Shadow Pricing Rules for Partially Traded Goods

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(long version)

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Abstract

This paper shows how to shadow price partially traded goods following the standard rules of cost-benefit analysis, i.e. identifying the individuals affected, measuring their corresponding compensating variations, and aggregating those measures according to a distributional value judgement. The analysis is conducted in a partial equilibrium framework, allowing for direct operational application.

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SHADOW PRICING RULES FOR PARTIALLY TRADED GOODS

by *Elio Londero* [*]

In a recent paper, Little and Mirrlees (1991, p. 353) reiterated their previous argument (Little and Mirrlees, 1974, p. 229) regarding the pricing of goods that are partially traded at the margin: "When price varies with the amount of trade, it is not exactly right to use marginal revenues and costs", adding that in such circumstances proper pricing "has tended to be neglected". This paper shows how to price partially traded goods following the standard rules of cost-benefit analysis, i.e. identifying the individuals affected, measuring their corresponding compensating variations and aggregating those measures according to a distributional value judgement. To that effect, two basic scenarios will be considered in the domestic market: perfect competition and pure monopoly. Although not all possible cases will be analyzed, those selected should be useful in guiding the analysis of those omitted. The presentation follows the approach used in Londero (1987) and the analysis is conducted in a partial equilibrium framework, allowing for direct operational application.

1. Introduction

A good is said to be internationally traded at the margin (imported or exported), or simply traded, when the adjustment to an additional demand or supply of that commodity is made *entirely* through a change in its exports or imports.[1] Conversely, a good is said to be

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[1] Note that the definition depends on what actually happens with the corresponding exports or imports, and *not* on what *would potentially happen if* export and import incentives and disincentives were altered or eliminated. In the latter case we speak of tradable (importable or exportable) goods.

non-traded at the margin when the adjustment to an additional domestic demand or supply does not directly affect imports or exports. It follows from the above definition that for non-traded goods the adjustment must take place either through changes in production (produced at the margin), changes in the allocation among alternative domestic uses (non-produced at the margin), or a combination of both. Finally, when the adjustment to an additional domestic demand or supply directly affects both trade and domestic production or allocation among domestic users, the good is said to be *partially traded*.[2]

The valuation of partially traded goods, as their name suggests, must take into account the effects on both the foreign exchange and the domestic markets. In this paper we will analyze several cases of partially traded consumption goods and deduce the corresponding pricing rules. Our approach will be to treat foreign and domestic markets separately, and allocate the effects of an additional supply or demand accordingly. We will start by presenting the case of two consumers and a non-traded good, and then build upon this example to analyze the cases of partially exported and imported consumer goods.

The analysis is conducted only for consumer goods. The analytical complications introduced by intermediate goods are not exclusive of partially traded goods and will not add to the main objective of the paper. For the sake of simplicity, it is assumed that there are no indirect taxes or subsidies to domestic sales (domestic market and basic prices are equal). Taking them into account would complicate the tables considerably without contributing much to the understanding of the problem. It is also assumed throughout that taxes are mere transfers with zero efficiency value, i.e. allocative effects of financing the impact on government budgets (Drèze and Stern, 1987; Squire, 1989) are ignored. Finally, accounting prices of investment are all assumed to be equal to one.

2. Two consumers and a non-traded good

Let us consider the simple case depicted in Figure 1 of an investment project

[2] Note that the definition does not require that the international price be affected. Cf. Little and Mirrlees (1991, p. 353).

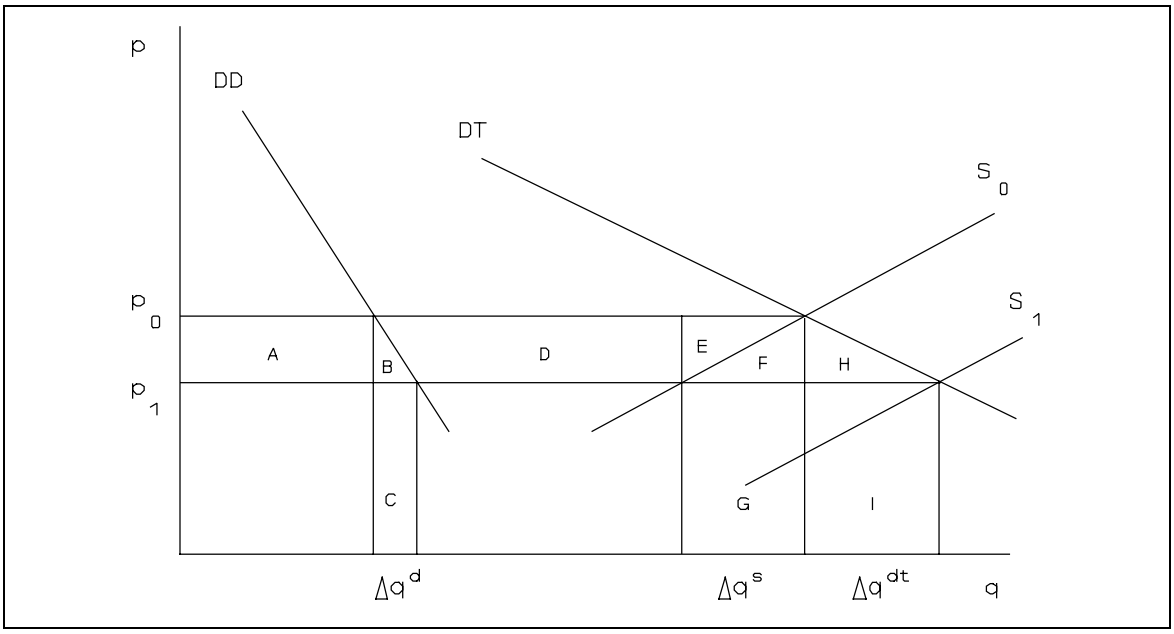

Figure 1. A supply increase

increasing the supply of a non-traded good consumed by only two persons purchasing $q(p_0)$ at price p_0, and sold under competitive conditions so that producers are price takers. When price falls to p_1 due to the supply shift ($\Delta q^s + \Delta q^{dt}$), the measures of consumers' gains are the corresponding compensating variations (*CVs*). In Table 1 these *CVs* have been approximated by the corresponding changes in consumers' surpluses.[3] The first consumer gains area ($A + B$) measured by using his individual demand curve. This can also be presented as his savings in purchasing the original amount $q(p_0)$, i.e. area A, plus his willingness to pay for his additional consumption ($B + C$), less what he actually pays for that additional consumption (C). The second consumer also gains his savings in purchasing the original amount ($B + D + E + F$), plus his willingness to pay for the additional consumption ($H + I - B - C$), less what he actually pays for it ($I - C$).

Turning now to producers' income changes, the amount the consumers pay for the additional consumption is additional revenue for the project (I). Similarly, the amount the

[3] Londero (1987, Appendix A) shows that in most practical cases, the difference between the *CV* and the change in the consumer's surplus is not significant. Also see Mishan (1981a, Ch. 7, and 1981b, Part V) for special qualifications in the case of rents (producers' surplus).

Table 1. Two consumers

	Project	Consumer 1	Consumer 2	Domestic Producers	Total
Consumers' *CV*					
Purchases of $q(p_0)$		$+A$	$+(B+D+E+F)$	$-(A+B+D+E+F)$	
Willingness to pay for $\Delta\underline{q}$		$+(B+C)$	$+(H+I-B-C)$		$+(H+I)$
Amount paid for $\Delta\underline{q}$	$+I$	$-C$	$-(I-C)$		
Producers' income changes					
Sales reduction at p_1	$+G$			$-G$	
Cost savings				$+(F+G)$	$+(F+G)$
Total	$+(I+G)$	$+(A+B)$	$+(D+E+F+H)$	$-(A+B+D+E)$	$+(H+I)+(F+G)$

consumers save due to the price reduction is a revenue loss for the remaining producers, who also reduce their sales in G when valued at p_1. (Note that if measured at p_0, the sales reduction is $E + F + G$, but we have already accounted for $E + F$.) When reducing their sales, however, they no longer incur the corresponding production costs, assumed here to equal $(F + G)$.

When we sum the columns of Table 1 we obtain the income changes of each one affected by the project: the additional revenue for the project, the consumers' compensating variations, and the revenue lost by the other producers of q. Recalling that we assumed that accounting prices of investment funds were all equal to one, and that no allocative effects were attributable to financing the impact on government budgets, in order to calculate the total benefits attributable to the project we only need a distributional value judgement that would allow us to express the change in "total welfare" as a function of measures of individual welfare changes. When such a value judgement translates into assigning equal valuations to the marginal income changes of all persons, we obtain the so-called "efficiency value" of the project's additional supply. Since equal valuations translate into unitary weights, and assuming that long-run marginal cost at market prices $(F + G)$ equals that at "efficiency" prices, the last column of Table 1 provides us with the standard result for the "efficiency" value of the project's sales when accounting prices of investment funds are equal to one and there are no allocative effects originating in the financing of government budgets; i.e. the willingness to pay for the additional consumption plus the value of the resources

released by replacing other producers.[4]

3. Exports: basic prices are equal

Supply increases

The preceding method can also be applied to the case of an exported good. Let us first consider the case of an increase in the supply of the exported good when domestic and export basic prices are equal, i.e. when producers are price takers. In Figure 2, *S* will be domestic supply, *DD* will be domestic demand, *DI* will be international demand, and *SI* will be total international supply. By increasing supply in the foreign market, the additional domestic supply $\Delta q^s + \Delta q^{dt}$ reduces price in both markets increasing domestic consumption Δq^d, reducing output of other domestic producers Δq^s, and increasing exports $\Delta q^{dt} - \Delta q^d$.

Initially, we will further assume that product q is not subject to export taxes or subsidies and that the difference between the market and the "efficiency" price of foreign exchange is fully explained by taxes. That situation is presented in Table 2, where a column for the government has been added in order to register the changes in import and export tax revenue (transfers) brought about by the net additional foreign exchange.[5] Considering that in cost-benefit analysis we are normally concerned only with the welfare of residents, income changes of "foreigners" have been treated separately.

The columns for the project, the domestic consumers, and the domestic producers are identical to the corresponding columns in Table 1. The column for the government shows the changes in tax revenue originating in the changes in exports and imports, i.e. the "efficiency" *premium* of foreign exchange. In other words, it shows that the "efficiency" price ratio of foreign exchange, or ratio of the efficiency to the market exchange rate, is

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[4] If the rate of discount were not equal to the marginal efficiency rate of return, we would have accounting prices of investment funds different from one (UNIDO, 1972; Londero, 1987). If that were the case, and under the assumption that savings are, *ceteris paribus*, a function of welfare levels (and not only monetary income), we would be able to use the results of Table 1 to apply UNIDO's approach. See Londero (1987, Part III).

[5] See Londero (1987, Ch. 3).

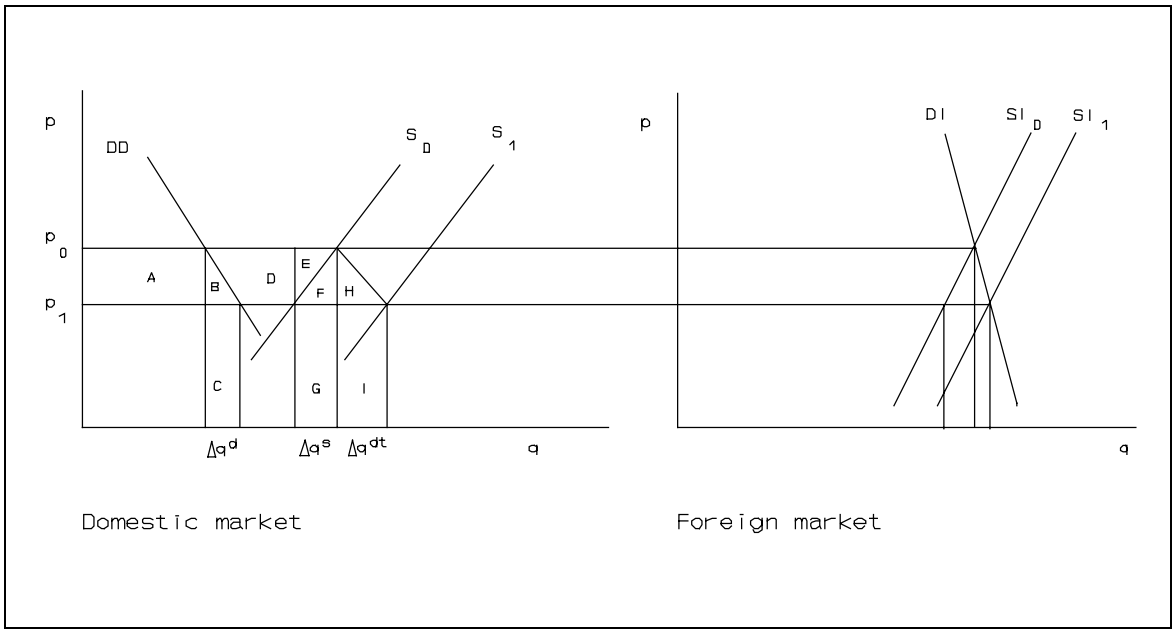

Figure 2. An increase in the supply of exports

Table 2. An increase in the supply of exports (basic prices are equal, no export taxes or subsidies

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Consumers' *CV*							
Purchases of $q(p_0)$		$+A$	$-(A+B+D+E+F)$	$-\alpha(B+D+E+F)$	$-(1+\alpha)(B+D+E+F)$	$+(B+D+E+F)$	
Willingness to pay for Δq		$+(B+C)$			$+(B+C)$	$+(H+I-B-C)$	$+(H+I)$
Amount paid for Δq	$+I$	$-C$		$\alpha(I-C)$	$(1+\alpha)(I-C)$	$-(I-C)$	
Producers' income changes							
Sales reduction at p_1	$+G$		$-G$				
Cost savings			$+(F+G)$		$+(F+G)$		$+(F+G)$
Total	$+(I+G)$	$+(A+B)$	$-(A+B+D+E)$	$\alpha(I-C-B-D-E-F)$	$+(B+C)+(F+G)+(1+\alpha)(I-C-B-D-E-F)$	$+(D+E+F+H)$	$+(H+I)+(F+G)$

Source: Figure 2.

$(1 + \alpha)$.[6] Finally, the *Domestic Total* column registers the sum of the income changes attributable to the additional supply of the project, i.e. its value at "efficiency" prices. It captures all the income changes of residents: the willingness to pay for the additional domestic consumption ($B + C$), the value of the resources released by replacing domestic producers ($F + G$), and the *net* foreign exchange generated by the project, the marginal export revenue ($I - C - B - D - E - F$), valued at "efficiency" prices. That net additional foreign exchange originates in two main sources: first, in the value of the additional exports at price p_1 ($I - C$), resulting from total additional sales less additional sales to the domestic market; and second, in the loss of foreign exchangedue to the fall in price ($B + D + E + F$).

Note that if foreign demand faced by the exporting country had been infinitely elastic (the "small-country" assumption), the price change would have been nil. Consequently, the whole production of the project would have constituted additional exports, and there would have been no effects on domestic consumers or producers. In other words, we would have reached the standard border price rule of "efficiency" analysis for goods that are fully exported at the margin.[7]

Also note that Table 2 accounts for only part of the effects on "foreigners", since the price reduction will affect foreign consumers in more than the effects from sales originating in this country and there will be effects on foreign producers.

Let us now consider the case when exports are subject to an *ad valorem* tax at the rate t, i.e. the domestic price p^d will be equal to

$$p^d = p^{fob} (1 - t)$$

the f.o.b. price plus the export tax. This is the price that will be faced by the producer and is designated by p_0 or p_1 in Figure 2. Consequently, the foreign exchange component of the

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[6] When goods are partially traded, the whole difference between the "efficiency" and the market exchange rate may not be explained by taxes alone. The assumption is used here only to simplify the presentation.

[7] In practice, estimates of demand and supply price elasticities will be required. The Appendix derives the formulas for this case.

transactions will be

$$p^{fob} = p^d / (1 - t)$$

In this case, some changes need to be introduced into our preceding analysis, but in order to make them, we need to know how the project allocates its sales between the domestic and the foreign markets. Let us assume, for the sake of simplicity, that the project will export all of its production, and, consequently, that it will be the remaining domestic producers that will change their sales to the domestic market. If that is the case, when exports are taxed, additional sales revenue for the project is no longer $I + G$, but

$$(I + G) / (1 - t)$$

However, only part of this sum will be appropriated by the project, as it will pay the government taxes in the amount of

$$t (I + G) / (1 - t)$$

So, the final result will be a revenue increase of $(I + G)$, as shown in Table 2a. As regards domestic producers, their revenue losses due to the price reduction will now be

$$A + (B + D + E + F) / (1 - t)$$

but they will pay less export taxes to the government in the amount of

$$t (B + D + E + F) / (1 - t)$$

At the same time, instead of receiving export revenue

$$C / (1 - t)$$

at price p_1, they will receive C for the additional domestic sales, and they will no longer pay

Table 2a. An increase in the supply of exports (basic prices are equal, there are export taxes)

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Consumers' *CV*							
Purchases of $q(p_0)$		$+A$	$-A-(B+D+E+F)/(1-t)$	$-\alpha(B+D+E+F)/(1-t)$	$-(1+\alpha)(B+D+E+F)/(1-t)$	$+(B+D+E+F)(1-t)$	$-\alpha(B+D+E+F)/(1-t)$
Willingness to pay for Δq		$+(B+C)$			$+(B+C)$	$+[(H+I)-(B+C)]/(1-t)$	$+(H+I)/(1-t)+t(B+C)$
Amount paid for Δq	$+I/(1-t)$	$-C$	$+C-[C/(1-t)]$	$\alpha(I-C)/(1-t)$	$(1+\alpha)(I-C)/(1-t)$	$-(I-C)/(1-t)$	$\alpha(I-C)/(1-t)$
Export tax due to Δq	$-tI/(1-t)$		$+tC/(1-t)$	$+t(I-C)/(1-t)$			
Export tax due to Δp			$+t(B+D+E+F)/(1-t)$	$-t(B+D+E+F)/(1-t)$			
Producers' income changes							
Sales reduction at p_1	$+G/(1-t)$		$-G/(1-t)$				
Export tax	$-tG/(1-t)$		$+tG/(1-t)$				
Cost savings			$+(F+G)$		$+(F+G)$		$+(F+G)$
Total	$+(I+G)$	$+(A+B)$	$-(A+B+D+E)$	$(\alpha+t)(I-C-B-D-E-F)/(1-t)$	$+(B+C)+(F+G)+(1+\alpha)(I-C-B-D-E-F)/(1-t)$	$+(D+E+F+H)/(1-t)$	$+(H+I)/(1-t)+(F+G)+\alpha(I-C-B-D-E-F)/(1-t)$ $t(B+C)$

Source: Figure 2.

export taxes in the amount of

$$t\ C\ /\ (1\ -\ t)$$

Finally, they will no longer sell Δq^s, with a value of $G\ /\ (1\ -\ t)$ at price p_1, and will no longer pay the corresponding export tax of

$$t\ G\ /\ (1\ -\ t)$$

The sales reduction will save the corresponding long-run marginal cost $F + G$. The net effect on government revenue of the additional exports and the international price reduction will include the changes in tax revenue due to the use of the additional foreign exchange, plus that originating in the additional exports of q, less the effect of the price reduction, i.e.

$$\frac{(\alpha + t)}{(1 - t)} (I - C - B - D - E - F)$$

The final efficiency result is the same as before, i.e. the willingness to pay for the additional domestic consumption $(B + C)$, plus the value of the resources released by replacing domestic producers $(F + G)$, plus the marginal export revenue valued at "efficiency" prices $[(1 + \alpha)(I - C - B - D - E - F) / (1 - t)]$. Had demand faced by domestic producers been infinitely elastic, we would have obtained the standard result: all additional production by the project would have constituted additional exports and the efficiency value of the additional supply of q would have been that of the corresponding amount of foreign exchange.

Demand increases

Let us now turn to Figure 3, which allows us to consider the case of a change in the domestic demand for the (at the margin partially) exported good. To consider the most common case, let us say that domestic demand in the "without project situation" (*DD*)

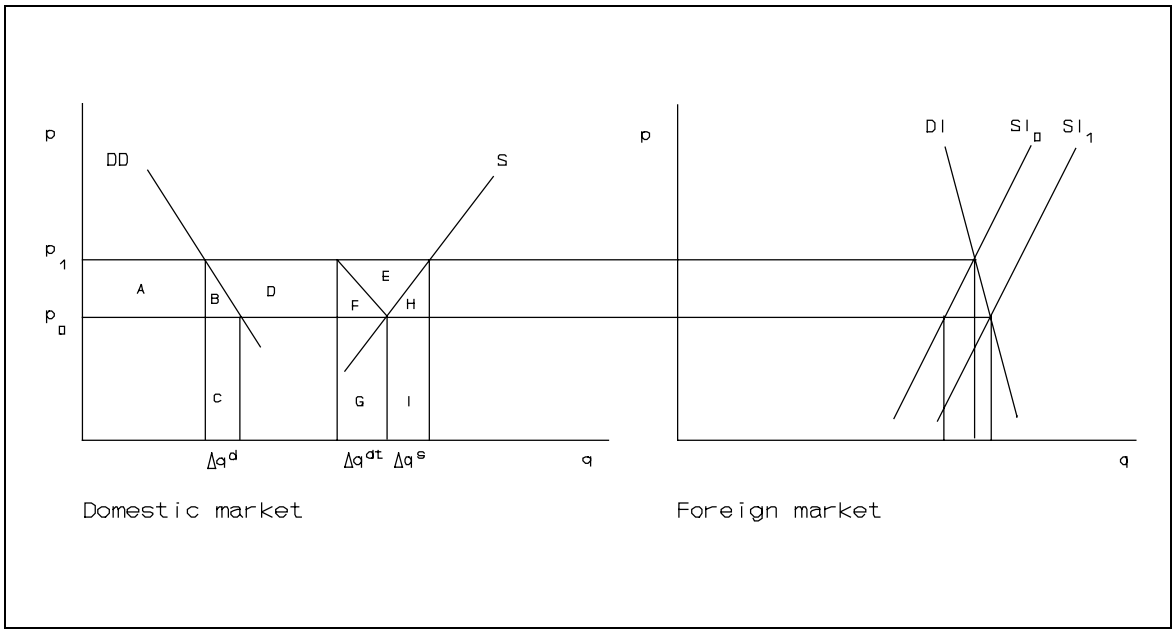

Figure 3 An increase in the domestic demand for exports (basic prices are equal)

Table 3. An increase in the domestic demand for exports (basic prices are equal, no export taxes or subsidies)

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Consumers' *CV*							
Purchases of $q(p_1)$		$-A$	$(A+B+D)$	$+\alpha(B+D)$	$+(1+\alpha)(B+D)$	$-(B+D)$	$+\alpha(B+D)$
Willingness to pay for Δq		$-(B+C)$			$-(B+C)$	$-(F+G-B-C)$	$-(F+G)$
Amount paid for Δq	$-G$	$+C$		$-\alpha(G-C)$	$-(1+\alpha)(G-C)$	$+(G-C)$	$-\alpha(G-C)$
Producers' income changes							
Domestic sales at p_1	$-(I+E+H+F)$		$+(I+E+H+F)$				
Cost savings			$-(H+I)$		$-(H+I)$		$-(H+I)$
Total	$-(G+I+E+H+F)$	$-(A+B)$	$+(A+B+D+E+F)$	$\alpha(B+D+C-G)$	$+(1+\alpha)(B+D-G+C)-(B+C)-(H+I)$	$-(D+F)$	$-(F+G)-(H+I)+\alpha(B+D-G+C)$

Source: Figure 3.

increases by ($\Delta q^s + \Delta q^{dt}$), raising price from p_0 to p_1, and generating the effects presented in Table 3 and explained below.

The project purchases an additional quantity of q at the new price, paying

$$p_1 (\Delta q^s + \Delta q^{dt}) = G + F + E + H + I$$

part of which is additional revenue for the domestic producers ($F + E + H + I$), andpart of which is the amount that foreign consumers previously paid for Δq^{dt}. Domestic consumers loose their *CVs* of the price increase ($A + B$) while domestic producers gain the effects of the price increase. Due to the effect of the higher f.o.b. price, the government receives the additional tax revenue implicit in the foreign exchange premium. The higher price increases the foreign exchange earned by the amount of exports corresponding to the "with project situation" ($B + D$), but reduces the foreign exchange revenue due to the reduction in the volume of exports valued at p_0 ($G - C$). Finally, foreign consumers loose their *CVs* of the price increase, part of which is ($D + F$).

The *Domestic Total* column indicates the sum of the *CVs* of all those affected, or value of the additional demand at "efficiency" prices, resulting in: the willingness to pay for the reduction in domestic consumption ($B + C$), the value of the resources used to produce the additional quantity Δq^s ($H + I$), and the value at "efficiency" prices of the net effect on foreign exchange earnings (marginal export revenue)

$$(1 + \alpha)(B + D - G + C)$$

Note that if all consumers were domestic, the *Government* column would not exist and the sum of all the *CVs* would have been the traditional "efficiency" result: the willingness to pay for the reduction in consumption ($F + G$) plus the cost of producing the additional quantity Δq^s ($H + I$). On the other hand, had foreign demand been infinitely elastic, the total cost at "efficiency" prices would have been equal to that of the foreign exchange forgone due to the reduction in exports, i.e. the standard "border price rule".

As in the case of the export tax, if the exporters were beneficiaries of an *ad valorem* export subsidy, the distribution of the real income changes becomes slightly more complicated because we

now have to take into account the changes in government revenue brought about by the price change. In this case, the domestic price received by producers will be equal to the f.o.b. price plus the export subsidy

$$p^d = p^{fob}\ (1 + s)$$

The results are presented in Table 3a. There we can see that there are two important differences when compared with the case when there are no export subsidies (Table 3): i) that in order to express foreign exchange flows correctly, the corresponding domestic currency flows have been divided by $(1 + s)$; and ii) that in this case the government is also affected by the export subsidy it pays, i.e. the net effect of the higher price and the smaller volume of exports. The "efficiency" cost of providing the additional amount of q to the project, recorded as the *Domestic Total*, is composed of the willingness to pay for the reduction in the domestic consumption $(B + C)$, plus the cost of the additional production $(H + I)$, less the efficiency value of the marginal export revenue $(1 + \alpha)(B + D - G + C)/(1 + s)$ gained due to the price increase. Here, also, had foreign supply faced by the domestic consumers been infinitely elastic, the result would have been the border price value of the forgone exports times the efficiency price ratio of foreign exchange.

Once again, if all consumers were domestic, and consequently $s = \alpha = 0$, we would obtain the standard "efficiency" result: the willingness to pay for the reduction in consumption $(F + G)$ plus the cost of producing the additional quantity $(H + I)$.

4. Exports: price discrimination

Foreign demand is infinitely elastic

So far, we have considered cases in competitive markets, where sellers are price takers. Let us now consider the case of a good produced by a perfectly discriminating monopolist benefitting from a prohibitive tariff and facing an infinitely elastic foreign demand, depicted in Figure 4(a). The necessary condition for profit maximization by the discriminating monopolist is

$$y^t = y^x = y^d = c$$

Table 3a. An increase in the domestic demand for exports (basic prices are equal, there are export subsidies)

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Consumers' *CV*							
Purchases of $q(p_1)$		$-A$	$+A$				
Willingness to pay for Δq		$-(B+C)$			$-(B+C)$	$-(F+G-B-C)/(1+s)$	$[s(B+C)-(F+G)]/(1+s)$
Amount paid for Δq	$-G/(1+s)$	$+C$	$-C+C/(1+s)$	$-\alpha(G-C)/(1+s)$	$-(1+\alpha)(G-C)/(1+s)$	$+(G-C)/(1+s)$	$-(\alpha+s)(G-C)/(1+s)$
Export subsidy due to Δq	$-sG/(1+s)$		$sC/(1+s)$	$s(G-C)/(1+s)$			
Producers' income changes							
Sales at p_1	$-(F+E+H+I)$		$+(B+D)/(1+s)+(F+E+H+I)$	$+\alpha(B+D)/(1+s)$	$+(1+\alpha+s)(B+D)/(1+s)$	$-(B+D)/(1+s)$	$+(\alpha+s)(B+D)/(1+s)$
Export subsidy due to Δp			$+s(B+D)/(1+s)$	$-s(B+D)/(1+s)$	$-s(B+D)/(1+s)$		$-s(B+D)/(1+s)$
Cost savings			$-(H+I)$		$-(H+I)$		$-(H+I)$
Total	$-(G+F+E+H+I)$	$-(A+B)$	$+(A+B+D+F+E)$	$(\alpha-s)(B+D+C-G)/(1+s)$	$+(1+\alpha)(B+D-G+C)/(1+s)-(B+C)-(H+I)$	$-(D+F)/(1+s)$	$[s(B+C)-(F+G)]/(1+s)-(H+I)+\alpha(B+D-G+C)/(1+s)$

Source: Figure 3.

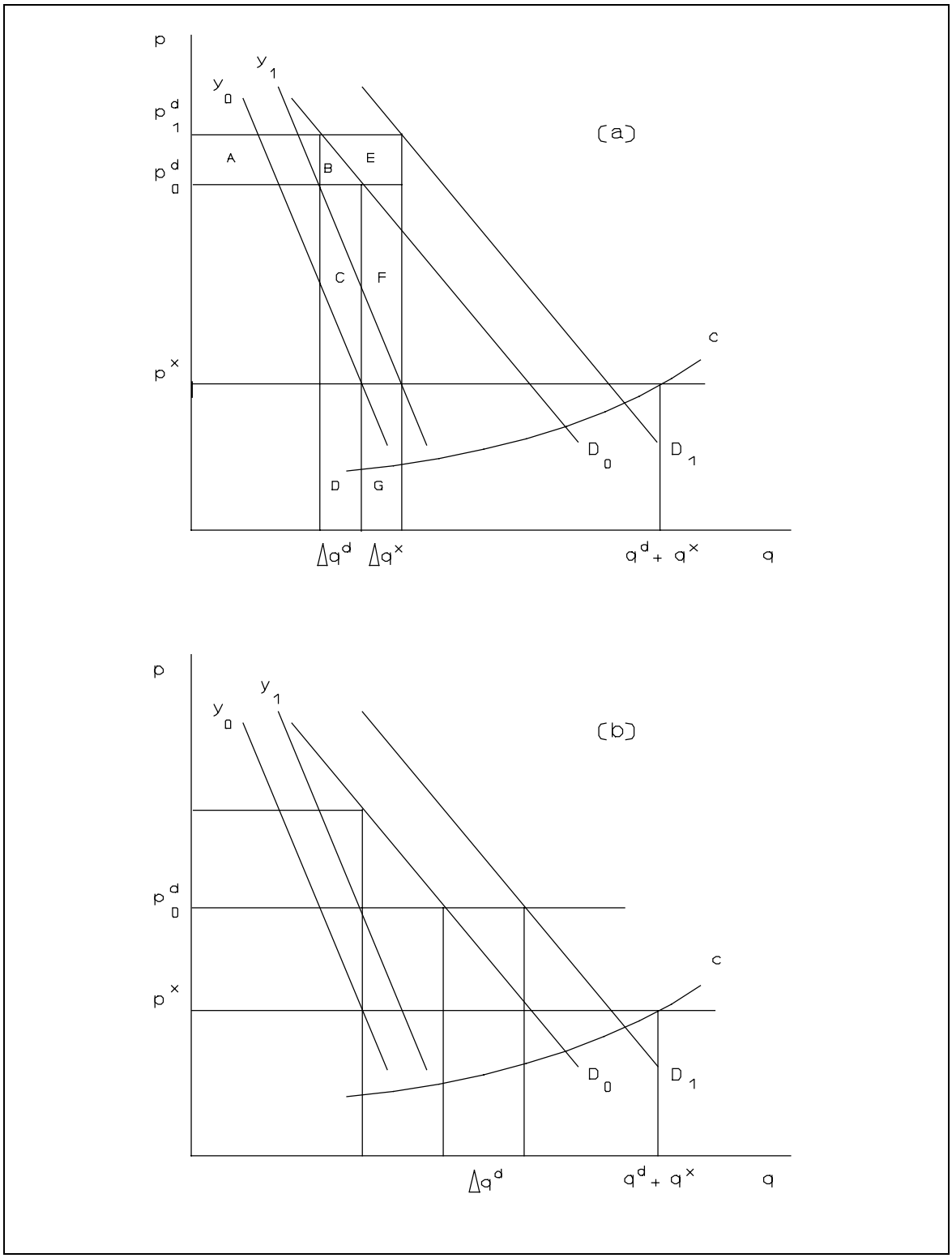

Figure 4 An increase in the domestic demand for exports (price discrimination)

where y^t, y^x, and y^d are total, foreign, and domestic marginal revenues, respectively, and c is marginal cost.[8] Consequently, in the case of Figure 4.(a), total production is fully determined by foreign marginal revenue $y^x = p^x$ and marginal cost c. However, due to the prohibitive tariff, the domestic producer is able to distribute that production between markets by setting profit maximizing price p_0^d in the domestic market. In such a case, an increase in the monopolist's supply will not affect the domestic market, i.e. for supply increases, the good is fully exported at the margin because the international price cannot be affected by the domestic monopolist.

However, an increase in the domestic demand for q good would affect both domestic consumption (Δq^d) and exports (Δq^x), fitting our definition of a partially traded good, while domestic production is not affected because foreign marginal revenue p^x is not affected. The project purchases the amount $\Delta q = \Delta q^d + \Delta q^x$ at the new domestic price p_1^d, spending

$$p_1^d (\Delta q^d + \Delta q^x) = B + C + D + E + F + G$$

shown as a revenue loss for the project in Table 4. Of that amount, $C + D$ was previously paid by domestic consumers and G by foreign buyers, so that the revenue change for the monopolist originating in the sale of Δq is only $B + E + F$. The price increase brought about by the additional domestic demand generates additional revenue for the monopolist (A) and creates a loss to the consumers measured by their *CVs* ($A + B$). Finally, the government loses αG in tax revenue due to the reduction in the supply of foreign exchange $p^x \Delta q^x$. As a result, the value at "efficiency" prices of the additional demand is the willingness to pay for the reduction in domestic consumption plus the "efficiency value" of the reduction in the supply of foreign exchange.

Note that what makes the good partially traded is the increase in the domestic price, which explains the reduction in domestic consumption. If the domestic price were not affected, as in Figure 4(b), due for example to an import tariff that imposes an upper limit p_0^d on the domestic price, the good would be fully exported at the margin.

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[8] See Ferguson and Gould (1975) or Henderson and Quandt (1971).

Table 4. An increase in the domestic demand for exports (price discrimination)

	Project	Domestic Consumers	Monopolist	Government	Total
Consumers' *CV*					
Purchases of $q(p_0)$		$-A$	$+A$		
Willingness to pay for Δq		$-(B+C+D)$			$-(B+C+D)$
Amount paid for Δq	$-(C+D)$	$+(C+D)$			
Producers' income changes					
Exports reduction	$-G$			$-\alpha G$	$-(1+\alpha)G$
Additional income	$-(B+E+F)$		$+(B+E+F)$		
Total	$-(B+C+D+E+F+G)$	$-(A+B)$	$+(A+B+E+F)$	$-\alpha G$	$-(B+C+D)-(1+\alpha)G$

Source: Figure 4.

Table 4a. An increase in the domestic demand for exports (price discrimination and export subsidies)

	Project	Domestic Consumers	Monopolist	Government	Total
Consumers' *CV*					
Purchases of $q(p_0)$		$-A$	$+A$		
Willingness to pay for Δq		$-(B+C+D)$			$-(B+C+D)$
Amount paid for Δq	$-(C+D)$	$+(C+D)$			
Producers' income changes					
Exports reduction	$-G/(1+s)$			$-\alpha G/(1+s)$	$-(1+\alpha)G/(1+s)$
Export subsidy	$+sG/(1+s)$			$-sG/(1+s)$	
Additional income	$-(B+E+F)$		$+(B+E+F)$		
Total	$-(B+C+D+E+F+G)$	$-(A+B)$	$+(A+B+E+F)$	$-(\alpha+s)G/(1+s)$	$-(B+C+D)-(1+\alpha)G/(1+s)$

Source: Figure 4.

If exports of q were subsidized at the *ad valorem* rate s, the (basic) export price faced by the discriminating monopolist would be

$$p^x = p^{fob} (1 + s)$$

Then, the only change to our preceding example would be that of the effect on government revenue (Table 4a). As the foreign exchange value of the reduction in exports would only be $G / (1 + s)$, the change in government revenue would be $-(\alpha + s)\ G / (1 + s)$.

Foreign demand is not infinitely elastic

When the domestic monopolist does not face an infinitely elastic foreign demand curve (Figure 5), the necessary condition for profit maximization remains

$$y^t = y^d = y^x = c$$

Consequently, additional domestic demand will raise not only domestic but also total marginal revenue ($y_0^t \rightarrow y_1^t$ in Figure 5), which in turn will affect both domestic and international prices. As a result, the adjustment will include reductions in both domestic *and foreign* consumption (Δq^{dd}, Δq^x), as well as an increase in production (Δq^s). The corresponding income changes are presented in Table 5. The project purchases $\Delta q = DT_0 - DT_1$ in the domestic market, paying a total of $(B + D + C + E)$. The domestic consumers lose their *CV* of the price increase $(A + B)$. The monopolist gains the domestic price increase times the new domestic sales $(A + B + D)$, plus the export price increase times the new export sales (F), plus the additional sales to the domestic market valued at p_0^d (E), less the reduction in export revenue due to the $p_1^x - p_0^x$ price increase (H), and less the additional costs to produce Δq^s (I). Government tax revenue is affected by the net change in foreign exchange $(F - H)$, and finally, foreign consumers lose their *CVs* of the export price increase. As expected, the

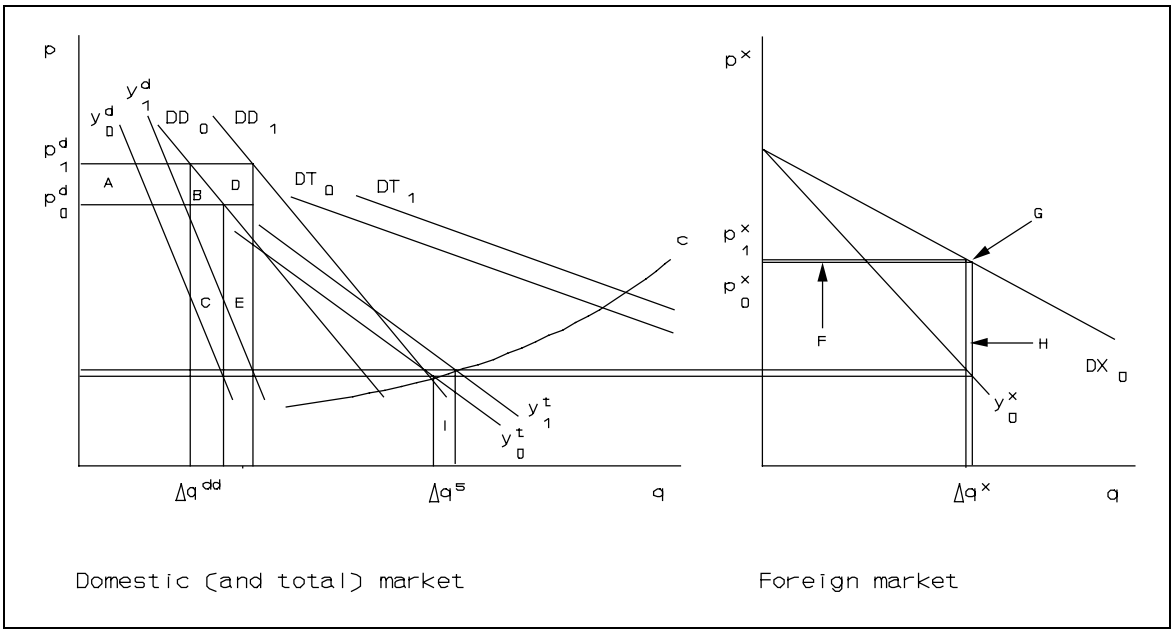

Figure 5 An increase in the domestic demand for exports (monopoly power in both markets)

domestic cost at efficiency prices is equal to the willingness to pay for the reduction in domestic consumption ($B + C$), plus the additional cost of increasing the production of q (I), plus the efficiency value of the net change in foreign exchange $(1 + \alpha)(F - H)$. As in the previous cases, had all consumers been domestic, the government would not have been affected and the efficiency cost would have been the willingness to pay for the reduction in domestic consumption plus the marginal cost of increasing production.

If the monopolist is subject to an *ad valorem* export tax at rate t, then the additional demand will have further effects on government revenues, as presented in Table 5a. The government will not only receive additional revenue due to the use of the additional foreign exchange, but will also be affected by the change in tax revenue originated in the marginal export revenue ($F - H$).

Let us now consider the case of an increase in the supply of exports depicted in Figure 6. The monopolist introduces a technical change represented by the shift in his long-

Table 5. An increase in the domestic demand for exports (monopoly power in both markets)

	Project	Domestic Consumers	Monopolist	Government	Domestic Total	Foreigners	Total
Consumers' *CV*							
Purchases of $q(p_1)$		$-A$	$(A+F)$	$+\alpha F$	$+(1+\alpha)F$	$-F$	$+\alpha F$
Willingness to pay for Δq		$-(B+C)$			$-(B+C)$	$-(G+H)$	$-(B+C+G+H)$
Amount paid for Δq	$-C$	$+C$	$-H$	$-\alpha H$	$-(1+\alpha)H$	$+H$	$-\alpha H$
Producers' income changes							
Domestic sales at p_1	$-(B+D+E)$		$+(B+D+E)$				
Additional costs			$-I$		$-I$		$-I$
Total	$-(B+D+C+E)$	$-(A+B)$	$+(A+B+D+F+E-H-I$	$\alpha(F-H)$	$+(1+\alpha)(F-H)-I-(B+C)$	$-(F+G)$	$-(B+C)-(G+H)-I+\alpha(F-H)$

Source: Figure 5.

Table 5a. An increase in the domestic demand for exports (monopoly power in both markets and export taxes)

	Project	Domestic Consumers	Monopolist	Government	Domestic Total	Foreigners	Total
Consumers' *CV*							
Purchases of $q(p_1)$		$-A$	$A+[F/(1-t)]$	$+\alpha F/(1-t)$	$+(1+\alpha)F/(1-t)$	$-F/(1-t)$	$+\alpha F/(1-t)$
Willingness to pay for $\Delta\underline{q}$		$-(B+C)$			$-(B+C)$	$-(G+H)/(1-t)$	$-(B+C)-(G+H)/(1-t)$
Amount paid for $\Delta\underline{q}$	$-C$	$+C$	$-H/(1-t)$	$-\alpha H/(1-t)$	$-(1+\alpha)H/(1-t)$	$+H/(1-t)$	$-\alpha H/(1-t)$
Export taxes			$-t(F-H)/(1-t)$	$t(F-H)/(1-t)$			
Producers' income changes							
Domestic sales at p_1	$-(B+D+E)$		$+(B+D+E)$				
Additional costs			$-I$		$-I$		$-I$
Total	$-(B+D+C+E)$	$-(A+B)$	$+(A+B+D+F+E-H-I)$	$(\alpha+t)(F-H)/(1-t)$	$+(1+\alpha)(F-H)/(1-t)-I-(B+C)$	$-(F+G)/(1-t)$	$-(B+C)-(G+H)/(1-t)-I+\alpha(F-H)/(1-t)$

Source: Figure 5.

run marginal cost (c), at an additional cost equal to

$$\Delta c = c_0[q(p_0^d; p_0^x)] - c_1[q(p_1^d; p_1^x)]$$

As a result, equilibrium prices drop from p_0^d to p_1^d and from p_0^x to p_1^x, increasing the monopolist's revenue by the additional sales ($C + F$) and reducing it due to the lower prices ($-A - D$). The price reduction benefits both domestic and foreign consumers in an amount equal to their corresponding *CVs*, ($A + B$) and ($D + E$), respectively. Finally, the government sees its tax revenue affected by the net change in the supply of foreign exchange. The final efficiency result is (Table 6), as it might be expected, the efficiency value of the net change in the supply of foreign exchange [$(1 + \alpha)(F - D)$], plus the willingness to pay for the additional domestic consumption, less the additional cost at efficiency prices. Had all consumers been domestic, the final result would have been the willingness to pay for the additional consumption, less the additional costs.

If exports were subject to an *ad valorem* tax (Table 6a), the government would also

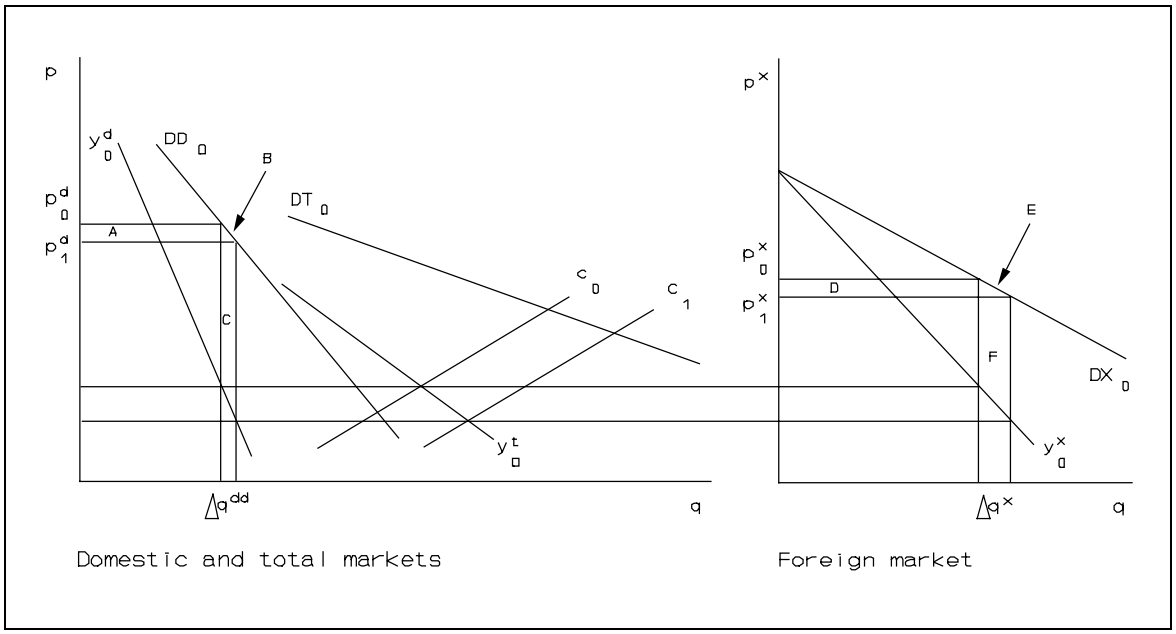

Figure 6 An increase in the supply of exports (monopoly power in both markets)

Table 6. An increase in the supply of exports (monopoly power in both markets)

	Domestic Consumers	Monopolist	Government	Domestic Total	Foreigners	Total
Consumers' *CV*						
Purchases of $q(p_1)$	A	$-(A+D)$	$-\alpha D$	$-(1+\alpha)D$	$+D$	$-\alpha D$
Willingness to pay for Δq	$+(B+C)$			$+(B+C)$	$+(E+F)$	$+(B+C+E+F)$
Amount paid for Δq	$-C$	$+(C+F)$	$+\alpha F$	$+(1+\alpha)F$	$-F$	$+\alpha F$
Producers' income changes						
Additional costs		$\Delta LRMgC$		$\Delta LRMgC$		$\Delta LRMgC$
Total	$(A+B)$	$-(C+F-A-D)+\Delta LRMgC$	$\alpha(F-D)$	$+(1+\alpha)(F-D)+(B+C)+\Delta LRMgC$	$+(D+E)$	$+(B+C+E+F)+(1+\alpha)(F-D)+\Delta LRMgC$

Source: Figure 6.

Table 6a. An increase in the supply of exports (monopoly power in both markets and export taxes)

	Domestic Consumers	Monopolist	Government	Domestic Total	Foreigners	Total
Consumers' *CV*						
Purchases of $q(p_1)$	A	$-A+[D/(1-t)]$	$+\alpha D$	$-(1+\alpha)D$	$+D/(1-t)$	$-\alpha D/(1-t)$
Willingness to pay for Δq	$+(B+C)$			$(B+C)$	$+(E+F)/(1-t)$	$+(B+C)+(E+F)/(1-t)$
Amount paid for Δq	$-C$	$+C+[F/(1-t)]$	$+\alpha F$	$+(1+\alpha)F$	$-F/(1-t)$	$+\alpha F/(1-t)$
Export taxes		$-t(F-D)/(1-t)$	$+t(F-D)/(1-t)$			
Producers' income changes						
Additional costs		$\Delta LRMgC$		$\Delta LRMgC$		$\Delta LRMgC$
Total	$(A+B)$	$-(C+F-A-D)+\Delta LRMgC$	$(\alpha+t)(F-D)$	$+(1+\alpha)(F-D)+(B+C)+\Delta LRMgC$	$+(D+E)/(1-t)$	$+(B+C)+(E+F)/(1-t)+(1+\alpha)(F-D)/(1-t)+\Delta LRMgC$

Source: Figure 6.

see its revenue affected by the net tax revenue originating in the marginal export revenue ($F - D$).

5. Imports: domestic markets are competitive

Demand increases

Let us now consider the case of a domestically produced, but marginally imported good when the importer has such a big share of the international market that it can affect the international price (Figure 7). An additional domestic demand for q will increase its international price, and consequently the domestic one, where producers are price takers. The additional domestic demand will thus be met by an increase in domestic production (Δq^{sd}), a reduction of alternative domestic uses (Δq^{d}), and an increase in imports ($\Delta q^{s} - \Delta q^{sd}$).

We can now turn to those affected (Table 7). The project pays the amount ($F + H + I + G$) for the additional demand; domestic consumers lose their *CVs* of the price increase ($A + B + C + E + F$); domestic producers ("factor owners") increase their rents by ($A + B$); and the government ceases to receive the taxes corresponding to the alternative use of the additional foreign exchange needed to finance the additional

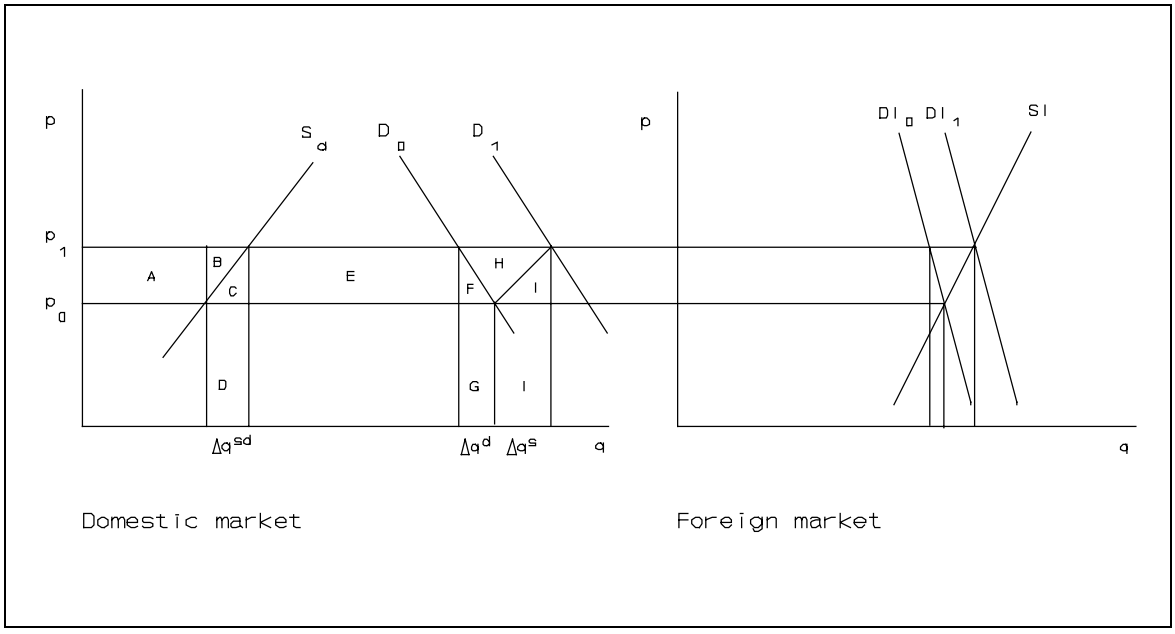

Figure 7 An increase in the demand for a marginally imported good

Table 7. An increase in the domestic demand for a marginally imported input (basic prices are equal and there are no import taxes or subsidies)

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Domestic consumers							
Purchases of $q(p_1)$		$-(A+B+C+E)$		$-\alpha E$	$-A-B-C-(1+\alpha)E$	$+E$	$-A-B-C-\alpha E$
Willingness to pay for Δq^d		$-(F+G)$			$-(F+G)$		$(F+G)$
Amount paid for Δq^d	$-G$	$+G$					
Domestic producers							
Additional income due to Δp			A		A		A
Willingness to receive			$-(C+D)$		$-(C+D)$		$-(C+D)$
Received			$+(B+C+D)$	$+\alpha D$	$+B+C+(1+\alpha)D$	$-D$	$+B+C+\alpha D$
Foreign producers							
Additional income	$-(F+H+I)$			$-\alpha(F+H+I)$	$-(1+\alpha)(F+H+I)$	$+(F+H+I)$	$+(F+H+I)$
Costs of $\Delta q^s - \Delta q^{sd}$						$-I+C+D$	$-I+C+D$
Total	$-(F+H+I+G)$	$-(A+B+C+E+F)$	$+(A+B)$	$-\alpha(E+F+H+I)+\alpha D$	$-(1+\alpha)(E+F+H+I)+$ $(1+\alpha)D-(C+D)-(F+G)$	$E+F+H+C$	$-\alpha(E+F+H-D)$ $-(1+\alpha)I-(F+G)$

Source: Figure 7.

imports ($E + F + H + I - D$). The sum of the *Domestic Total* column indicates the "efficiency" cost of the additional demand, composed of the "efficiency" value of the foreign exchange needed for the additional imports, plus the marginal cost of producing Δq^{sd}, plus the domestic willingness to pay for the amount diverted from alternative uses. By looking at the last column, we can see that if all producers had been domestic, we would have arrived at the standard "efficiency" result: the willingness to pay for the diverted consumption plus the marginal cost of the additional production.

If imports were subject to an *ad valorem* tax at rate t (Table 7a) government revenue would be further affected by: the additional taxes generated by the marginal import cost, i.e. $t\ (E + F + H + I) / (1 + t)$, less the taxes lost from diverting foreign exchange to this use α $(E + F + H + I) / (1 + t)$, less the taxes no longer paid on the substituted imports $t\ D / (1 + t)$, plus the taxes gained by the alternative use of the foreign exchange so released $\alpha\ D / (1 + t)$. The *Domestic Total* indicates that the efficiency value of the additional demand equals that of the net additional foreign exchange $(1 + \alpha)(E + F + H + I - D) / (1 + t)$, plus the efficiency cost of substituting imports (assumed equal to $C + D$), plus the willingness to pay for the reduction in domestic consumption (F + G). *I*n the last column we can see that the traditional result would have been obtained (willingness to pay for the forgone consumption $F + G$, plus the cost of the additional production I), had all producers been domestic.

Supply increases

The case of an increase in the domestic supply of a marginally imported input (Figure 8) when that increase affects the international price, is similar to the preceding one. By reducing demand in the foreign market, the additional domestic supply ($\Delta q^s + \Delta q^d$) will reduce price from p_0 to p_1, increasing domestic consumption by Δq^d, reducing domestic production by Δq^{sd}, and substituting imports by $\Delta q^s - \Delta q^{sd}$. The project will receive additional revenue for selling $\Delta q^s + \Delta q^d$ at the new price p_1 $(I + G)$; domestic consumers will gain the *CV* of the price reduction $(A + B + C + E + F + H)$; domestic producers will lose the *CV* of the price reduction, assumed to equal $A + B$; and the government will gain the

Table 7a. An increase in the domestic demand for a marginally imported input (basic prices are equal, there are import taxes)

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Domestic consumers							
Purchases of $q(p_1)$		$-(A+B+C+E)$		$(t-\alpha)E/(1+t)$	$-[A+B+C+(1+\alpha)E/(1+t)]$	$+E/(1+t)$	$-(A+B+C)-\alpha E/(1+t)$
Willingness to pay for Δq^d		$-(F+G)$			$-(F+G)$		$-(F+G)$
Amount paid for Δq^d	$-G$	$+G$					
Import taxes							
Domestic producers							
Additional income due to Δp			A		A		A
Willingness to receive			$-(C+D)$		$-(C+D)$		$-(C+D)$
Received			$+(B+C+D)$	$+(\alpha-t)D/(1+t)$	$+B+C+(1+\alpha)D/(1+t)$	$-D/(1+t)$	$+B+C+\alpha D/(1+t)$
Foreign producers							
Additional income	$-(F+H+I)$			$(t-\alpha)(F+H+I)/(1+t)$	$-(1+\alpha)(F+H+I)/(1+t)$	$+(F+H+I)/(1+t)$	$-\alpha(F+H+I)/(1+t)$
Costs of $\Delta q^s - \Delta q^{sd}$						$(-I+C+D)/(1+t)$	$(-I+C+D)/(1+t)$
Total	$-(F+H+I+G)$	$-(A+B+C+E+F)$	$+(A+B)$	$(t-\alpha)(E+F+H+I-D)/(1+t)$	$-(1+\alpha)(E+F+H+I)/(1+t)+$ $(1+\alpha)D/(1+t)-(C+D)-(F+G)$	$(E+F+H+C)/(1+t)$	$-\alpha(E+F+H-D)/(1+t)$ $-(1+\alpha)I/(1+t)-(F+G)$

Source: Figure 7.

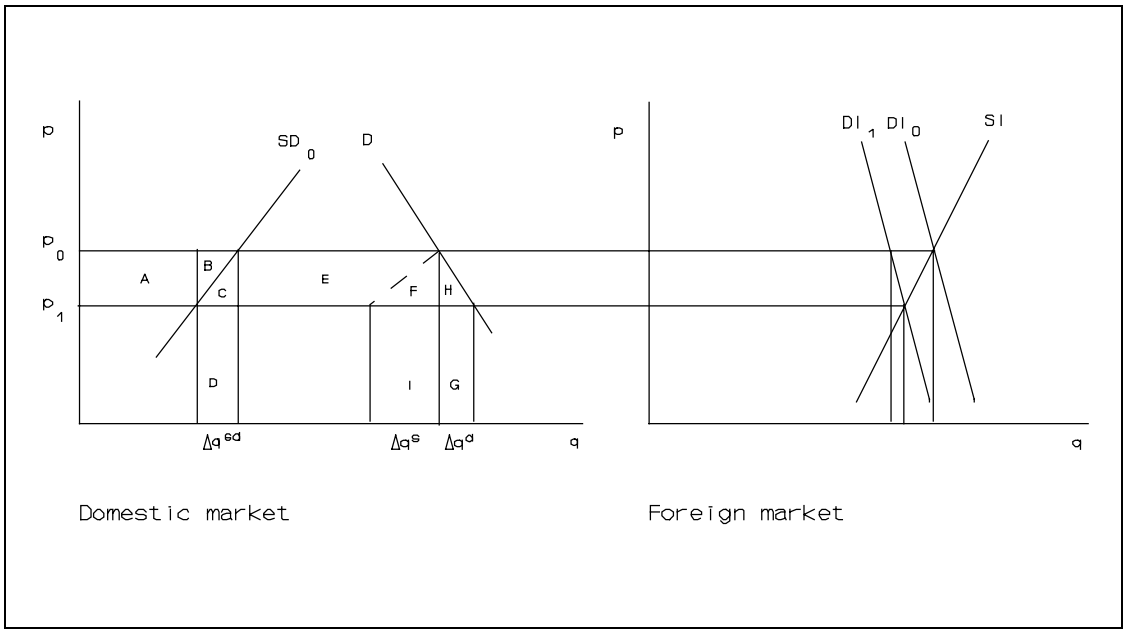

Figure 8 An increase in the domestic supply of a marginally imported good

additional taxes collected from the alternative use of the foreign exchange released by the import substitution and by the reduction in the international price.

The *Domestic Total* column in Table 8 indicates that the "efficiency" value of the additional supply is the "efficiency" value of the additional foreign exchange $[(1 + \alpha)(E + F + I - D)]$, plus the "efficiency" value of the resource savings resulting from the reduction in the supply of other producers, assumed to equal $(C + D)$, plus the willingness to pay for the additional consumption $(H + G)$. The *Total* column allows us to see what the result would have been if all producers had been domestic. Since there would have been no effects on government revenue ($\alpha = 0$), we would have obtained the familiar result: the willingness to pay for the additional consumption $(H + G)$, plus the "efficiency" value of the resource savings, assumed here to be equal to $F + I$.

When there are import taxes at an *ad valorem* rate t (Table 8a), the government receives additional revenue due to the alternative use of the net foreign exchange liberated by the import substitution $[\alpha (E + F + I - D) / (1 + t)]$, but sees its import tax revenue reduced due the reduction in the value of such imports $[t (E + F + I - D) / (1 + t)]$. The

Table 8. An increase in the domestic supply of a marginally imported input (basic prices are equal and there are no import taxes or subsidies)

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Domestic consumers							
Purchases of $q(p_1)$		$(A+B+C+E+F)$		$\alpha(E+F)$	$A+B+C+(1+\alpha)(E+F)$	$-(E+F)$	$A+B+C+\alpha(E+F)$
Willingness to pay for Δq^d		$(H+G)$			$+(H+G)$		$+(H+G)$
Amount paid for Δq^d	$+G$	$-G$					
Domestic producers							
Income reduction due to Δp			$-A$		$-A$		$-A$
Willingness to receive			$+(C+D)$		$+(C+D)$		$+(C+D)$
Received	$+D$		$-(B+C+D)$		$-(B+C)$		$-(B+C)$
Foreign producers							
Income reduction	$+(I-D)$			$\alpha(I-D)$	$(1+\alpha)(I-D)$	$-(I-D)$	$\alpha(I-D)$
Cost savings for $\Delta q^s - \Delta q^{sd}$						$(F+I)-(C+D)$	$(F+I)-(C+D)$
Total	$+(I+G)$	$(A+B+C+E+F+H)$	$-(A+B)$	$\alpha(E+F+I-D)$	$-(1+\alpha)(E+F+I-D)+(C+D)+(H+G)$	$-(E+C)$	$\alpha(E+F+I-D)+(H+G)+(F+I)$

Source: Figure 8.

Domestic Total will be the "efficiency" value of the net foreign exchange earnings, plus the resource savings originating in reducing production due to the price fall ($C + D$), plus the willingness to pay for the additional domestic consumption ($H + G$). Had the product been non-traded, the traditional result of willingness to pay for the additional consumption, less resource savings due to production replacement, would have been obtained.

6. Non-traded products with close traded substitutes

So far, we have considered cases of homogeneous goods. However, in practice, and particularly in relatively open economies, the additional demand or supply of a non-traded product may significantly affect the foreign exchange market via the effects on close substitutes. This is particularly the case when product differentiation exists. Consider, for example, the case depicted in Figure 9, where non-traded product q has a very close imported substitute m. An increase in the demand for q will raise its price, and that higher price will increase the demand for the imported substitute. Consequently, although q is strictly non-traded (its additional demand is met by increasing its domestic production and withdrawing it from other users), an additional demand or supply will have an important effect in the

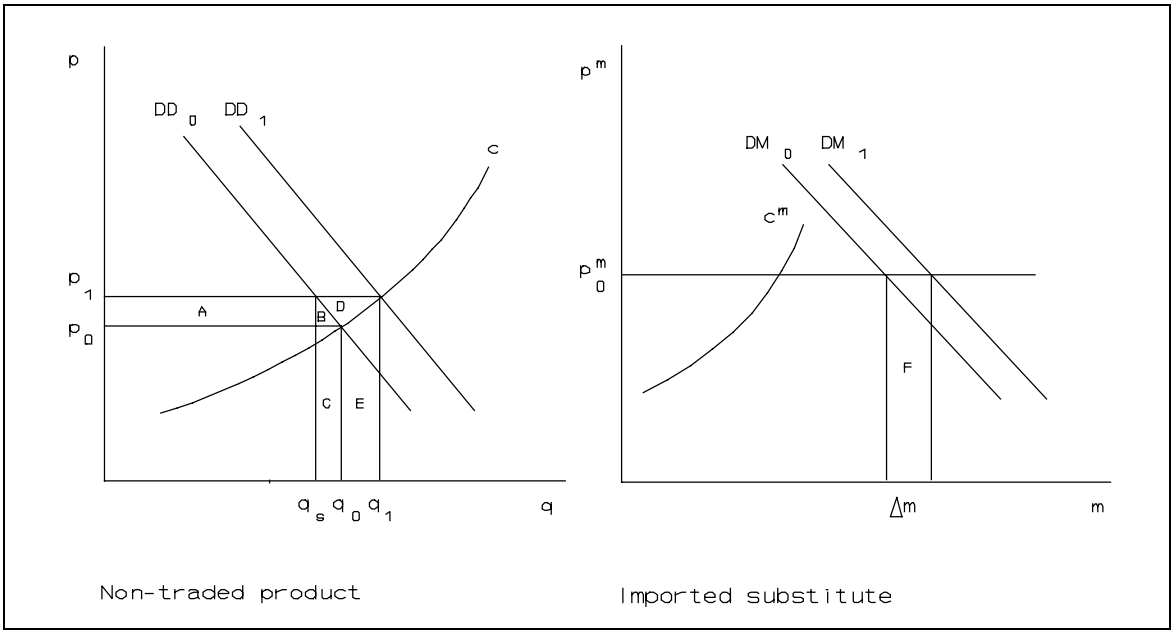

Figure 9 An increase in the domestic demand of a non-traded good with an imported substitute

Table 8a. An increase in the domestic supply of a marginally imported input (basic prices are equal, there are import taxes)

	Project	Domestic Consumers	Domestic Producers	Government	Domestic Total	Foreigners	Total
Domestic consumers							
Purchases of $q(p_1)$		$(A+B+C+E+F)$		$(\alpha-t)(E+F)/(1+t)$	$A+B+C+(1+\alpha)(E+F)/(1+t)$	$-(E+F)/(1+t)$	$A+B+C+\alpha(E+F)/(1+t)$
Willingness to pay for Δq^d		$(H+G)$			$+(H+G)$		$+(H+G)$
Amount paid for Δq^d	$+G$	$-G$					
Domestic producers							
Income reduction due to Δp			$-A$		$-A$		$-A$
Willingness to receive			$+(C+D)$		$+(C+D)$		$+(C+D)$
Received	$+D$		$-(B+C+D)$		$-(B+C)$		$-(B+C)$
Foreign producers							
Income reduction	$+(I-D)$			$(\alpha-t)(I-D)/(1+t)$	$(1+\alpha)(I-D)/(1+t)$	$-(I-D)/(1+t)$	$\alpha(I-D)/(1+t)$
Cost savings for $\Delta q^s - \Delta q^{sd}$						$[(F+I)-(C+D)]/(1+t)$	$[(F+I)-(C+D)]/(1+t)$
Total	$+(I+G)$	$(A+B+C+E+F+H)$	$-(A+B)$	$(\alpha-t)(E+F+I-D)/(1+t)$	$(1+\alpha)(E+F+I-D)/(1+t)+(C+D)+(H+G)$	$-(E+C)/(1+t)$	$\alpha(E+F+I-D)/(1+t)+(H+G)+(F+I)$

Source: Figure 8.

foreign exchange market through its effect in the market of the imported substitute. In other words, using an additional demand as an example, the bulk of the reduction in the consumption of q, $(q_0 - q_s)$, is in fact compensated by an increase in the consumption of the imported substitute (Δm).

The example in Figure 9 is presented in Table 9, where the columns for the project, the consumers, and the producers correspond to the conventional case. However, since the great majority of amount C previously paid for $q_0 - q_s$ will now be spent on imported good m, we specify the effects of that expenditure. The consumers will spend on the imported good an amount equal to their willingness to pay, and that is why we do not record those effects $(F - F)$ on the column for the consumers. The importers receive an amount designated in Figure 9 as F, which we assumed to be equal to the cost of importing

$$F = p^m \Delta m = (1 + t)\, p^b \Delta m + \Delta C$$

where p^m is the domestic price of m, Δm are the additional imports of m, t is the import tax rate, p^b is the border price of m, and ΔC are the additional costs the importer incurs in order to sell Δm in the domestic market. Consequently, by assumption, there are no net effects

Table 9. An increase in the demand of a non-traded good with an imported close substitute

	Project	Consumers of q	Producers of q	Importers of m	Government	Total
Consumers' *CV*						
Purchases of $q(p_0)$	$-A$	$+A$				
Willingness to pay for Δq		$-(B+C)$				$-(B+C)$
Amount paid for Δq	$-C$	$+C$				
Producers' income changes						
Additional revenue at p_1	$-(B+D+E)$		$+(B+D+E)$			
Additional costs			$-E$			$-E$
Importers' income changes						
Additional revenue				$(1+t)\,p^b\Delta m+\Delta C$		$(1+t)\,p^b\Delta m+\Delta C$
Foreign exchange				$-p^b\Delta m$	$-\alpha p^b\Delta m$	$-(1+\alpha)\,p^b\Delta m$
Other domestic costs				$-(tp^b\Delta m+\Delta C)$	$+tp^b\Delta m$	$-\Delta C$
Total	$-(B+C+D+E)$	$-(A+B)$	$+(A+B+D)$	$-$	$(t-\alpha)\,p^b\Delta m$	$-(B+C+E)-(t-\alpha)\,p^b\Delta m$

Source: Figure 9.

on the importers.[9] Government revenue, however, is affected by the difference between the tax on the imported good and the revenue forgone due to the reallocation of the foreign exchange. If all income changes were equally valuable, the domestic total would show the conventional efficiency result plus a term consisting of the difference between the market and the efficiency prices of *m*. Note that if $t = 0$, then the correction amounts to valuing the foreign exchange at efficiency prices, and that the correction would be worth the additional work only when the difference $t - \alpha$ (i.e. the difference between the market and the efficiency price of the imported substitute) were significant.

The case of a non-traded product with an exported close substitute, depicted in Figure 10, is similar to that of the imported substitute. In this case, a great proportion of the amount no longer spent on *q* (area C) is spent on exported good *x* (area *F*), sold domestically at price

$$p^x = (1 - t)\, p^b\, \Delta x + \Delta C^x$$

where t is now the *ad valorem* export tax, p^b is now the border price of x, and ΔC^x now represents the additional export costs. As a result (Table 10), and as long as they do not enjoy extraordinary profits (due, for example, to a quota), exporters are not affected. They now receive the domestic sales revenue $(1 - t)\, p^b\, \Delta x + \Delta C^d$, but cease to receive the export revenue $-p^b\, \Delta x + t\, p^b\, \Delta x + \Delta C^x$. On the cost side, they have to pay for the domestic distribution costs $(-\Delta C^d)$ while no longer incurring in export distribution costs ΔC^x. If all income changes were equally valuable, the *Total* column would show the conventional result plus a term capturing the difference between the domestic and the efficiency price of the exported substitute. Note that if the exported good is taxed, the effects on the traded substitute will amount to a significant correction. On the other hand, if it is subsidized (a negative tax) the magnitude of the correction will depend on the difference between the *ad valorem* subsidy rate and α.

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[9] If those effects existed, they could be taken into account by specifying an additional revenue *F* that is different from the import cost.

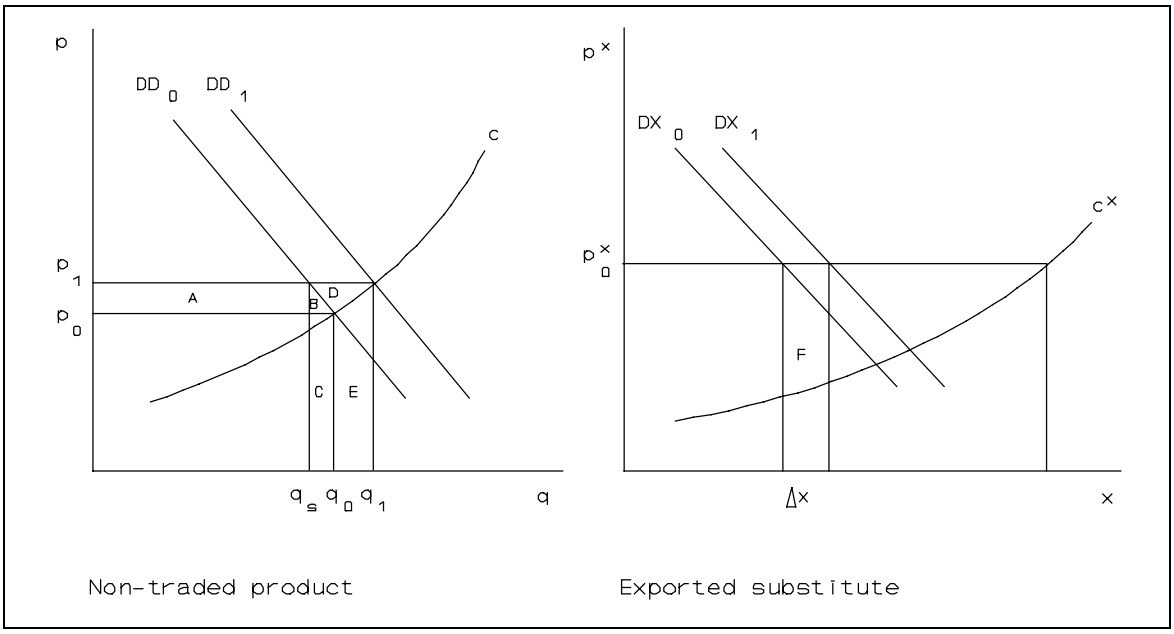

Figure 10 An increase in the domestic demand of a non-traded good with an exported substitute

Table 10. An increase in the demand of a non-traded good with an exported close substitute

	Project	Consumers of q	Producers of q	Exporters of m	Government	Total
Consumers' *CV*						
Purchases of $q(p_0)$		$-A$	$+A$			
Willingness to pay for Δq		$-(B+C)$				$-(B+C)$
Amount paid for Δq	$-C$	$+C$				
Producers' income changes						
Additional revenue at p_1	$-(B+D+E)$		$+(B+D+E)$			
Additional costs			$-E$			$-E$
Exporters' income changes						
Additional revenue				$(1-t)p^b\Delta x+\Delta C^d-\Delta C^x$		$(1-t)p^b\Delta x+\Delta C^d-\Delta C^x$
Foreign exchange				$-p^b\Delta x$	$-\alpha p^b\Delta x$	$-(1+\alpha)p^b\Delta x$
Other domestic costs				$+tp^b\Delta x+\Delta C^x-\Delta C^d$	$-tp^b\Delta x$	$+\Delta C^x-\Delta C^d$
Total	$-(B+C+D+E)$	$-(A+B)$	$+(A+B+D)$	$-$	$-(t+\alpha)p^b\Delta x$	$-(B+C+E)$ $-(t+\alpha)p^b\Delta x$

Source: Figure 10.

7. Conclusions

The first important conclusion of this paper is that, as stated by Little and Mirrlees (1991, p. 353), "marginal foreign revenue alone" is not a good approximation to shadow pricing partially traded goods, even when income changes are equally valuable regardless of beneficiary.

The second is that "a good applicable model of the economy" is not necessarily required in order to reach practical approximations to "hard-to-trace effects" (Little and Mirrlees, 1991, p. 353). Traditional comparative statics using partial equilibrium analysis provides an adequate framework for identifying and quantifying the main income changes according to those affected. The difficult problem, where such model may become necessary, is that of estimating the appropriate shadow prices for those income changes, whether they are based on more traditional distributional weights and accounting prices of investment funds, or on parameters capturing the marginal value of public income to account for the allocative effects of financing the impact on public sector accounts.

Thirdly, a good may be partially traded even though its international price is not affected by an additional demand or supply. That is the case of the perfectly discriminating monopolist facing an infinitely elastic international demand, as well as that of the domestically produced good with a fully traded substitute. In the case of the perfectly discriminating monopolist facing an infinitely elastic international demand, it has also been shown that the good is fully traded for domestic supply increases, because domestic and international prices are not affected, but it is partially traded for domestic demand increases because they affect the domestic price.

Also, an important practical case of partially traded goods, particularly in open economies, has been considered: that of domestically produced goods with close traded substitutes. In these situations, the presentation shows that practical problems of estimating income changes in both markets may considerably complicate the appropiate shadow pricing.

Finally, the paper provides an interesting application of the traditional method of identifying those affected, measuring their corresponding compensating variations, and then valuing those real income changes using appropriate shadow prices. Its use helps to show

that tracing distributional effects in order to apply shadow prices to marginal income changes is more complicated in the case of partially traded goods than in the case of fully traded or non-traded goods. Even more so when there are domestic taxes or subsidies, be they imposed on either foreign or domestic transactions. Those complications arise not only from the need of estimating changes in consumers' surpluses, but also from the difficulties of tracing effects in more than one market simultaneously, and of properly allocating the effects according to those affected.

Appendix A

When a project increases the production of a marginally exported good, total production by the project Δq is absorbed by additional domestic consumption Δq^{dd}, reductions in domestic production Δq^{ds}, additional foreign consumption Δq^{fd}, and reductions in foreign production Δq^{fs}, that is

$$\Delta q = \Delta q^{dd} + \Delta q^{ds} + \Delta q^{fd} + \Delta q^{fs} \qquad [A.1]$$

Equation [A.1] may also be expressed as a function of the proportional price change $\Delta p/p$, and demand and supply price elasticities:

$$\Delta q = \Delta p/p \; [q_0^d \; (\eta_d + \varepsilon_d) + q_0^f \; \eta_f + (q_0^f - q_0^x) \; \varepsilon_f] \qquad [A.2]$$

where q_0^d is total domestic consumption at price p_0, η_d is price elasticity of domestic demand, ε_d is price elasticity of domestic supply, q_0^f is total sales in foreign markets, η_f is price elasticity of demand in foreign markets, q_0^x are total exports of the country where the project is located, and ε_f is price elasticity of supply to the international market of the *other* suppliers. Once the price change is known, quantity changes may be estimated; for example, the reduction in the supply by foreign producers will be

$$\Delta q^{fs} = \frac{\Delta p}{p_0} (q_0^f - q_0^x) \; \varepsilon_f \qquad [A.3]$$

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