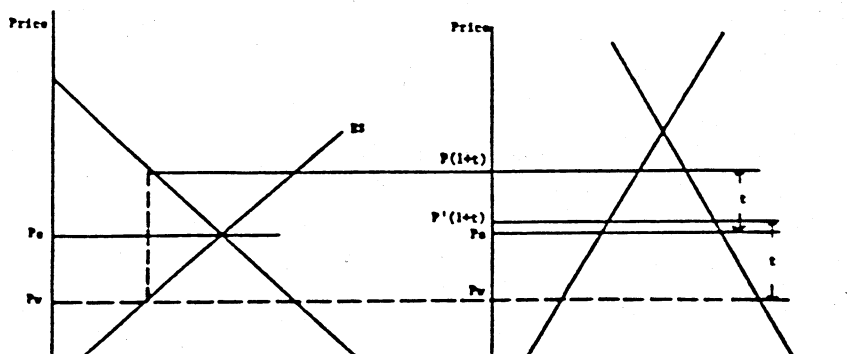

Figure 2: Effects of a Sugar Tariff Reduction: Large Country Case

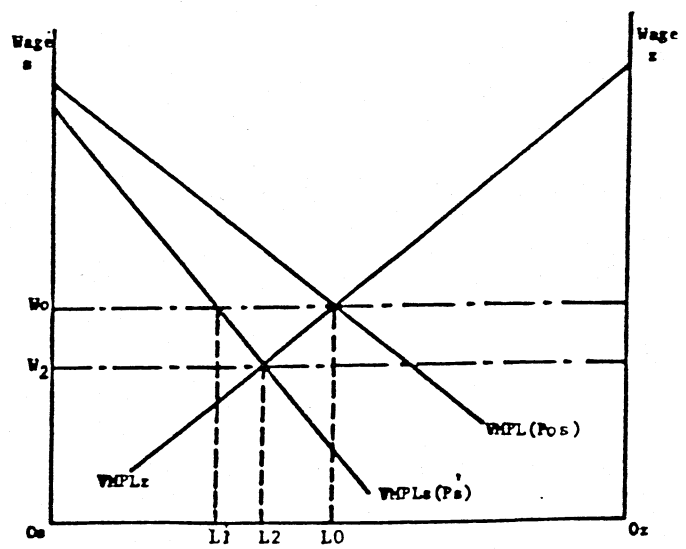

Figure 3: Impact of a Tariff Reduction on Wage Rates and Labor Force Allocation

TABLE 1

Calculation of Benefits

I. Estimation of Qo and Production Effect	
% Decrease in Price: $t = \frac{\text{Decline in } P_{USA}}{\text{Mean } P_{USA}}$	$t = \frac{27.66}{393.50} = 7.0\%$
Weighted e_s:	
% Decrease in domestic quantity supplied: $\%dQ_s = e_s \times t$	$\%dQ_s = 1.66 \times 7.0 = 11.62\%$
Change in domestic quantity supplied: $dQ_s = Q_s' \times \frac{\%dQ_s}{100}$	$dQ_s = 6,294,050 \times \frac{11.62}{100} = 731,369$ tons
Domestic quantity supplied without protection (Q_s): $Q_s = Q_s' - dQ_s$	$Q_s = 5,562,681$
Production effect (b):	$8,445,463
II. Estimation of Q_d and Consumption Effect	
e_d:	
% Decrease in domestic quantity demanded: $\%dQ_d = e_d \times t$	$\%dQ_d = .055 \times 7.0 = .385$
Change in domestic quantity demanded: $dQ_d = Q_d' \times \%dQ_d$	$dQ_d = 10,523,000 \times .385 = 40,514$ tons
Domestic quantity demanded without protection (Q_d):	10,482,486 tons
Consumption effect (d):	$527,300
III. Total Static Benefit- (Dead weight Loss): $b + d$	$8,972,763
IV. Total Benefit	

Discount Rate	Present Value
.05	$179,455,260
.10	89,727,630
.20	44,863,815

TABLE 3

Benefit and Cost Estimations

Benefit/Cost

Discount Rate	Land unemployed for 6 months	Land unemployed for 1 year
.05	16.4	10.7
.10	10.2	6.2
.20	6.5	3.8

Benefit - Cost

.05	$168,534,425	$162,711,070
.10	80,911,927	75,351,625
.20	37,976,024	33,033,533

TABLE 2

Pay in First Post-Layoff Job

Variable	(1)	(2)	(3)	(4)
AGELO	-7.153	-13.648		-8.959
	(-1.134)	(-3.174)***		(-1.358)*
SEN	-9.319		-14.851	-5.260
	(-1.403)*		(-3.289)***	(-.363)
SCHOOL	3.809	14.769	2.912	79.792
	(.218)	(.942)	(.167)	(1.025)
GRADE	28.284	23.129	29.297	15.230
	(2.160)**	(1.832)**	(2.240)**	(.359)
EFIL	131.781	149.486	126.593	133.361
	(1.259)	(1.432)*	(1.209)	(1.221)
EHAW	234.656	239.553	225.878	236.544
	(2.249)**	(2.289)**	(2.168)**	(2.249)**
EJPN	110.045	106.369	94.808	123.833
	(1.035)	(.996)	(.897)	(1.133)
U	-34.271	-36.926	-35.367	-35.375
	(-1.636)*	(-1.762)**	(-1.688)**	(-1.669)**
$ANGELO^2$				.364
				(-1.009)
SEN^2				-.100
				(-.359)
$SCHOOL^2$				-4.681
				(-1.015)
$GRADE^2$				.907
				(.337)
a	1257.707			
R^2	.240	.226	.231	.249
adj R^2	.185	.178	.183	.173
F	4.413***	4.722***	4.847***	3.287***
	n=121			

Note: a = intercept

*** Significant at α=.01.

** Significant at α=.05.

* Significant at α=.10.

TABLE 4

Distribution of Welfare Effects

I. Areas under the Demand and Supply Curves

area a	area b	area c	area d
$153,863,757	$8,445,463	$116,974,140	$527,300

II. Surpluses

Consumer	Producer	Net Effect
$288,265,123	- $170,754,683	$117,501,440

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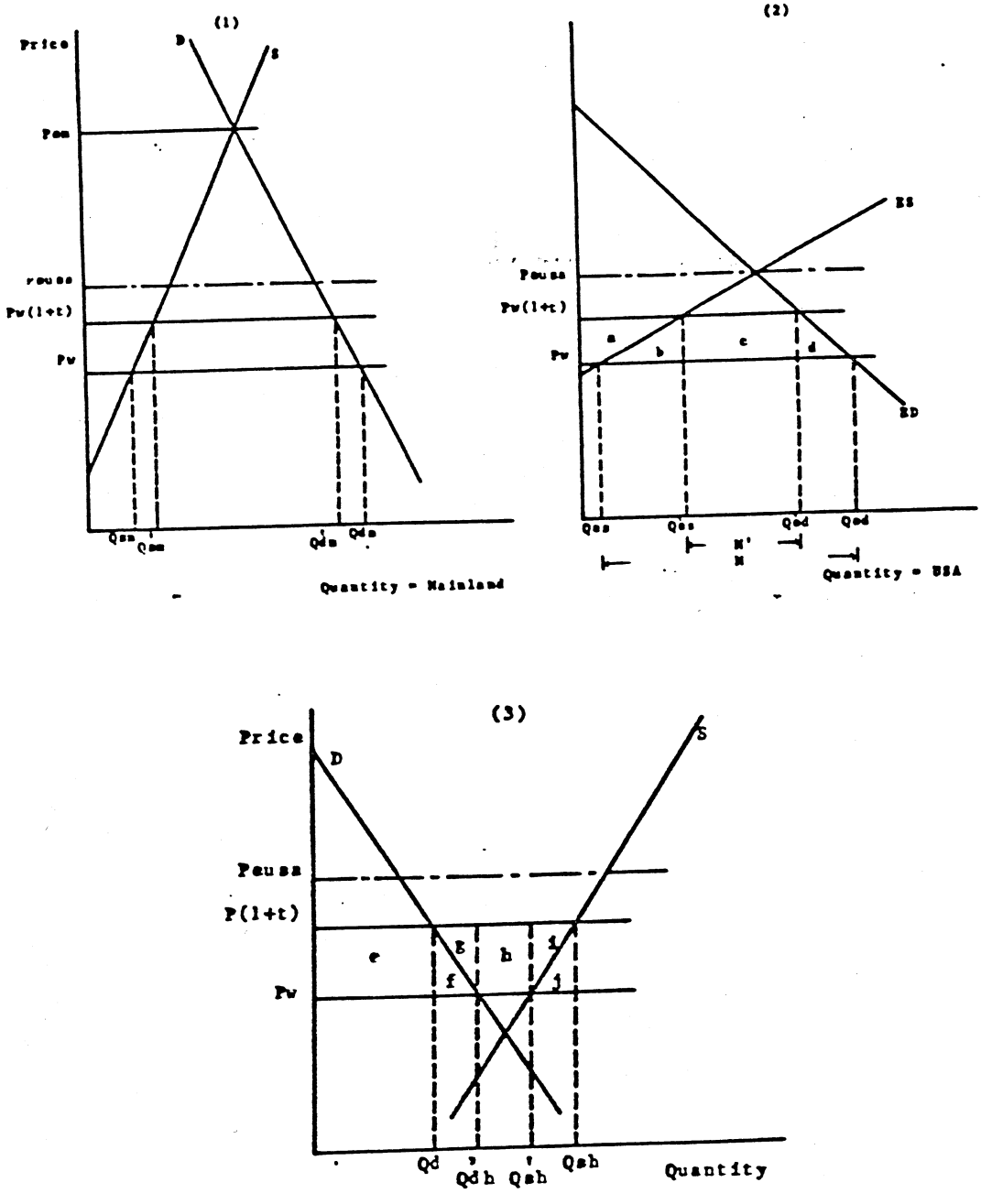

Figure A: Impact of a Reduction in Sugar Protection on the Nation and Hawaii