CHAPTER 4

Border Interventions: Taxes, Subsidies, and Quotas

Three major types of public measures altering trade patterns are border interventions, macroeconomic policies, and commodity programs. Chapters 5 and 6 treat the latter two. This chapter analyzes impacts on the level and distribution of costs and benefits from border interventions in the form of taxes (tariffs), subsidies, and quotas. These policies can be applied to exports or imports.

Border measures have different impacts for very large, large, and small countries where size refers not to geographic area or aggregate output but rather whether the actions of a nation affect world prices:

- A nation is a *small-country case* if the demand for its exports or supply of its imports is perfectly elastic (horizontal).
- A nation is a *large-country case* if the demand for its exports or supply of its imports is neither perfectly elastic nor perfectly inelastic.
- A nation is a *very-large-country case* if the demand for its exports or supply of its imports is perfectly inelastic (vertical).

Negotiations under the General Agreement on Tariffs and Trade (GATT) have focused mainly on reducing tariff barriers. The negotiations have been highly successful in reducing tariff barriers (Table 4.1). US tariffs as a percent of all import value fell from 57 percent in 1830 to 3.1 percent in 1980. For the world as a whole, tariffs average approximately 5 percent of trade value.

Border interventions are now dominated by nontariff measures. The nontariff border measures take numerous forms but many resolve to forms of subsidies or quotas. For example, unofficial and unauthorized delays in processing import or export permits behave like quotas. The monopoly-like guild of wholesale merchants in Japan who frequently reject foreign merchandise also constitutes de facto quota behavior. Excessive packing requirements or shipping costs behave like taxes. Credit concessions provided by the United States and other exporters to foreign buyers of wheat are agricultural export subsidies. The European Community imposes a variable levy on imports equal to the difference between the domestic support price and the world price -- a hybrid between a tariff and a nontariff barrier but generally classified as the latter. A host of nontariff distortions were listed in Table 3.1 of the previous chapter.

The purpose of this chapter is to illustrate conceptually who gains and who loses from border interventions. The three types of interventions, three country size cases, and the exporter-importer dichotomy represent 18 cases. The organization of this chapter is to present first the situations for importers, then for exporters.

Table 4.1. US Tariff Rates Through 1984.

Year	Imports	Duty-Free	Calculated Duties	Ratio of Calculated Duties to: Total Imports	Dutiable Imports	Federal Revenue
	($ Mil.)	(Percent)	($ Mil.)		(Percent)	
1791	NA	NA	4	NA	NA	99.5
1800	91	NA	9	9.9	NA	83.7
1810	85	NA	9	10.6	NA	91.5
1820	74	NA	15	20.3	NA	83.9
1830	50	8.0	28	57.3	61.7	88.2
1840	86	48.0	15	17.6	34.4	69.3
1850	164	9.8	40	24.5	27.1	91.0
1860	336	20.2	53	15.7	19.7	94.9
1870	426	4.7	192	44.9	47.1	47.3
1880	628	33.1	183	29.1	43.5	55.9
1890	766	33.7	227	29.6	44.6	57.0
1900	831	44.2	229	27.6	49.5	41.1
1910	1,547	49.2	327	21.1	41.6	49.4
1915	1,648	49.2	206	12.5	33.5	30.1
1920	5,102	61.1	326	6.4	16.4	4.8
1925	4,176	64.9	552	13.2	37.6	14.5
1930	3,114	66.8	462	14.8	44.7	14.1
1932	1,325	66.9	260	19.6	59.1	16.3
1935	2,039	59.1	357	17.5	42.9	9.0
1940	2,541	64.9	318	12.5	35.6	5.9
1945	4,098	67.1	381	9.3	28.2	0.7
1950	8,743	54.5	522	6.0	13.1	1.0
1955	11,337	53.3	633	5.6	12.0	0.9
1960	14,650	39.5	1,084	7.4	12.2	1.2
1965	21,283	34.9	1,643	7.7	11.9	1.2
1970	39,756	34.9	2,584	6.5	9.9	1.2
1975	96,516	32.2	3,780	3.9	5.8	1.3
1980	224,007	43.8	7,535	3.1	5.7	1.4
1984	322,990	31.9	12,042	3.7	5.5	1.4

Source: Lande and Van Grasstek.

INTERVENTIONS BY IMPORTERS

This section considers impacts on producers, consumers, governments, nations, and the world of taxes, subsidies, and quotas imposed by importers on commodities.

Import Tax (Tariff)

Assumptions

Conditions underlying Figure 4.1 are defined as follows:

t = import tariff applied by importer per unit imported
P_w = world price before the tariff
P_w' = world price after the tariff
$P_w'+t$ = domestic price in A with the tariff
s = domestic supply in country A
d = domestic demand in country A
S = supply in ROW
D = demand in ROW
ES = excess supply for importer A, S-D
ED = excess demand for importer A, d-s
q_c = consumption in country A before the tariff
q_c' = consumption in country A after the tariff
q_p = production in country A before the tariff
q_p' = production in country A after the tariff
Q_c = consumption in ROW before the tariff
Q_c' = consumption in ROW after the tariff
Q_p = production in ROW before the tariff
Q_p' = production in ROW after the tariff
q_c-q_p (imports of A) = Q_p-Q_c (exports of ROW) = q_e before the tariff
$q_c'-q_p'$ (imports of A) = $Q_p'-Q_c'$ (exports of ROW) = q_e' after the tariff.

The tariff (import tax or duty) lowers the excess demand curve for imports of A to ED - t. The *specific* tariff makes ED and ED - t parallel, differing vertically by distance t. (An *ad valorem* tariff proportional to price would make the lower curve proportional to ED; that is, the lower curve would be ED(1-t) where t is the tax rate so that ED and ED(1-t) would have the same vertical axis intercept.)

In the large-country case, ES slopes upward to the right so that less excess demand ED - t lowers world price to P_w'. In the extreme large-country case where ES is vertical (perfectly inelastic), the world price is reduced by the full amount of the tariff t. Then producers and consumers in A face the same price $P_w' + t = P_w$ with or without the tariff. ROW price falls by the amount of the tariff. Quantities are the same with and without the tariff.

Taking the other extreme, the small-country case, ES is perfectly elastic. It is a horizontal line at P_w. Hence the equilibrium indicated by intersection of ES and ED-t is at zero trade. The impact of the tariff shows up only in ROW price in the very-large-country case and only in quantity and in A's price in the small-country case.

Welfare Analysis

Changes in welfare compared to an open market with imposition of an import tax are shown by areas in Figure 4.1:

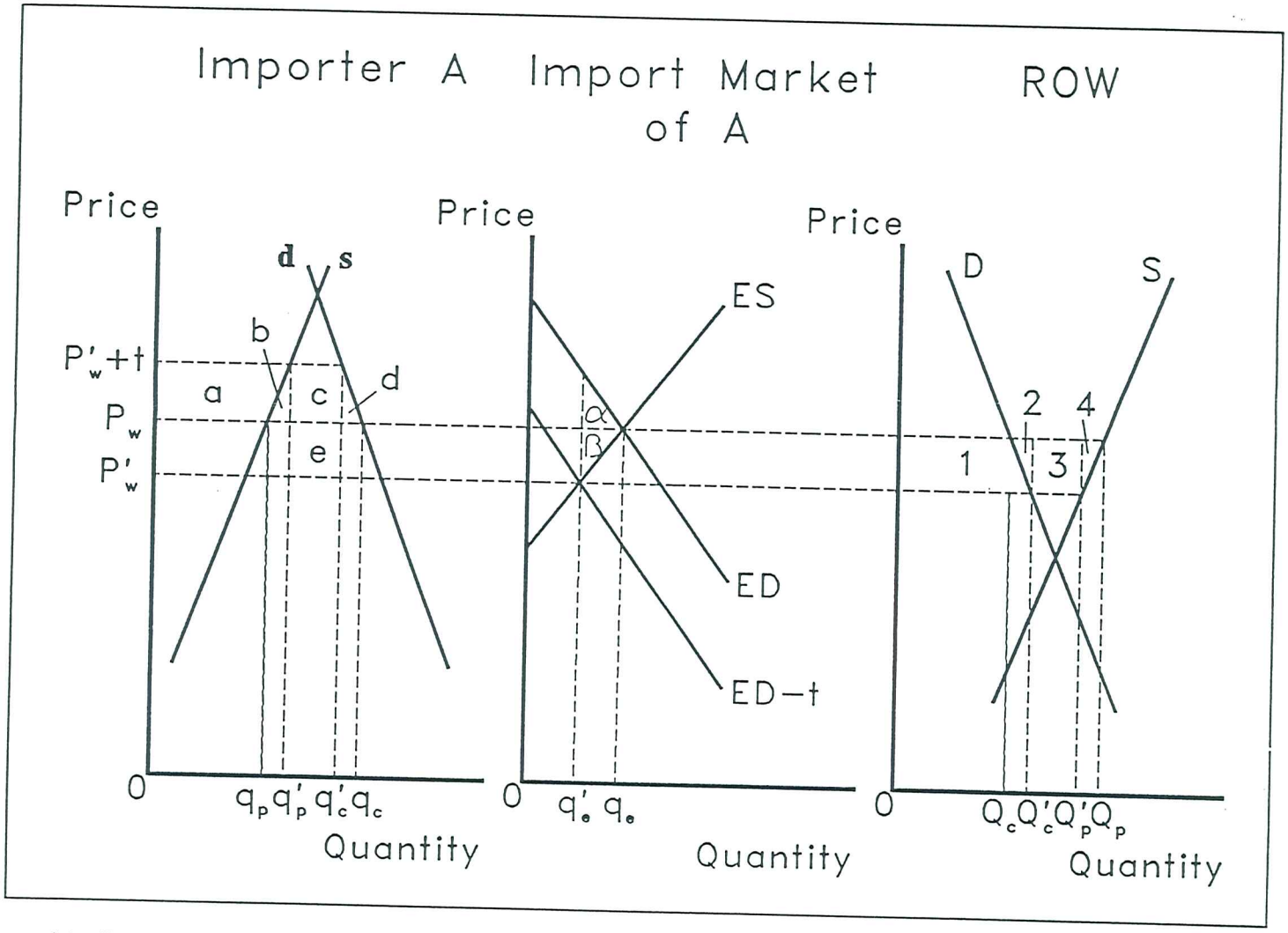

Figure 4.1. Effects of an Import Tariff.

	Importer A	ROW
Consumer surplus gain	-a-b-c-d	1
Producer surplus gain	a	-1-2-3-4
Government revenue change	c+e	---
Net national welfare	-b-d+e	-2-3-4
Net world welfare (because e=3)	-b-d-2-4	

Because area b+d is equal to area α and area 2+4 is equal to β, it follows that world deadweight loss can be taken directly from the middle panel in Figure 4.1.

Summarizing welfare effects by "size" of country, results are as follows:

Very large country. If ES is vertical, the entire impact of the tariff shows up as a low world price $P_w' = P_w - t$. Areas 2 and 4 would not exist if D and S were vertical. Domestic price would be $P_w = P_w' + t$. Hence producers and consumers in A would face the same prices as with no tariff, removing b+d. Net social cost would be zero and the tariff would provide a pure transfer from ROW to A. If the purpose of the tariff is to raise government revenue or to raise producers' income, transfer efficiency is high -- assuming in the latter case that the tariff revenue would be transferred to producers at no deadweight loss. In this and later cases, the "government" might be a quasi-public organization such as a marketing board or state trading company.

Large country. Given that ES is neither perfectly elastic nor perfectly inelastic and assuming that the purpose of the tariff is to raise full national income, it follows that the *optimal tariff* for the nation maximizes the area e-b-d. If ES is elastic, b+d is likely to exceed e in value so that A is worse off from the import tax.

Small country. Where ES is perfectly elastic, the tariff on imports will show up solely as a change in domestic price in A. With the tariff, the price in A will be P_w+t and in ROW will be P_w. In this case, areas 2 and 4 for ROW will vanish but full national income loss b+d in A will be larger than in the large-country case. Because e will no longer exist, small-country importer A will be irrational to impose a tariff if its goal is to maximize full national income. Gains to producers or government will be more than offset by losses to consumers.

If its goal is to raise government revenue, a tariff will do so but at a deadweight loss of (b+d)/c per unit of revenue raised. Producers in A will be better off; the gain to producers, deadweight loss, and gain to government come at the expense of consumers in A.

In the small-country case, consumers in A may spend more or less on the commodity after imposition of the tariff depending on the price elasticity of domestic demand. If demand is elastic, the tariff proportionately will increase domestic price less than decrease quantity so consumers will spend less. If demand is inelastic, the tariff will decrease domestic quantity relatively less than it will increase domestic price so consumers will spend more.

Figure 4.1 can be used to illustrate an *optimal import tariff.* The tariff on each unit is the difference between ED and ES curves to the left of q_e in the middle panel of Figure 4.1. The marginal tariff is highest at 0 but quantity is zero so revenue is zero. Similarly, revenue is zero at q_e because the tariff rate (difference between ES and ED) is zero. A perfectly discriminating tariff collector could reap the entire area between ED and ES from 0 to q_e. If only one tariff rate can be charged on all units, maximum tariff revenue is at

quantity $q_c/2$ if ES and ED are straight lines.[1] The exact maximum position will depend on the elasticity of excess supply E_m for imports by A. In the general case, the *optimal import tariff* is where the ratio of domestic price p to the tariff t is E_m, i.e. $E_m = p/t$.[2] Because $t = p/E_m$, it is apparent that the optimal tariff is zero in the small-country case (E_m is very large) and approaches infinity in the very-large-country case where E_m is very small.

Maximizing revenue from a tariff does not necessarily maximize revenue to domestic producers, the nation, or the world. In the small-country case, the revenue comes from domestic consumers, thus the maximum revenue tariff merely maximizes transfers from domestic consumers to government as noted from Figure 4.1. An optimal tariff maximizes net revenue from the import market but not necessarily from the import plus the domestic market as noted in Chapter 8.

The host of individual tariff and nontariff measures to support farm income defy individual attention in international trade negotiations. Consequently, the United States in the Uruguay Round of GATT proposed in November 1988 that all nations over time convert all income supports to tariffs. This process is called *tariffication* (see Bredahl *et al.*). The intent after tariffication would be to gradually reduce all agricultural product tariffs to zero or low levels as had been done so successfully for industrial products. The US recommendation in part reflected a lack of confidence that an earlier proposal for *decoupling* (lump-sum direct government payments unrelated to production replacing other supports) would be acceptable and in part satisfaction with an agreement with the Japanese to replace their beef and citrus quotas with tariffs that in turn will gradually be phased out.

Import Subsidy

We now turn to the import subsidy. The subsidy is assumed to be a flat amount paid by the government on each unit of import of a good.

Assumptions

Conditions in Figure 4.2 are defined as follows:

su = specific fixed-rate import subsidy by importer A per unit of imports
P_w = world price before the subsidy
P_w' = world price after the subsidy
P_w'-su = price faced by producers and consumers in importing country A with the subsidy
s = domestic supply in country A
d = domestic demand in country A
S = supply in ROW
D = demand in ROW
ES = excess supply for importer A, S-D
ED = excess demand for importer A, d-s
q_c = consumption in country A before the subsidy

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[1]Given demand curve $p_d = a + bq_d$ and supply curve $p_s = c + dq_s$, the unit tariff is $t = p_d - p_s = (a-c) + (b-d)q$ with equilibrium at $q_s = q_d = q$. The total tariff is $(p_d-p_s)q$ or $T = (a-c)q + (b-d)q^2$. The tariff T is maximized where $dT/dq = (a-c) + 2(b-d)q = 0$. Given that market equilibrium quantity is where $p_d = p_s$ or $q_c = (c-a)/(b-d)$, it follows that the optimal tariff quantity is $q = (c-a)/2(b-d) = q_c/2$. This optimal tariff quantity $q_c/2$ applies where ES and ED are linear and only one price can be charged.

[2]Marginal cost of imports is $p + p/E_m$. Marginal revenue is $p + t$. Equating marginal cost with marginal revenue gives optimal import tariff $t = p/E_m$. Issues of retaliation are ignored.

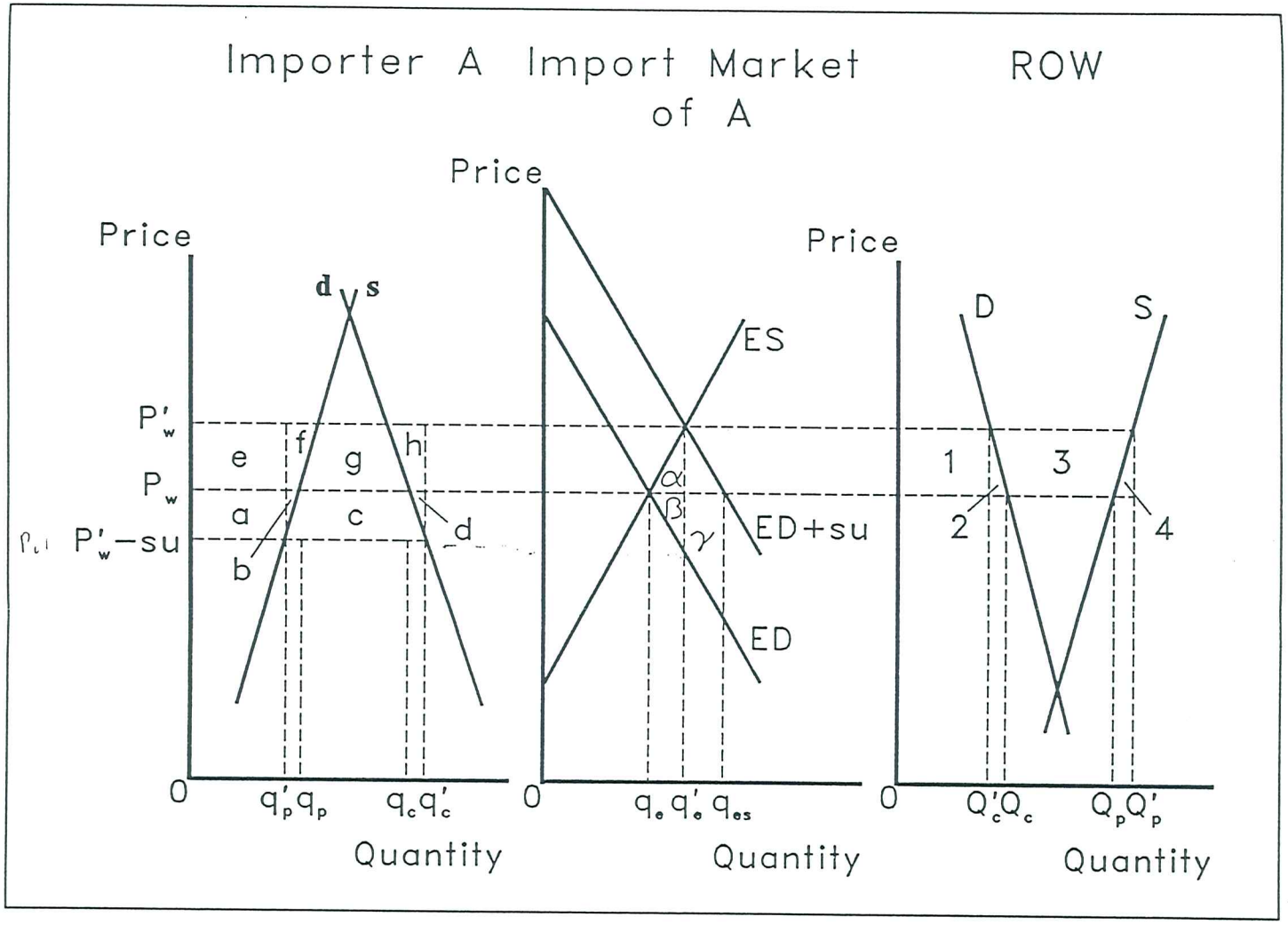

Figure 4.2. Effects of an Import Subsidy.

q_c' = consumption in country A after the subsidy
q_p = production in country A before the subsidy
q_p' = production in country A after the subsidy
Q_c = consumption in ROW before the subsidy
Q_c' = consumption in ROW after the subsidy
Q_p = production in ROW before the subsidy
Q_p' = production in ROW after the subsidy
q_c-q_p (imports by A) = Q_p-Q_c (exports of ROW) = q_e before the subsidy
q_c'-q_p' (imports by A) = Q_p'-Q_c' (exports of ROW) = q_e' after the subsidy.

When importing country A subsidizes each unit of its imports by su, the excess demand ED for imports is raised vertically by su to ED + su. In the large-country case, ES slopes upward to the right so the additional excess demand raises world price from P_w to P_w'. In the extreme large-country case where ES is vertical (perfectly inelastic), P_w' rises by the amount of the subsidy so that $P_w = P_w'$ - su and producers and consumers in A face the same price for q with or without the import subsidy. At the other extreme of a small-country case, ES is horizontal (perfectly elastic) so that $P_w' = P_w$ and the entire subsidy is passed to producers and consumers in A.

Welfare Analysis

Changes in welfare compared to an open market with imposition of an import subsidy as shown by areas in Figure 4.2 are as follows:

	Importer A	ROW
Consumer surplus gain	a+b+c	-1-2
Producer surplus gain	-a-b	1+2+3
Government revenue change	-b-c-d-f-g-h	---
Net national welfare	-b-d-f-g-h	3
Net world welfare (because f+g+h=2+3+4)	-b-d-2-4	

Welfare effects differ by country "size."

Very large country. If ES is perfectly inelastic because S and D are perfectly inelastic, areas 2 and 4 vanish. And because the subsidy is entirely above P_w for A, areas a+b+c+d do not exist, hence area b+d+2+4, the world social cost, is zero. The import subsidy does not result in a lower price to producers and consumers in country A but instead is passed as a higher price to ROW. ROW producers rather than the intended beneficiary, consumers in A, receive the entire subsidy. The transfer efficiency to consumers, a+b+c divided by the subsidy, is zero.

Large country. Where ES is neither perfectly elastic nor perfectly inelastic, the transfer inefficiency to consumers, defined as (b+d+f+g+h)/(a+b+c), is greater than zero. Although consumers gain, the country imposing an import subsidy loses national income. ROW gains, however.

Small country. Where ES is perfectly elastic, there is no import subsidy price slippage to ROW. That is, the subsidy goes solely "below P_w." Imports are q_{es}' rather than q_e'. Area e+f+g+h does not exist but a+b+c+d becomes larger because P_w - su, the new domestic price, is below P_w' - su, the former price with large-country slippage. The net social cost is α(i.e. 2+4) + β(i.e. b+d) in the large-country case and $\beta + \gamma$ in the small-country case. Whether social cost is greater or smaller than in the large-country case depends on whether α is greater or smaller than γ.

In conclusion, an import subsidy by A results in a net welfare loss to the importer because of (1) deadweight domestic loss and (2) leakage of the subsidy to the rest of the world.

Import Quota

Assumptions

Conditions in Figure 4.3 are defined as follows:

$P_d = P_w$ = domestic price equal to world price before the quota
P_d' = domestic price after the quota
P_w' = world price after the quota
q_e' = quota y-x, the horizontal distance between s and s´
s = domestic supply in country A
s´ = domestic supply in country A including quota imports
d = domestic demand in country A
S = supply in ROW
D = demand in ROW
ES = excess supply for importer A, S-D
ED = excess demand for importer A, d-s
ED´ = excess demand for imports with the quota
q_c = consumption in country A before the quota
q_c' = consumption in country A after the quota
q_p = production in country A before the quota
q_p' = production in country A after the quota
Q_c = consumption in ROW before the quota
Q_c' = consumption in ROW after the quota
Q_p = production in ROW before the quota
Q_p' = production in ROW after the quota
$q_c - q_p$ (imports of A) = $Q_p - Q_c$ (exports of ROW) = q_e before quota
$q_c' - q_p'$ (imports of A) = $Q_p' - Q_c'$ (exports of ROW) = q_e' after quota.

Markets are initially assumed to be in equilibrium at world price P_w and imports q_e to A. A quota q_e' is imposed on imports to A, which shifts the excess demand curve from ED to a new position ED´. The latter follows ED to the quota, then becomes perfectly inelastic.

If the excess supply curve ES would have intersected ED´ along its segment common with ED, the *inoperative quota* would have left world market prices and quantities unchanged. In fact, we have an operative quota that changes the equilibrium price and quantity.

Welfare Analysis

Welfare effects of the operative quota compared to competitive world market equilibrium are illustrated with areas shown in Figure 4.3:

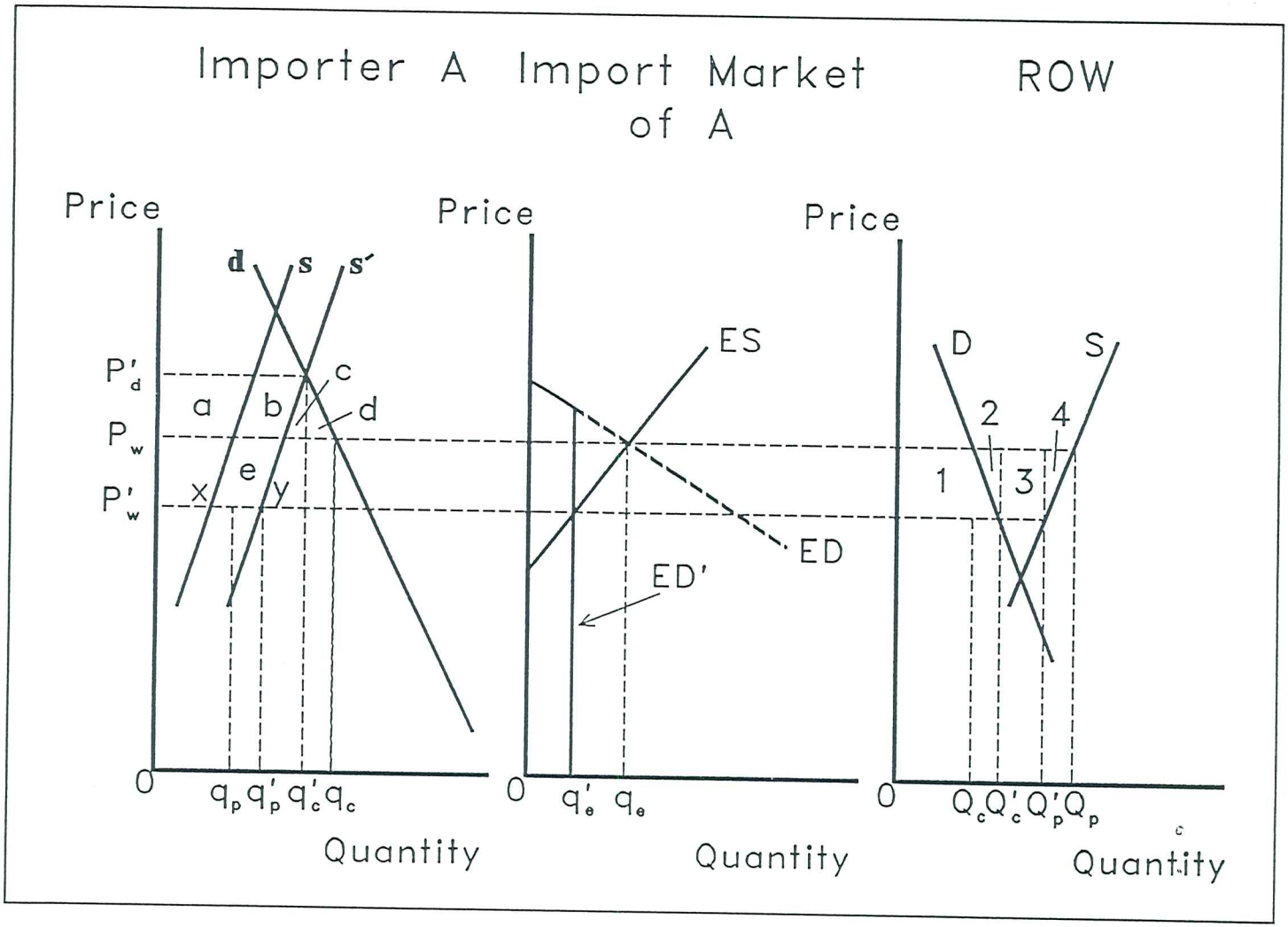

Figure 4.3. Effects of an Import Quota.

	Importer A	ROW
Consumer surplus gain	-a-b-c-d	1
Producer surplus gain	a	-1-2-3-4
Quota revenue change	b+e	---
Net national welfare	-c-d+e	-2-3-4
Net world welfare (because e=3)	-c-d-2-4	

Results are summarized below by "size" of country.

Very large country. With ES assumed to be perfectly inelastic in the very-large-country case, only two outcomes are possible with a quota. One is for ES to intersect ED´ in its ED segment, giving the same outcome as with no quota. The other outcome is for ES to lie to the right of ED´ in which case the outcome is indeterminate.

Large country. In the large-country case where the ES elasticity is between zero and infinity and the quota is operative, imports of A fall to the quota level, driving a tariff-like wedge between world and domestic price $P_w' - P_d'$. The quota is like an import tariff in benefitting producers and hurting consumers. The Japanese food agency uses a variable quota on grains to maintain stable domestic prices -- a policy giving outcomes similar to the EC variable levy. Either policy exports instability to ROW.

An economic rent of b+e in excess of necessary costs to import accrues to the government if it imports q_e' at the world price and sells domestically at the market clearing price or if it auctions quotas to foreign exporters. In contrast, the benefit accrues to ROW if foreigners are allowed to administer the quota established by a mandatory or voluntary export agreement. Quotas have been widely used to control US imports of beef, sugar, autos, steel, footwear, and textiles. Foreigners prefer quotas for which they receive the economic rent as compared to a tariff accruing to the home country.

Importer A will gain from a quota if it retains quota rent e exceeding c+d in Figure 4.3. In the large-country case, where quotas are operative, foreign producers are big losers. However, if ROW is allowed to obtain rents it can be a gainer from quotas if b+e exceeds 2+3+4. At any rate, the world loses from quotas.

Small country. In the small-country case, an operative quota for importer A does not export social costs to ROW. Economic rent e from ROW does not accrue even if A controls the quota so that any economic rent b accruing to the government or agency of A must come from A's consumers. Cost of the quota to consumers is a+b+c+d, gain to producers is a and to the quota administrator is b, leaving a net national and world deadweight loss of c+d.

In short, import quotas are designed to help producers of an importing country. Whether the transfer inefficiency measured by the ratio (c+d)/a is large or small depends on elasticities of supply and demand of A in the small-country case. In the large-country case, it is also necessary to include the social cost 2+4 in Figure 4.3 borne by ROW. Importer A or ROW may be a net gainer depending on who retains quota rents, but the world is a net loser.

INTERVENTIONS BY EXPORTERS

Interventions by exporters have analytical parallels with interventions by importers examined in the previous section. Again we examine taxes, subsidies, and quotas by country "size." The very large- and small-country cases are instructive but in the real world are never found in the precise forms shown here.

Export Tax

The export tax is widely used by developing countries to provide hard currency to the government. An overvalued currency to be analyzed in the next chapter is an implicit export tax. Export taxes are often on agricultural exports. They constitute a "cheap food policy" and can cause large deadweight losses in developing countries fitting the "small-country" assumption.

Assumptions

The following apply to Figure 4.4:

t = specific export tax (tariff) applied by exporter A
P_w = world price before the tax
P_w' = world price after the tax
P_w-t = domestic price in country A after the tax
s = domestic supply in country A
d = domestic demand in country A
S = supply in ROW
D = demand in ROW
ES = excess supply for exporter A, s-d
ES_t = excess supply for exporter A after tax
ED = excess demand for exporter A, D-S
q_c = consumption in country A before the tax
q_c' = consumption in country A after the tax
q_p = production in country A before the tax
q_p' = production in country A after the tax
Q_c = consumption in ROW before the tax
Q_c' = consumption in ROW after the tax
Q_p = production in ROW before the tax
Q_p' = production in ROW after the tax
$q_p - q_c$ (exports of A) = $Q_c - Q_p$ (imports of ROW) = q_e before export tax
$q_p' - q_c'$ (exports of A) = $Q_c' - Q_p'$ (imports of ROW) = q_e' after export tax.

Imposition of the specific fixed-rate export tariff or tax shifts upward the excess supply curve ES by the vertical distance t to ES_t. In the large-country case, the excess demand curve ED slopes upward to the left so that the lower export supply quantity at a given price raises the world price to P_w'.

Welfare Analysis

Changes in welfare with imposition of the export tax compared to unrestricted market equilibrium are shown by areas from Figure 4.4.

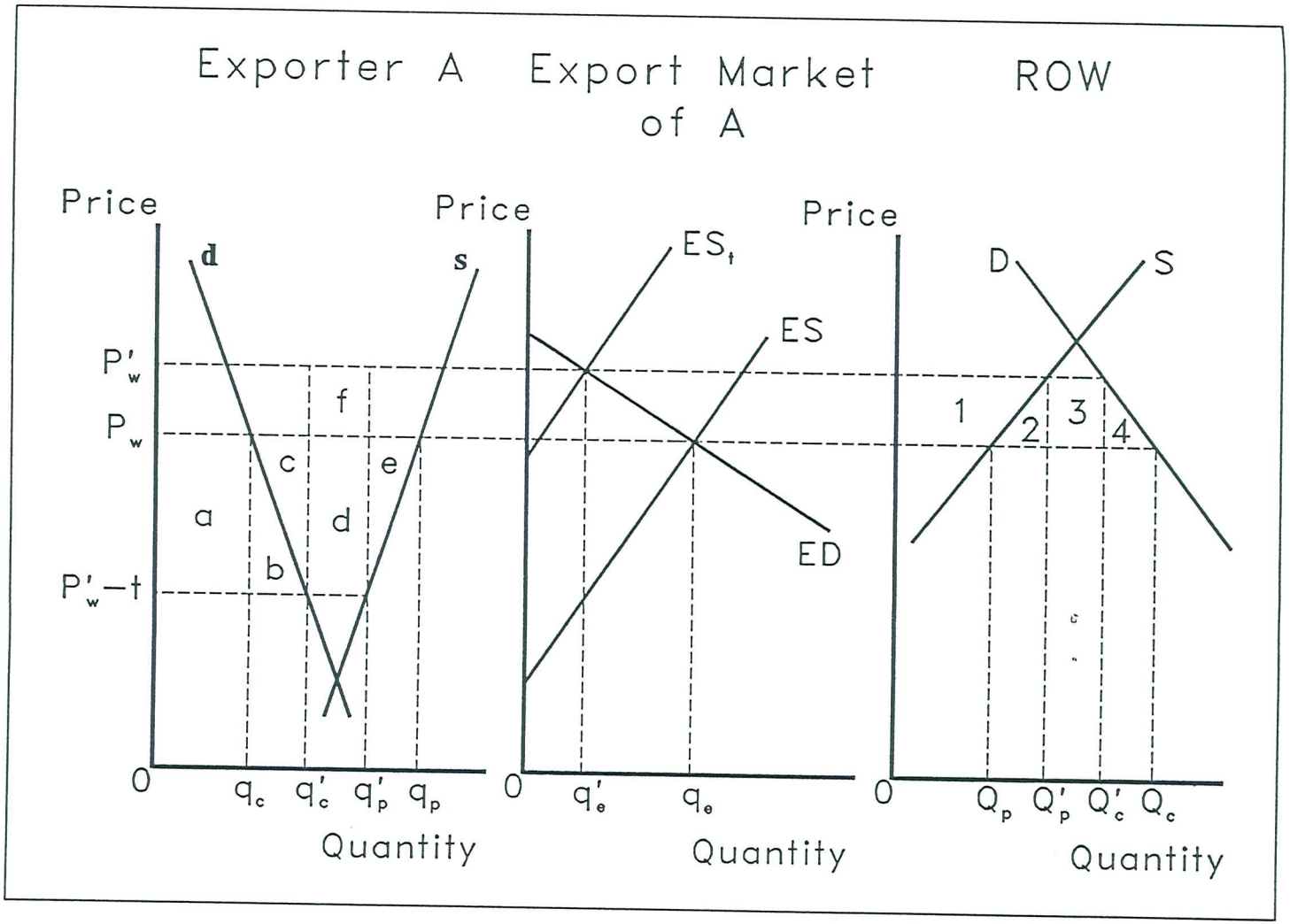

Figure 4.4. Effects of an Export Tax.

	Exporter A	ROW
Consumer surplus gain	a+b	-1-2-3-4
Producer surplus gain	-a-b-c-d-e	1
Government revenue change	d+f	---
Net national welfare	-c-e+f	-2-3-4
Net world welfare (because f=3)	-c-e-2-4.	

Welfare effects are summarized by "size" of country.

Very large country. If D, S, and ED are perfectly inelastic (vertical), $P_w' = P_w + t$. The world price rises by the amount of the export tax imposed by A. In that case, social cost 2+4 is small as D and S approach perfect inelasticity. Domestic price in A is $P_w = P_w' - t$ so social costs are zero and national welfare gain is f in country A. The magnitude of transfer f from ROW to A depends on the amount of exports and the export tax rate t.

Large country. The elasticity of ED is between zero and infinity in the large-country case. The optimal tariff would be where f-c-e is a maximum. Of course, for any arbitrary value of t the net benefit to A is negative if c+e exceeds f. A could be better or worse off from the tariff, depending on elasticities of supply and demand.

Small country. With ED perfectly elastic in the small-country case, P_w equals P_w' and f is zero. The entire cost of the tariff is borne by producers in A. Exporter A loses c+e, hence imposing the tariff is irrational. Welfare in ROW does not change.

Whether the case is for a very large, large, or small country, the world loses from export tariffs as indicated by the negative value c+e+2+4 in the welfare analysis. Tariffs are prohibited by law on American exports.

An *optimal export tariff* maximizes area f+d in Figure 4.4. A perfectly discriminating monopolist exporter could reap revenue equal to the entire triangle bounded by the price axis and ES and ED in the middle panel of Figure 4.4. If only one price can be charged and the demand ED and supply ES are linear, the optimal export tariff is at quantity $q_e/2$ (see footnote 1). In the general case, the optimal export tariff is $t = -p/E_x$ where E_x is the export elasticity of the demand curve ED.[3] In the small-country case where $E_x = -\infty$, t is zero. In the very-large-country case where E_x approaches zero, the optimal export tariff approaches infinity.

The analysis ignores issues of retaliation. It assumes that tariff revenue is all important. In fact, extraction of economic rent from monopoly pricing in the domestic market can be a larger source of additional revenue to producers. As Figure 4.4 showed, a tax that maximizes export revenue can make domestic producers, the nation, and the world worse off.

Export Subsidy

Assumptions

Conditions are defined as follows for Figure 4.5:

su = fixed-rate export subsidy applied by exporter A
P_w = world price before the subsidy
P_w' = world price after the subsidy
$P_w' + su$ = domestic price in country A with the subsidy
s = domestic supply in country A

[3]Marginal revenue from exports is $p + p/E_x$. Marginal cost is p - t. Equating marginal cost and marginal revenue gives optimal export tariff $t = -p/E_x$.

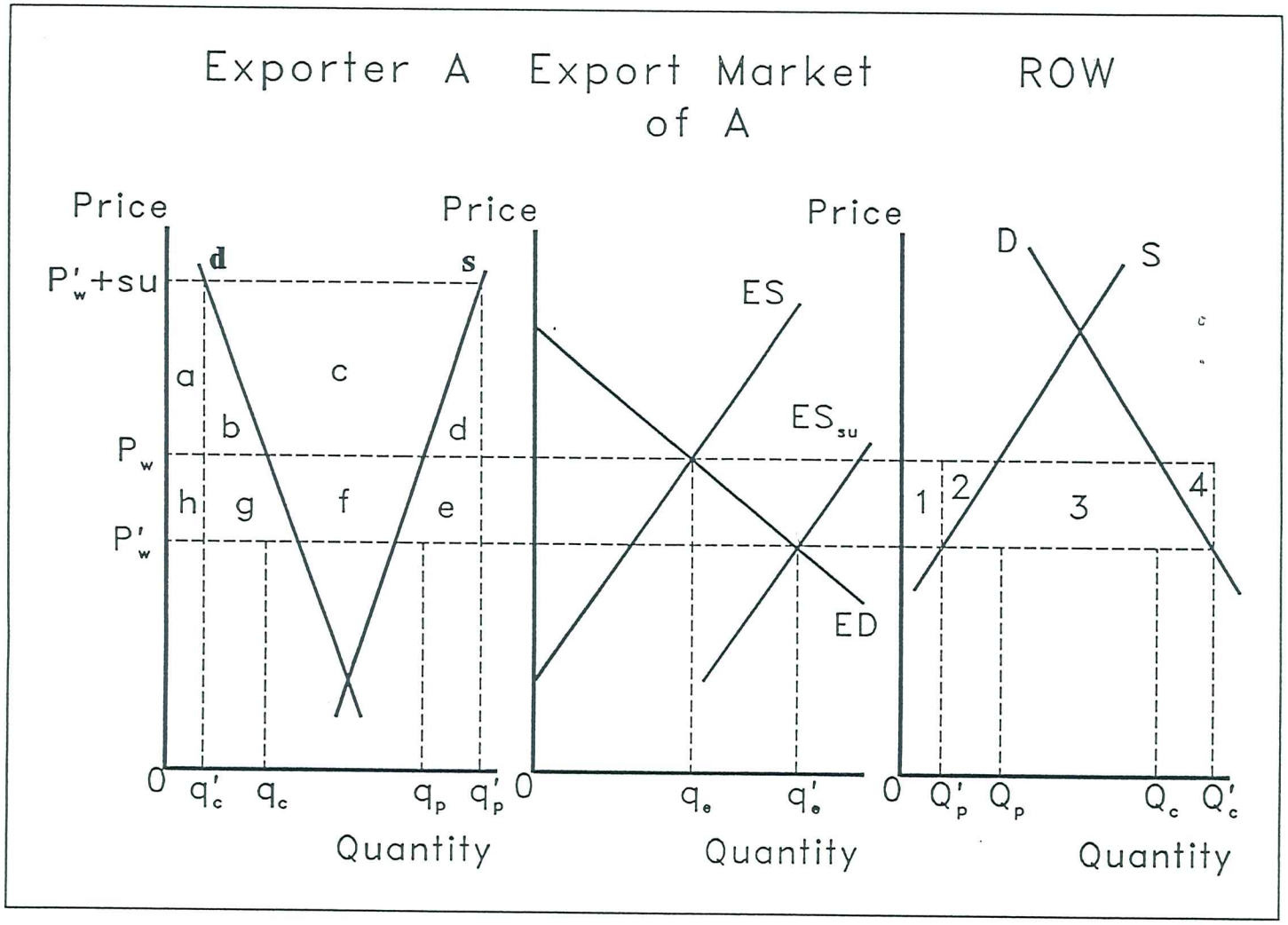

Figure 4.5. Effects of an Export Subsidy.

d = domestic demand in country A
S = supply in ROW
D = demand in ROW
ES = excess supply for exporter A, **s-d**
ES_{su} = excess supply for exporter A with the subsidy
ED = excess demand for exporter A, D-S
q_c = consumption in country A before the subsidy
q_c' = consumption in country A after the subsidy
q_p = production in country A before the subsidy
q_p' = production in country A after the subsidy
Q_c = consumption in ROW before the subsidy
Q_c' = consumption in ROW after the subsidy
Q_p = production in ROW before the subsidy
Q_p' = production in ROW after the subsidy
$q_p - q_c$ (exports of A) = $Q_c - Q_p$ (imports of ROW) = q_e before subsidy
$q_p' - q_c'$ (exports of A) = $Q_c' - Q_p'$ (imports of ROW) = q_e' after subsidy.

The export subsidy is widely used by developed countries to enhance income of producers. The subsidy reduces world price, expands exports of A, and expands imports of ROW. The subsidy at a flat amount of su per unit causes the new excess supply curve of A, ES_{su}, to be below the former excess supply, ES, by the vertical distance su.

Welfare Analysis

Compared to open market equilibrium, imposition of the export subsidy causes changes indicated by areas in Figure 4.5 as follows:

	Exporter A	ROW
Consumer surplus gain	-a-b	1+2+3
Producer surplus gain	a+b+c	-1-2
Government revenue change	-b-c-d-e-f-g	---
Net national welfare	-b-d-e-f-g	3
Net world welfare (because 2+3+4=e+f+g)	-b-d-2-4	

We now turn to welfare impacts by "size" of country.

Very large country. With ED perfectly inelastic, the export subsidy drives the world price down to $P_w' = P_w$ - su. As a net importer, ROW gains from this maximum reduction in world price. The entire export subsidy is transferred from A to ROW. The larger the country the less rational the subsidy.

Large country. With ED neither perfectly elastic nor inelastic, some but not all the export subsidy provided by A is transferred to ROW. Although A's producers gain, the loses to taxpayers and consumers more than offset the gain to producers so the export subsidy makes A worse off. That the European Community provides export subsidies despite overall losses to the community is partly a testimony to the power of producers and partly an indication of the worth of other objectives such as price stability and food security. By varying the export subsidy in the face of shifting domestic supply and demand, the domestic price can be maintained at a constant level P_w' + su for domestic consumers while price variability is exported to ROW.

Small country. In the small-country case, ED is perfectly elastic. Thus $P_w' = P_w$ and the domestic price is P_w + su. Domestic consumers may object to paying a higher price

than ROW consumers for the commodity and ROW may object to A's dumping in world markets at less than prices charged at home. However, ROW experiences no welfare effects in the small-country case. The entire cost of the transfer a+b+c to producers is borne by domestic consumers and taxpayers. Full national income of A is reduced by b+d. However, the export subsidy is more successful for A than in the larger-country case because benefits of the subsidy do not leak to ROW.

Because of the welfare losses to exporters using export subsidies, their widespread use by the US and the European Community seems incongruent. The beneficiaries of export subsidy competition are importing countries.

Export Quota

Assumptions

Definitions and assumptions for Figure 4.6 are as follows:

$P_d = P_w$ = domestic price equal to world price before the export quota
P_d' = domestic price after the quota
P_w' = world price after the quota
q_e' = export quota y-x, the horizontal distance between **d** and **d'** in A
d = domestic demand before the quota in country A
d' = domestic demand plus the quota in country A
s = domestic supply in country A
S = supply in ROW
D = demand in ROW
ES = excess supply for exports of country A, **s-d**
ED = excess demand for exports of country A, D-S
ES' = excess supply for export of country A, given the quota
q_c = consumption in country A before the quota
q_c' = consumption in country A after the quota
q_p = production in country A before the quota
q_p' = production in country A after the quota
Q_c = consumption in ROW before the quota
Q_c' = consumption in ROW after the quota
Q_p = production in ROW before the quota
Q_p' = production in ROW after the quota
$q_p - q_c$ (exports of A) = $Q_c - Q_p$ (imports of ROW) = q_e before the export quota
$q_p' - q_c'$ (exports of A) = $Q_c' - Q_p'$ (imports of ROW) = q_e' = the export quota.

World markets, initially assumed to be in equilibrium at world price P_w equal to domestic price P_d with exports of q_e from A, are subjected to an export quota q_e' imposed by A. If q_e' would have exceeded q_e, the quota would have been inoperative and had no effect.

With q_e', the world market finds a new equilibrium where ES' intersects ED at world price P_w'. However, excess supply remains in country A at that price. The excess is eliminated at the domestic equilibrium price P_d' where **d'** and s intersect. Thus domestic price falls, world price rises, and trade falls if the quota is operative.

Welfare Analysis

Welfare impacts of an operative exporter quota compared to an open market solution are summarized below using areas of Figure 4.6:

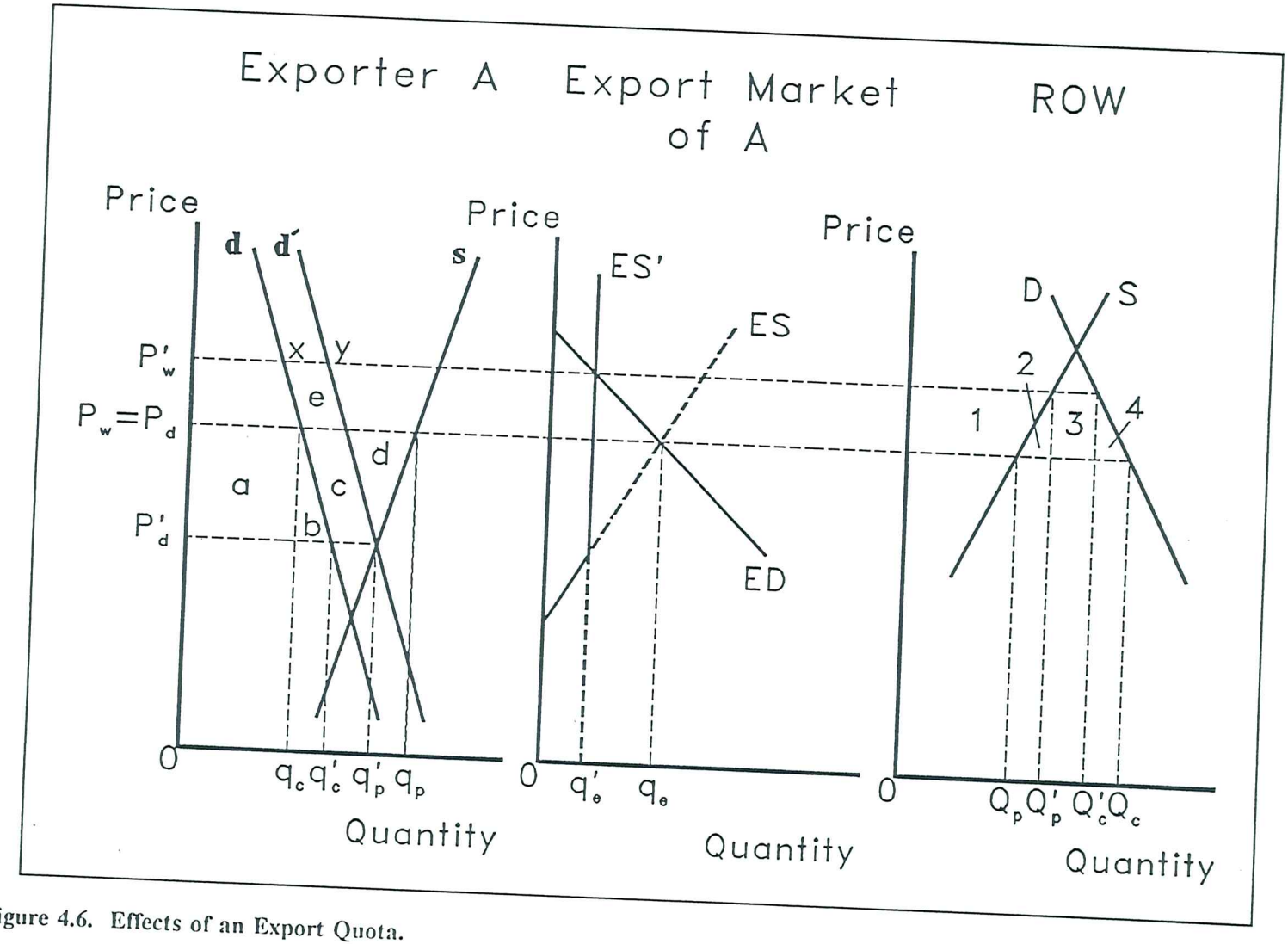

Figure 4.6. Effects of an Export Quota.

	Exporter A	ROW
Consumer surplus gain	a+b	-1-2-3-4
Producer surplus gain	-a-b-c-d	1
Quota revenue change	c+e	---
Net national welfare	-d+e	-2-3-4
Net world welfare (because e=3)	-d-2-4	

Welfare impacts of export quotas vary by "size" of country.

Very large country. With ED perfectly inelastic for the very-large-country case, the outcome of an export quota imposed by exporter A is trivial. Either ED will lie to the right of the quota q_e' represented by ES′ and the outcome is inconclusive, or ED will lie to the left of q_e' and the outcome will be the same as a free market. The quota in that case is inoperative.

Large country. If area e exceeds area d in Figure 4.6, exporter A gains from an export quota. Consumers and quota holders gain. If the government or other quota holder is willing to redistribute revenue, then consumers, producers, and taxpayers can gain if e exceeds d.

ROW loses from an operative quota. With the quota, losses to ROW exceed gains to A so that the world loses d+2+4 of full income.

Small country. With ED perfectly elastic, $P_w = P_w'$. Because A receives no transfers from ROW, e vanishes and rent transfers from the quota are from producers to the government or other quota holders. Net social cost to A is d.

Trade Embargo

A trade *embargo*, which may be a partial or complete withholding of exports to one or more importers by one or more exporters, is a form of quota (see also Chapter 11). From 1970 to 1990, the United States engaged in five farm export embargoes (see US Department of Agriculture for extensive history and analysis).

Export embargoes are effective if they are a concerted effort of all major exporters, if supplies are short and stocks are low, if there are no good substitutes for the commodity, and if compliance can be assured. Most embargoes have not met these conditions and have not been effective. Following the US embargo in 1980, for example, the Soviet Union merely turned to other exporters for grains. The US directly lost few sales in the short run because world grain supplies were sufficiently tight so that the US merely switched sales to markets vacated by competing exporters' sales to the Soviets. The greatest cost, in addition to deadweight losses depicted in Figure 4.6, is the long-term sales foregone because of our lost reputation for being a reliable supplier. Importers work to diversify supply sources as evidenced by Japan's investments in Brazil's soybean industry. Whether costs have outweighed benefits to the US of embargoes is difficult to judge because issues are political as well as economic.

IMPORT AND EXPORT TAX SYMMETRY

Import and export taxes have been addressed separately but in fact they are interconnected (Lerner). Developing countries trying to protect industry and promote import substitution by taxing imports are also retarding industry by implicitly taxing exports.

To see why an explicit tax on imports (exports) is an implicit tax on exports (imports), a distinction between importables, exportables, and nontraded goods is useful. In the small-

country case, a tax on imports raises domestic import prices and costs. If importables are inputs into exportables, export good costs are raised. Exporters in the small-country case must absorb the cost -- an implicit tax. Higher input prices also cause prices of import goods to rise relative to nontradables, causing substitution of nontradables for imports. The price of nontradables rises. If nontradables such as labor are inputs for exportable products, again the result is a tax on exportables.

The process applies also to an explicit tax on exports which becomes an implicit tax on imports. This so called *Lerner symmetry* is not 1:1, however. The degree of tax passthrough depends on the degree of substitution among importables, exportables, and nontradables, among inputs in production, among products in consumption, and also on small- and large-country assumptions. Studies for developing countries indicate on average that half or more of import taxes are passed on as implicit export taxes (Thomas and Nash, p. 53; see also Clements and Sjaastad for procedures and estimates).

CONCLUSIONS

Border interventions in some but not all cases enhance welfare of nations imposing them. However, in the absence of externalities or other market failures that are corrected by interventions, policy distortions reduce full income in global perspective. That is one reason why nations seek to reduce trade barriers through international negotiations.

Sometimes combinations of border interventions are employed. The United States uses both quotas and import duties for sugar. The quotas are allocated in part by political considerations. The quotas entitle the holder to receive more than the world price for delivery to the US. Hence, the quota in part transfers the rents from import tariffs to favored less-developed-country quota holders. Following a complaint by Australia to the General Agreement on Tariffs and Trade (GATT) organization, the American sugar quota system was rejected as a violation of trade rules by a panel of GATT in 1989.

This chapter has treated trade distortions in a first-round, partial equilibrium analysis. In fact, an action by country A tends to invite retaliation by country B. Country A, B, or third countries may gain or lose in the swirl of measures and counter-measures. Strategic trade policy for such situations is addressed in Chapters 7 and 8.

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