Estimating the Accounting Price of Foreign Exchange: An Input-Output Approach

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ESTIMATING THE ACCOUNTING PRICE OF FOREIGN EXCHANGE: AN INPUT-OUTPUT APPROACH

(Revised version)

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Abstract

When adjustments in the foreign exchange market involve changes in the production of marginally traded goods, the traditional formula for calculating the accounting (shadow) price of foreign exchange assumes that domestic prices and marginal costs at efficiency prices for those goods are equal. In this paper a method is proposed for estimating an accounting price ratio of foreign exchange in a partial equilibrium framework, abandoning that assumption. For that purpose, input-output techniques are used, so as to take into account the effects of changes in the production of traded goods.

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ESTIMATING THE ACCOUNTING PRICE OF FOREIGN EXCHANGE: AN INPUT-OUTPUT APPROACH *

Elio Londero[1]

1. Introduction

All formulas for calculating an accounting (shadow) price of foreign exchange or an accounting price ratio of foreign exchange, i.e. the ratio of the accounting price to its market price, are based on assumptions on: i) how markets adjust to an additional demand or supply of foreign exchange; and ii) on the relations between market and accounting prices of traded goods. The best known formula for the accounting price of foreign exchange corresponds to the criteria and value judgements of the so called "efficiency analysis",[1] under the assumptions that: (a) the adjustment of the foreign exchange market consists of changes in exports and imports induced by changes in the equilibrium exchange rate; (b) the rate of discount equals the marginal rate of return on investment (accounting prices of investment are equal to one); and (c) domestic prices of traded goods equal the corresponding efficiency values of reducing domestic consumption or increasing domestic production. When adjustments in the foreign exchange market involve changes in the production of marginally traded goods, assumption (c) implies that domestic prices and marginal costs at efficiency prices for those goods are equal. In this paper a method is proposed for estimating an accounting price ratio of foreign exchange in a partial equilibrium context, retaining assumptions (a) and (b), but abandoning that of equality between market price and marginal cost at efficiency prices in the production of traded goods. For that purpose, input-output techniques are used, so as to take into account the effects of changes in the production of traded goods.

2. Calculating accounting prices with input-output techniques

This section contains a brief presentation of the input-output approach to estimating accounting prices. We assume that the reader is already familiar with the subject and our main purpose is to introduce the notation that will be used.[2] The composition of long-run marginal costs at market prices for non-traded good i in relation to its price can be represented as

$$\Sigma_j a_{ij} + \Sigma_h v_{ih} = 1$$

where a_{ij} and v_{ih} are the value coefficients of produced input j and non-produced input or transfer h, needed to produce i.[3] Consequently, the accounting price ratio of good i (apr_i) will be

$$\Sigma_j a_{ij}\, apr_j + \Sigma_h v_{ih}\, apr_h^v = apr_i \qquad (i = 1, ..., n; j = 1, ..., n)$$

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The set of equations for all goods *i* can be written in matrix form as

$$\mathbf{apr} = \mathbf{A}\ \mathbf{apr} + \mathbf{V}\ \mathbf{apr}^{v}$$

From this expression, **apr** turns out to be

$$\mathbf{apr} = (\mathbf{I} - \mathbf{A})^{-1}\ \mathbf{V}\ \mathbf{apr}^{v} \qquad [1]$$

that can be interpreted as follows. Matrix

$$\mathbf{V}^{*} = [v^{*}_{i\,h}] = (\mathbf{I} - \mathbf{A})^{-1}\ \mathbf{V}$$

provides total, direct and indirect, requirements of non-produced inputs and transfers (valued at market prices) needed to produce a unit value of produced goods *i*. Then, by multiplying those total requirements by their corresponding apr^{v}_{h}

$$apr_i = \Sigma_i\ v^{*}_{i\,h}\ apr^{v}_{h}$$

we revalue them at their corresponding accounting prices.

In the conventional approach to estimating *apr*, foreign exchange is treated as a non-produced input (v_{ih}) and the corresponding total requirements are revalued by an accounting price ratio of foreign exchange (*aprf*) exogenous to the system. In the case of efficiency prices, this *aprf* is normally calculated according to the conventional formula

$$aprf = \frac{apf}{oer} = \frac{\Sigma_g\ \Delta m_g\, p_g + \Sigma_k\ \Delta x_k\, p_k}{\Delta f\ oer} \qquad [2]$$

where *apf* is the accounting price of foreign exchange, *oer* is the official exchange rate (that could differ from the equilibrium one), Δf is the additional demand or supply for foreign exchange, Δm_g and Δx_k are the changes in quantities imported and exported resulting from the adjustment in the markets, and p_g and p_k are the corresponding unit efficiency values of reducing domestic consumption or increasing domestic production.[4] When domestic equilibrium prices are equal to border prices plus (less) trade taxes, and in turn equal to those unit efficiency values, the latter can be expressed as

$$p_g = p^{cif}_{g}\ eer\ (1 + t_g)$$
$$p_k = p^{fob}_{k}\ eer\ (1 - t_k) \qquad [3]$$

where t_g and t_k are the *ad valorem* equivalents to trade incentives and disincentives, and *eer* is the long run equilibrium exchange rate.[5] Replacing [3] in [2] we obtain

$$aprf = \frac{eer}{oer}\ \frac{\Sigma_g\ \Delta m_g\, p^{cif}_{g}\,(1 + t_g) + \Sigma_k\ \Delta x_k\, p^{fob}_{k}\ (1 - t_k)}{\Delta f} \qquad [4]$$

where

$$\Delta f = \Sigma_g\ \Delta m_g\, p^{cif}_{g} + \Sigma_k\ \Delta x_k\, p^{fob}_{k}$$

i.e., the additional demand for foreign exchange Δf is fully offset by changes in the value of exports and imports.[6] If we now multiply and divide [4] by the change in the *eer* induced by the additional demand for foreign exchange (Δeer), and replace by

$$\phi_g = \frac{\Delta m_g \, p_g^{cif}}{\Delta eer} \frac{\Delta eer}{\Delta f}$$

$$\phi_k = \frac{\Delta x_k \, p_k^{fob}}{\Delta eer} \frac{\Delta eer}{\Delta f} \qquad [5]$$

we arrive at the conventional formula

$$aprf = (eer/oer)\ \Sigma_g\ \phi_g\ (1 + t_g) + \Sigma_k\ \phi_k\ (1 - t_k) \qquad [6]$$

where t_g and t_k are the *ad valorem* equivalents to the trade incentives and disincentives in the long-run equilibrium situation, i.e. that to which the *eer* corresponds.

3. The effects on the production of traded goods

The assumption of equality between domestic market prices and unit efficiency values of reducing domestic consumption or increasing domestic production for traded goods is not a statement about reality, but one on the conditions for expressions [2] or [4] to be strictly valid, and a warning on potential error margins. Changes in imports (Δm_g) and in exports (Δx_k) are actually composed by changes in the domestic consumption of those goods (Δm_g^d and Δx_k^d), and changes in their production (Δm_g^s and Δx_k^s), i.e.

$$\Delta m_g = \Delta m_g^d + \Delta m_g^s$$

$$\Delta x_k = \Delta x_k^d + \Delta x_k^s$$

When changes in the production of traded goods are a significant part of the adjustment, input-output techniques allow us to improve our estimation of the *aprf* insofar as we can (partially) liberate from assuming equality between the domestic price of traded goods and their corresponding long-run marginal cost at efficiency prices.

In order to show how to deal with the production of traded goods within the intersectoral relations, let us start by presenting expression [2] in a slightly different form, i.e.

$$\Delta f\ apf = \Sigma_g\ \Delta m_g^d\, p_g^d + \Sigma_g\ \Delta m_g^s\, p_g^s + \Sigma_k\ \Delta x_k^d\, p_k^d + \Sigma_k\ \Delta x_k^s\, p_k^s \qquad [7]$$

This expression can be interpreted as follows: the sum of the compensating variations attributable to an additional demand (supply) of foreign exchange Δf, per definition equal to its value at efficiency prices, is equal to the changes in exports and imports attributable to that additional demand (supply) times their corresponding unit efficiency values, the latter assumed to be equal to their respective domestic prices. Expression [7] differs from [2] in that changes in imports and exports have been decomposed into: (a) changes in the domestic consumption of traded goods (Δm_g^d and Δx_k^d), and (b) changes in their domestic production (Δm_g^s and Δx_k^s).

Now, if the efficiency value of the resources used (released) to increase (reduce) the production of traded goods in one unit, differs from the respective domestic prices p^s_g and p^s_k, these prices must be replaced in the right hand side of equation [7]. Let us denote by v^*_{gh} and v^*_{kh} the market value of total requirements of non-produced inputs and transfers h needed to substitute a unit value of imports of good g or to export a unit value of k, *both corresponding to their respective CIF or FOB values expressed in national currency at the equilibrium exchange rate* ($\Sigma_h\ v^*_{gh} = 1,\ \Sigma_h\ v^*_{kh} = 1$). Consequently, the efficiency value of those long-run marginal costs per unit of foreign exchange valued at the *eer* will be

$$
\begin{aligned}
apr^m_g &= \frac{C^m_g}{p^{cif}_g\ eer} = \Sigma_h\ v^*_{gh}\ apr^v_h \\
apr^x_k &= \frac{C^x_k}{p^{fob}_k\ eer} = \Sigma_h\ v^*_{kh}\ apr^v_h
\end{aligned}
\qquad [8]
$$

where C^m_g and C^x_k are the marginal costs at efficiency prices of domestically producing one unit of marginally imported good g and marginally exported good k, respectively. From [8] it follows that

$$
\begin{aligned}
C^m_g &= p^{cif}_g\ eer\ \ \Sigma_h\ v^*_{gh}\ apr^v_h \\
C^x_k &= p^{fob}_k\ eer\ \Sigma_h\ v^*_{kh}\ apr^v_h
\end{aligned}
\qquad [9]
$$

We can now turn to expression [7] and rewrite it for the case when domestic prices p^s_g and p^s_k differ from their respective long-run marginal costs at efficiency prices. We thus obtain

$$
\Delta f\ apf = \Sigma_g\ \Delta m^d_g\, p^d_g + \Sigma_k\ \Delta x^d_k\, p^d_k + \Sigma_g\ \Delta m^s_g\, p^s_g\ \frac{C^m_g}{p^s_g} + \Sigma_k\ \Delta x^s_k\, p^s_k\ \frac{C^x_k}{p^s_k} \qquad [10]
$$

If we now simplify p^s_g and p^s_k, replace C^m_g and C^x_k by their corresponding expressions [8], and follow the same sequence used to convert [2] into [6], that we omit for brevity, we arrive at the expression for the *aprf* when domestic prices differ from their corresponding long-run marginal costs

$$
aprf = (eer/oer)\ [\Sigma_g\ \phi^d_g\,(1 + t_g) + \Sigma_k\ \phi^d_k\,(1 - t_k) + \Sigma_g\ \phi^s_g\ \Sigma_h\ v^*_{gh}\ apr^v_h + \Sigma_k\ \phi^s_k\ \Sigma_h\ v^*_{kh}\ apr^v_h] \qquad [11]
$$

In order to facilitate our later presentation, let us define the average tax rates $\bar{t}_m$ and $\bar{t}_x$, such that

$$
\begin{aligned}
\Sigma_g\ \phi^d_g\,(1 + t_g) &= (1 + \bar{t}_m)\ \Sigma_g\ \phi^d_g = (1 + \bar{t}_m)\ \phi^d_m \\
\Sigma_k\ \phi^d_k\,(1 - t_k) &= (1 - \bar{t}_x)\ \Sigma_k\ \phi^d_k = (1 - \bar{t}_x)\ \phi^d_x
\end{aligned}
\qquad [12]
$$

from where

$$\bar{t}_m = \frac{\Sigma_g \phi^d_g t_g}{\Sigma_g \phi^d_g} = \frac{\Sigma_g \phi^d_g t_g}{\phi^d_m}$$
$$\bar{t}_x = \frac{\Sigma_k \phi^d_k t_k}{\Sigma_k \phi^d_k} = \frac{\Sigma_k \phi^d_k t_k}{\phi^d_x} \qquad [13]$$

Consequently, using [12] we can also write [11] as

$$aprf = (eer/oer)\ [(1 + \bar{t}_m)\ \phi^d_m + (1 - \bar{t}_x)\ \phi^d_x + \Sigma_g\ \phi^s_g\ \Sigma_h\ v^*_{gh}\ apr^v_h + \Sigma_k\ \phi^s_k\ \Sigma_h\ v^*_{kh}\ apr^v_h] \qquad [14]$$

4. Foreign exchange in the input-output matrix

In this section we present the method to prepare the intersectoral relations matrix used to calculate the *apr* for the non-traded goods, using equation [14] to calculate the *aprf*. We will also see how to calculate the *aprf* itself. For that purpose, we will assume that the current exchange rate is equal to the equilibrium one, i.e. $eer = oer$, assumption that we will drop in section 6.

The first step is to treat foreign exchange *as if* it were a produced good. So, the additional demand for foreign exchange generated by an increase in the production of a non-traded good will be assigned to the intersectoral transactions matrix **A**. The corresponding coefficient will register that additional demand, valued at the *eer*, as a proportion of the non-traded good price. That coefficient "demands" foreign exchange to a sector (row) that "produces" it according to equation [14].[7] This equation can, in turn, be presented generically as

$$\Sigma_j\ a_{fj} + \Sigma_h\ v_{fh} = 1$$

where the a_{fj} will be the coefficients for the changes in the production of traded goods *j* needed to adjust the market to a unit additional demand for foreign exchange. In other words,

$$a_{fj} = \phi^s_g,\ \phi^s_k$$

where ϕ^s_g and ϕ^s_k are the weights for the *apr* of the changes in the production of traded goods *g* and *k* in expression [14]. Regarding the coefficients for the demand of non-produced inputs v_{fh}, only two will be different from zero: those corresponding to the changes in the domestic consumption of imported (v_{fm}) and exported (v_{fx}) goods

$$v_{fm} = \phi^d_m$$
$$v_{fx} = \phi^d_x \qquad [15]$$
$$v_{fh} = 0, \text{ for all } h \neq m, x$$

where ϕ^d_m and ϕ^d_x are the weights for the *apr* of the changes in the domestic consumption of imported and exported goods in expression [14].

Treatment of foreign exchange in the I-O table is presented in an schematic way in Table 1.

Coefficients $a_{fj} = \phi^s_g,\ \phi^s_k$ demand the production of traded goods (foreign exchange) to the corresponding rows $i = g, k$. In turn, these rows contain the corresponding costs of substituting imports or increasing exports, where coefficients are calculated as proportions of the CIF or FOB value of production expressed in domestic currency at the *eer*.[8] When calculating the total requirements of non-produced inputs and transfers, the demand for foreign exchange of the i sector ($a_{n+1,i}$ in Table 1) will be decomposed according to column $n + 1$ of Table 1 into reductions in the domestic consumption of imported goods, reductions in the domestic consumption of exported goods, and increases in the domestic production of marginally imported ($k = n+2$) and exported ($k = n+3$) goods.

The latter will be further decomposed into non-produced inputs and transfers, and that, together with the reduction in the domestic consumption of imported and exported goods, will be added to the direct and indirect requirements originated in the remaining coefficients, and so yield the corresponding total requirements, i.e.

$$apr_i = v^*_{i\,m} + v^*_{i\,x} + \Sigma_{h \neq m,x}\, v^*_{i\,h} = 1$$

These, in turn, can be valued at efficiency prices to obtain the *apr* of non-traded good i as

$$apr_i = v^*_{i\,m}\,(1 + \bar{t}_m) + v^*_{i\,x}\,(1 - \bar{t}_x) + \Sigma_{h \neq m,x}\, v^*_{i\,h}\, apr^v_h \qquad [16]$$

where total, direct and indirect demand of foreign exchange has been replaced by total requirements of: (a) reductions in the domestic consumption of imported goods, (b) reductions in the domestic consumption of exported goods, and (c) other non-produced inputs and transfers needed to produce the additional import substitutes and exports. It can be demonstrated (see Appendix) that this is equivalent to valuing total foreign exchange requirements according to expression [16].

The latter will be further decomposed into non-produced inputs and transfers, and that, together with the reduction in the domestic consumption of imported and exported goods, will be added to the direct and indirect requirements originated in the remaining coefficients, and so yield the corresponding total requirements, i.e.

$$apr_i = v^*_{i\,m} + v^*_{i\,x} + \Sigma_{h \neq m,x}\, v^*_{i\,h} = 1$$

These, in turn, can be valued at efficiency prices to obtain the *apr* of non-traded good i as

$$apr_i = v^*_{i\,m}\,(1 + \bar{t}_m) + v^*_{i\,x}\,(1 - \bar{t}_x) + \Sigma_{h \neq m,x}\, v^*_{i\,h}\, apr^v_h \qquad [16]$$

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The latter will be further decomposed into non-produced inputs and transfers, and that, together with the reduction in the domestic consumption of imported and exported goods, will be added to the

Table 1

Foreign exchange as a "produced" input in an input-output table *

Matrix	Input	Output	(i) Non-traded good i	(n+1) Foreign exchange	(n+2) Imported good n+2	(n+3) Exported good n+3
	(1)	Non-traded good 1	a_{1i}	-	$a_{1,n+2}$	$a_{1,n+3}$
		.	.			
		.	.			
		.	.			
	(j)	Non-traded good j	a_{ji}	-	$a_{j,n+2}$	$a_{j,n+3}$
		.	.			
[a_{ji}]		.	.			
		.	.			
	(n)	Non-traded good n	a_{ni}	-	$a_{n,n+2}$	$a_{n,n+3}$
	(n+1)	Foreign exchange (at *oer*)	$a_{n+1,i}$	-	$a_{n+1,n+2}$	$a_{n+1,n+3}$
	(n+2)	Imported good n+2	-	$a_{n+2,n+1}=\phi^s_{n+2}$	-	-
	(n+3)	Exported good n+3	-	$a_{n+3,n+1}=\phi^s_{n+3}$	-	-
	Reduction in the domestic consumption of imports (v_m)		-	$v_{m,n+1}=\phi^d_m$	-	-
	Reduction in the domestic consumption of exports (v_x)		-	$v_{x,n+1}=\phi^d_x$	-	-
[v_{hi}]	Export taxes (v_t)		-	-	$v_{t,n+2}=t_{n+2}$	$v_{t,n+3}=t_{n+3}$
	Other v_h		v_{hi}	-	$v_{i,n+2}$	$v_{i,n+3}$
	Total ($\Sigma_j\, a_{ji} + \Sigma_h\, v_{hi}$)		1	1	$CIF_{n+2}\ oer$=1	$FOB_{n+3}\ oer$=1

* Note that for presentational purpose, the matrix has been transposed (rows appear as columns) and coefficients a_{ij} and v_{ih} in the text appear as a_{ji} and v_{hi}, respectively.

direct and indirect requirements originated in the remaining coefficients, and so yield the corresponding total requirements, i.e.

$$apr_i = v^*_{i\,m} + v^*_{i\,x} + \Sigma_{h\neq m,x}\, v^*_{i\,h} = 1$$

These, in turn, can be valued at efficiency prices to obtain the *apr* of non-traded good *i* as

$$apr_i = v^*_{i\,m}\,(1 + \bar{t}_m) + v^*_{i\,x}\,(1 - \bar{t}_x) + \Sigma_{h\neq m,x}\, v^*_{i\,h}\, apr^v_h \qquad [16]$$

where total, direct and indirect demand of foreign exchange has been replaced by total requirements of: (a) reductions in the domestic consumption of imported goods, (b) reductions in the domestic consumption of exported goods, and (c) other non-produced inputs and transfers needed to produce the additional import substitutes and exports. It can be demonstrated (see Appendix) that this is equivalent to valuing total foreign exchange requirements according to expression [16].

5. A numerical example

Let us first consider the conventional treatment where the demand for foreign exchange is assigned to the matrix of non-produced inputs **V**. Table 2 presents a simple input-output table so prepared. There, production of goods $i = 1, 2, 3$ requires purchasing produced inputs and foreign exchange (f), paying trade taxes (t) and land rents (la), and hiring labor (w). As a result of prevailing market prices, activities i receive "excess profits" b_i, equal to the difference between value of production and the corresponding long-run marginal costs, all at market prices.[9]

According to our presentation of section 2, the apr_i ($i = 1, 2, 3$) can be calculated according to expression [6]. For that purpose, let us assume that the corresponding $aprf$ has been calculated as

$$aprf = 0.55 \times 1.22 + 0.45 \times 0.95 \qquad [17]$$

$$aprf = 1.0985$$

where

$$\phi_m = \Sigma_g\, \phi_g^d + \phi_g^s = 0.55$$

$$\phi_x = \Sigma_k\, \phi_k^d + \phi_k^s = 0.45$$

and where $\bar{t}_m = 0.22$ and $\bar{t}_x = 0.05$ have been calculated according to [13], but with respect to both reductions in consumption and increases in production.

Let us further assume that in the case of land, the market rent is taken as the efficiency one, while labor will be coming out of unemployment, so only its compensating variation, amounting to 60 per cent of the wage, will be taken into account. Finally, trade taxes and excess profits are transfers, so their apr^v will be taken as equal to zero. Consequently, vector $\mathbf{apr}^v$ will be

$$\mathbf{apr}^v = \begin{bmatrix} apr(f) \\ apr(w) \\ apr(la) \\ apr(t) \\ apr(b) \end{bmatrix} = \begin{bmatrix} 1.0985 \\ 0.6000 \\ 1.0000 \\ 0.0000 \\ 0.0000 \end{bmatrix}$$

from where the apr of goods (1), (2) and (3) turn out to be[10]

Table 2
Numerical example

Outputs	Inputs (1)	(2)	(3)	*f*	*w*	*la*	*t*	*b*	Total
(1)	-	0.37	0.05	0.30	0.15	0.10	0.03	-	1.00
(2)	0.14	-	0.06	0.40	0.20	0.15	0.03	0.02	1.00
(3)	0.09	0.14	-	0.60	0.05	0.15	-	−0.03	1.00

$$\mathbf{apr} = \begin{bmatrix} apr(1) \\ apr(2) \\ apr(3) \end{bmatrix} = \begin{bmatrix} 0.904 \\ 0.899 \\ 1.046 \end{bmatrix}$$

The preceding presentation is the traditional approach, where the total (direct and indirect) additional demand for foreign exchange is revalued using an *aprf* that has been calculated exogenously. We can now incorporate into the matrix presented in Table 2, the treatment of foreign exchange presented in section 3. In order to do it, we have to previously decompose the changes in imports and exports into changes in domestic consumption of traded goods and increases in production. Let

$$\phi_m^d = \Sigma_k\, \phi_g^d = 0.40$$
$$\phi_x^d = \Sigma_k\, \phi_k^d = 0.25$$

be the value at the *eer* (equal to the *oer*) of the foreign exchange released by the reduction in the domestic consumption of traded goods, and let

$$\phi_5^s = 0.15$$
$$\phi_6^s = 0.20$$

be the value at the *eer* of the foreign exchange generated by increasing the domestic production of the only two traded goods (5) and (6).[11] We can now reformulate our treatment of foreign exchange in Table 2 to obtain Table 3. First we move the foreign exchange row to the transactions matrix incorporating row and column (4). That row, in turn, "demands" what is needed to adjust the foreign exchange market, i.e.:

(a) reductions in the domestic consumption of imports and exports by $\phi_m^d = 0.40$ and $\phi_x^d = 0.25$, incorporated to matrix $[v_{ih}]$; and

(b) an increase in the production of import substitutes by $a_{45} = \phi_5^s = 0.15$ and of exports by $a_{46} = \phi_6^s = 0.20$.

Finally we incorporate to the matrix the rows (and columns) containing the marginal import substituting and export cost structures for goods (5) and (6), respectively. These are the sectors that

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Table 3
Numerical example of an intersectoral relations matrix incorporating the production of traded goods

	Inputs												
Outputs	(1)	(2)	(3)	(4)	(5)	(6)	ϕ_m^d	ϕ_x^d	w	la	t	b	Total
(1)	-	0.37	0.05	0.30	-	-	-	-	0.15	0.10	0.03	-	1.00
(2)	0.14	-	0.06	0.40	-	-	-	-	0.20	0.15	0.03	0.02	1.00
(3)	0.09	0.14	-	0.60	-	-	-	-	0.05	0.15	-	−0.03	1.00
(4)	-	-	-	-	0.15	0.20	0.40	0.25	-	-	-	-	1.00
(5)	0.13	0.15	0.07	0.35	-	-	-	-	0.15	0.10	0.05	-	1.00
(6)	0.07	0.13	0.03	0.12	-	-	-	-	0.10	0.50	0.05	-	1.00

Source: Prepared from Table 2.

Table 4
Total requirements of non-produced inputs and transfers

$\mathbf{v}^*_{ih}$	ϕ_m^{d*}	ϕ_x^{d*}	w^*	la^*	t^*	b^*	$\Sigma_h v^*_{ih}$
$\mathbf{v}^*_{1h}$	0.243	0.152	0.283	0.259	0.057	0.006	1.000
$\mathbf{v}^*_{2h}$	0.238	0.149	0.279	0.266	0.049	0.020	1.000
$\mathbf{v}^*_{3h}$	0.331	0.207	0.159	0.303	0.026	−0.026	1.000
$\mathbf{v}^*_{4h}$	0.460	0.288	0.074	0.153	0.024	0.001	1.000
$\mathbf{v}^*_{5h}$	0.252	0.157	0.266	0.248	0.075	0.002	1.000
$\mathbf{v}^*_{6h}$	0.113	0.071	0.170	0.580	0.064	0.002	1.000

Source: Calculated from Table 3.

would increase the production of such goods in response to the price increase generated by the additional demand of foreign exchange.

Now, following the procedure presented in section 2, we can calculate total, direct and indirect requirements of non-produced inputs and transfers needed to increase the production of i, where $\mathbf{A}$ is the 6×6 matrix containing the transactions among the three non-traded sectors, foreign exchange and the two traded sectors. The $\mathbf{V}$ matrix contains the direct requirements of non-produced inputs and transfers of the six sectors included in the transactions matrix. By performing the calculations we obtain the total requirements matrix $\mathbf{V}^*$ (Table 4), from which we can calculate the *apr* at efficiency prices of the three non-traded goods and the *aprf*.[12] To that effect, we need to know, from outside the system, the *apr* for labor, land, reductions in the domestic consumption of imported goods, and reductions in the domestic consumption of exported goods. According to [17], the *apr* for the last two are[13]

$apr(\phi_m^d) = (1 + \bar{t}_m) = 1.22$

$apr(\phi_x^d) = (1 - \bar{t}_x) = 0.95$ [18]

Consequently, the new $\mathbf{apr}^v$ vector will be

$$\mathbf{apr}^v = \begin{bmatrix} apr(\phi_m) \\ apr(\phi_x^d) \\ apr(w) \\ apr(la) \\ apr(t) \\ apr(b) \end{bmatrix} = \begin{bmatrix} 1.22 \\ 0.95 \\ 0.60 \\ 1.00 \\ 0.00 \\ 0.00 \end{bmatrix} \qquad [19]$$

By performing $\mathbf{V}^* \mathbf{apr}^v$ we obtain the new **apr** vector that corresponds to treating foreign exchange as a partially produced good, i.e.

$$\mathbf{apr} = \begin{bmatrix} apr(1) \\ apr(2) \\ apr(3) \\ apr(4) \\ apr(5) \\ apr(6) \end{bmatrix} = \begin{bmatrix} 0.870 \\ 0.865 \\ 0.99\,9 \\ 1.033 \\ 0.864 \\ 0.887 \end{bmatrix}$$

where the *aprf* is that of sector (4). This result for the *aprf* corresponds to expression [14]. As demonstrated in the previous section, it is the value at efficiency prices of the total requirements of non-produced inputs and transfers of the sector "producing" the foreign exchange. Consequently, the *aprf* can be calculated by multiplying vector $\mathbf{v}^*_{4h}$ from Table 4 by [19]

$aprf = 0.460 \times 1.22 + 0.288 \times 0.95 + 0.074 \times 0.60 + 0.153 \times 1 + 0.024 \times 0 + 0.001 \times 0$

$aprf = 1.033$

Note that in this example, the reduction in the *aprf* resulting from the new calculation (from 1.0985 to 1.032) is due almost entirely to abandoning the assumption of equality between the domestic price and the long-run marginal cost at efficiency prices in a situation where the market wage is considerably above the corresponding efficiency wage. The reader may verify that if the market and the efficiency wage were equal *in all sectors*, there would be almost no difference between the *aprf* calculated and the weighted average of import and export taxes.

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It should be noted that the *apr* for the marginally traded goods resulting from the calculation, those for sectors (5) and (6) in our example, should not be used for evaluating projects because they do not refer to the cost of supplying an additional domestic demand by increasing imports or reducing exports, but to that of increasing the domestic production of traded goods in response to an exogenous price increase.

If we are not interested in distributional effects, the foreign exchange used or generated by a project can be valued at efficiency prices by simply multiplying it by the *aprf*. Otherwise, we will have to first decompose the net foreign exchange used (generated) by the project into its total requirements of non-produced inputs and transfers so we can record the transfers explaining the difference between the *eer* and its efficiency price.[14] For example, an additional supply of foreign exchange by 1,000 can be decomposed into non-produced inputs and transfers by using the corresponding vector of total requirements per unit value from matrix $[v^*_{ih}]$. In our example, that is provided by the row

$$\mathbf{v}^*_{4h} = [0.460; 0.288; 0.074; 0.153; 0.024; 0.001]$$

from Table 4, and the additional supply will be decomposed as shown in the first column of Table 5. Then we can allocate the transfers explaining the difference between market and efficiency prices, among those affected. So, the additional consumption of imported goods by 460 when valued at the equilibrium exchange rate, will increase the import tax collection in 22 per cent of that amount ($\bar{t}_m = 0.22$); the increase in the domestic consumption of exported goods will reduce the export tax collection by $288 \times (-0.05)$; labor will loose the difference between the foregone wages (74) and the compensating variation of accepting that employment (74×0.60) due to employment reduction in traded industries; land owners will not be affected; and, finally, taxes and excess profits are income transfers among individuals.

Table 5
The valuation of foreign exchange at "efficiency prices"

	Project	Government	Unskilled workers	Other firms	Total
Additional consumption of imported goods	460	101	-	-	561
Additional consumption of exported goods	288	−14	-	-	274
Wages	74	-	−30	-	44
Rents	153	-	-	-	153
Taxes	24	−24	-	-	-
Excess profits	1	-	-	−1	-
Total	1000	63	−30	−1	1033

Source: Calculated from Table 4, as explained in the text.

6. Differences between the official and the equilibrium exchange rates

When the *oer* and the *eer* differ, we need to include the effect of the real depreciation needed to reach long-run equilibrium. In the traditional case of an exogenous *aprf*, such effect is incorporated directly when using expression [6]. If a 20 per cent real depreciation with respect to the wage were needed to reach equilibrium, according to [17] our *aprf* would simply be[15]

$aprf = 1.20 \times 1.0985 = 1.318$

and the resulting **apr** vector would be

$$\mathbf{apr} = \begin{bmatrix} apr(1) \\ apr(2) \\ apr(3) \end{bmatrix} = \begin{bmatrix} 1.020 \\ 1.012 \\ 1.204 \end{bmatrix}$$

When foreign exchange is treated as a partially produced good at the margin, the case is somewhat more complicated because the matrix of Table 3, including the production cost structures of the traded goods, will be valued at the *oer*. Consequently, total requirements v^*_{ih} of Table 4 will also correspond to that exchange rate. That is what allows us to calculate the *aprf* according to expression [14]. Using our data from Table 4, we obtain

$aprf = 1.20\ (0.460 \times 1.22 + 0.288 \times 0.95 + 0.074 \times 0.60 + 0.153 \times 1 + 0.024 \times 0 + 0.001 \times 0)$

$aprf = 1.24$

However, to calculate an apr_i from Table 4 we would need to separate from the total requirements of non-produced inputs an transfers, those corresponding to the production of foreign exchange, which, according to expression [14], need to be corrected by the ratio of the *eer* to the *oer*. Although this is theoretically possible, it is very difficult in practice.

One way of "dealing" with the above problem is to ignore it, and correct only total requirements ϕ^{d*}_m y ϕ^{d*}_x using expressions

$apr(\phi^d_m) = (eer/oer)\ (1 + \bar{t}_m)$

$apr(\phi^d_x) = (eer/oer)\ (1 - \bar{t}_x)$

These expressions correspond to [18] when the *eer* differs from the *oer*. By using them, we take into account that the value of the domestic consumption of traded goods, that corresponds to the *oer*, underestimates the value at efficiency prices in the equilibrium situation. However, we ignore that long-run marginal costs for traded goods have been underestimated and the corresponding cost structures distorted. Consequently, we underestimate the impact of adjusting the exchange rate.

Following this approach in our numerical example would require to calculate

$apr(\phi_m) = 1.20 \times 1.22 = 1.46$

$apr(\phi^d_x) = 1.20 \times 0.95 = 1.14$

to replace these values in [19], and to recalculate **apr**. By so doing we would obtain

$$\mathbf{apr} = \begin{bmatrix} apr(1) \\ apr(2) \\ apr(3) \\ apr(4) \\ apr(5) \\ apr(6) \end{bmatrix} = \begin{bmatrix} 0.957 \\ 0.950 \\ 1.118 \\ 1.198 \\ 0.954 \\ 0.928 \end{bmatrix}$$

An alternative, more comprehensive approach is to include the full effect of the devaluation inside the matrix. For that purpose, two alternative methods may be followed. The first one consists of leaving the coefficients ϕ_m^s and ϕ_x^s valued at the *oer*, valuing coefficients ϕ_m^d and ϕ_x^d at the *eer*, allocating the difference with their valuation at the *oer* to (negative) abnormal profits in the row "producing" the foreign exchange (row (4) in our example), and estimating the (negative) abnormal profits of each traded-good producing sector, allocating it to the corresponding cost structure. In the second method, all four coefficients ϕ_m^d, ϕ_m^s, ϕ_x^d and ϕ_x^s are valued at the *eer*, the difference with their valuation at the *oer* is allocated to abnormal profits in the row "producing" the foreign exchange, and the cost structures of the traded sectors are valued at the *eer*.

In this paper, we will follow the second method. To that effect we value the elements of the row "producing" foreign exchange at the *eer* and include the transfer corresponding to the difference between the *oer* and the *eer*, so the sum of the row continues to refer to the *oer*. Recalling that

$$1 = \phi_m^d + \phi_m^s + \phi_x^d + \phi_x^s$$

we multiply each element by the ratio of the *eer* to the *oer* and subtract the per unit difference between the two exchange rates, i.e.

$$1 = \gamma_m^d + \gamma_m^s + \gamma_x^d + \gamma_x^s + (oer - eer)/oer \qquad [20]$$

where $\gamma = \phi\,(eer/oer)$, and the last term indicates the transfer that takes place through the overvalued domestic currency. Let us assume, for example, that Table 3 describes the data valued at the *oer*. So, according to the above method, we first have to revalue coefficients ϕ at the *eer* and register the corresponding transfer. Consequently, from row (4) in Table 3, and [20] we will have

$$0.18 + 0.24 + 0.48 + 0.30 - 0.2 = 1$$

which becomes row (4) in Table 6.

Since the coefficients in the row "producing" the foreign exchange now correspond to the *eer*, it becomes necessary to value the rows producing the traded goods at the same exchange rate. As values at the *eer* are not known, they will have to be estimated. Let us assume that the cost structures of traded goods (5) and (6) were estimated from survey data and that the gross operating surplus (*gos*), incorrectly assumed to be equal to the capital cost annuity, was allocated between land rents, traded capital inputs, and non-traded capital inputs. As a result, the cost structures were

$$1 = \Sigma_j a_{ij} + f_i + t_i + w_i + la_i \qquad [21]$$

A real depreciation by a factor of $1 + d$ with respect to the wage will result in

$$1 + d = \Sigma_{j \neq K} (1 + \alpha_j d) a_{ij} + \Sigma_{j=K} a_{ij} + \beta_{ic} (1 + d)(f_i + t_i) + (1 - \beta_{ic})(f_i + t_i) + w_i + la_i + \Delta gos_i \qquad [22]$$

where the $\alpha_j < 1$ weight the effects of the devaluation on the prices of the non-traded current inputs ($j \neq K$), β_{ic} is the proportion of current traded inputs,[16] and Δgos_i is the increase in the gross operating surplus. The α_j may be interpreted as the total traded goods content of those inputs, and can be estimated accordingly. Since the real depreciation has been defined with respect to the nominal wage, w_i will remain unchanged, as it will initially la_i since it has no foreign exchange cost component. Finally, Δgos_i reflects the original underestimation of capital costs that resulted from a low *gos* due to the overvaluation, plus the effects of the higher real exchange rate on the domestic prices of capital goods.

Consequently, reconstructing the cost structures of the two traded sectors requires the recalculation of coefficients a_{ij} ($j \neq K$), $\beta_{ic} f_i$, and $\beta_{ic} t_i$, as well as an approximate distribution of Δgos_i among non-traded capital goods, traded capital goods ($(1 - \beta_{ic})(f_i + t_i)$), and rents.

Since sector (1) is assumed to produce capital goods, only total requirements of foreign exchange and trade taxes for sectors (2) and (3) are required as estimates for α_j[17]

$$\alpha_2 = 0.554 \qquad \alpha_3 = 0.729 \qquad [23]$$

Finally, the proportions of current traded inputs are assumed to be

$$\beta_{5c} = 0.66 \qquad \beta_{6c} = 0.50 \qquad [24]$$

By replacing [23] and [24] in [22], and rearranging, we obtain

$$\Delta gos_5 = 0.1204 \qquad \Delta gos_6 = 0.1642$$

The criteria for distributing the Δgos_i between capital goods and rents will have to take into consideration the method originally followed for constructing the matrix; in other words, it will be based on a diagnosis of the error then made. For the sake of simplicity, let us say that while total *gos* was underestimated in our numerical example, its original distribution is considered a good estimate of the composition of the capital coefficient. In that case, the Δgos coefficient can be distributed among the non-traded capital goods (sector (1)), traded capital goods, and rents according to the same proportions used for distributing the original gross operating surplus, i.e.

	Sector (5)		Sector (6)		
Δa_{i1}	0.0428	0.3552	0.0176	0.1069	
Δf_i	0.0391	0.3251	0.0150	0.0916	
Δt_i	0.0056	0.0464	0.0063	0.0382	[25]
$\underline{\Delta la_i}$	$\underline{0.0329}$	$\underline{0.2732}$	$\underline{0.1254}$	$\underline{0.7634}$	
Δgos_i	0.1204	1.0000	0.1642	1.0000	

We can now calculate the new coefficients by replacing [23] and [24] to account for the cost effect of the devaluation on current inputs, using estimates [25] to correct for the original underestimation of capital costs, and dividing by $(1 + d)$. By so doing we obtain the new rows (5) and (6) in Table 6, which is used to calculate the total requirements of non-produced inputs presented as Table 7. Those total requirements will comprise non-produced inputs originated in sectors (2) and (3), as well as those coming from the production of the traded goods, including the (negative) excess profits originated in the production of the traded goods but recorded in row (4).

Table 6
Intersectoral relations matrix incorporating the production of traded goods

	Inputs												
Outputs	(1)	(2)	(3)	(4)	(5)	(6)	ϕ_m^d	ϕ_x^d	w	la	t	b	Total
(1)	-	0.37	0.05	0.30	-	-	-	-	0.15	0.10	0.03	-	1.00
(2)	0.14	-	0.06	0.40	-	-	-	-	0.20	0.15	0.03	0.02	1.00
(3)	0.09	0.14	-	0.60	-	-	-	-	0.05	0.15	-	−0.03	1.00
(4)	-	-	-	-	0.18	0.24	0.48	0.30	-	-	-	−0.20	1.00
(5)	0.1440	0.1389	0.0668	0.3628	-	-	-	-	0.1250	0.1107	0.0518	-	1.00
(6)	0.0730	0.1203	0.0286	0.1225	-	-	-	-	0.0833	0.5211	0.0511	-	1.00

Source: Prepared from Table 3.

Table 7
Total requirements of non-produced inputs and transfers

$\mathbf{v}^*_{ih}$	ϕ_m^{d*}	ϕ_x^{d*}	w^*	la^*	t^*	b^*	$\Sigma_h v^*_{ih}$
$\mathbf{v}^*_{1h}$	0.301	0.188	0.287	0.283	0.060	−0.119	1.000
$\mathbf{v}^*_{2h}$	0.295	0.184	0.282	0.289	0.052	−0.103	1.000
$\mathbf{v}^*_{3h}$	0.411	0.257	0.164	0.335	0.031	−0.197	1.000
$\mathbf{v}^*_{4h}$	0.571	0.357	0.081	0.198	0.031	−0.237	1.000
$\mathbf{v}^*_{5h}$	0.319	0.199	0.246	0.286	0.081	−0.131	1.000
$\mathbf{v}^*_{6h}$	0.139	0.087	0.153	0.610	0.066	−0.056	1.000

Source: Calculated from Table 6.

Ve3ctor **apr** can be now calculated using $\mathbf{apr}^v$ vector [19], where *oer* = *eer*, because the effect of the difference between the *eer* and the *oer* has been included as a transfer in the column "producing" the foreign exchange. In our example, we obtain

$$\mathbf{apr} = \begin{bmatrix} apr(1) \\ apr(2) \\ apr(3) \\ apr(4) \\ apr(5) \\ apr(6) \end{bmatrix} = \begin{bmatrix} 1.001 \\ 0.994 \\ 1.178 \\ 1.282 \\ 1.012 \\ 0.954 \end{bmatrix}$$

The new *aprf* (1.282) is higher than 1.2 times that calculated in the preceding section under the assumption that *oer* = *eer*. That is because the former takes into account not only the additional 20 percent value of the foreign exchange, but it is also corrected for the changes in the cost structures of the traded goods, which are intensive in non-produced inputs whose *apr* are relatively high (land and foreign exchange).

This approach has not only the advantage of simultaneously providing the apr_i and the *aprf*, but also of allowing direct calculation of the distribution of costs and benefits generated by the project in the simple way presented in Table 5.

7. Conclusions

In the conventional approach to estimate accounting price ratios using input-output techniques, foreign exchange is treated as a non-produced input valued with an exogenously calculated *apr* that takes into account what are normally the most important differences between border prices in domestic currency and domestic market prices, i.e. trade taxes and subsidies. This approach is valid if, inter alia, market prices for domestically produced, but marginally traded goods equal their corresponding long-run marginal costs at efficiency prices. We have shown that when that is not the case, the traditional input-output model can be modified to treat foreign exchange as a partially produced input at the margin. That allows us to correct for differences between market prices and marginal costs at accounting prices, simultaneously providing the *apr* for the marginally produced goods and the corresponding *aprf*. We have also shown that the method allows us to take into account possible differences between the equilibrium exchange rate and that at which the transactions are valued.

The error in estimating the *aprf* avoided by using this approach will be bigger the greater the difference between domestic (basic) prices of traded goods and their long-run marginal costs at accounting prices, and the greater the participation of changes in the production of those goods in the value of the marginal basket. Examples of the first condition will be countries producing marginally traded goods that are intensive in the use of domestically subsidized inputs (e.g., petroleum derivatives in some oil-producing countries), or in the use of marginally exported inputs subject to export taxes. External effects that lead to significant differences between private and social costs (e.g., pollution) may also be a source of significant differences between market prices and marginal costs at accounting prices.

Different estimates of the *aprf* will affect relative accounting prices between traded and non-traded goods, as well as the relative apr_i among non-traded goods. The former will be greater the lower the total foreign exchange content of producing non-traded goods, while the latter will be greater, the greater the variation in total foreign exchange content among those goods.

Finally, differences between the two approaches for estimating the *aprf* will be most important in the appraisal of projects with a large *net* effect on foreign exchange; e.g. the production of marginally traded (non-traded) goods using primarily non-traded (traded) inputs. In these cases, small percentage differences in the accounting price ratio for foreign exchange may have significant effects on internal rates of return and benefit-cost ratios.[18]

Appendix

In order to demonstrate the equivalence of expressions [14] and [16], let us start from the latter and present total requirements v^*_{ih} as the sum of the direct and indirect, i.e.

$$v^*_{ih} = v_{ih} + \Sigma_j\, a_{ij}\, v^*_{jh} \qquad \text{[A.1]}$$

Using [A.1], [16] can be written as

$$apr_i = \Sigma_h\, v_{ih}\, apr^v_h + \Sigma_j\, a_{ij}\, \Sigma_h\, v^*_{jh}\, apr^v_h$$

Considering that foreign exchange is treated as a produced good, we can separate from the above expression the total requirements of non-produced inputs and transfers associated to the additional demand of foreign exchange (*f*) generated by increasing the production of *i* as

$$a_{if}\, \Sigma_h\, v^*_{fh}\, apr^v_h \qquad \text{[A.2]}$$

In turn, we can also decompose total requirements v^*_{fh} into the sum of the corresponding direct and indirect ones

$$v^*_{fh} = v_{fh} + \Sigma_j\, a_{fj}\, v^*_{jh}$$

and then write [A.2] as

$$a_{if}\, \Sigma_h\, v^*_{fh}\, apr^v_h = a_{if}\, (\Sigma_h\, v_{fh}\, apr^v_h + \Sigma_h\, \Sigma_j\, a_{fj}\, v^*_{jh}\, apr^v_h) \qquad \text{[A.3]}$$

The expression between parenthesis should be the correction of the direct (and, consequently, also of the indirect) additional demand of foreign exchange valued at the *eer*, or *aprf*, which must be equal to expression [14]. In other words, we must be able to demonstrate that expressions [14] and

$$aprf = \Sigma_h v_{fh}\, apr^v_h + \Sigma_h \Sigma_j a_{fj}\, v^*_{j\,h}\, apr^v_h \qquad [A.4]$$

are equal. To that effect, let us recall that the only direct requirements of non-produced inputs v_{fh} contained in the row "producing" foreign exchange are those in [15], and the direct requirements of produced inputs a_{fj} corresponding to traded goods *j* whose production changes due to the additional demand of foreign exchange. Consequently, those inputs are goods *g* and *k* of expression [14] verifying that

$$a_{fj} = \phi^s_g\,,\ \phi^s_k \qquad [A.5]$$

according to the construction of the foreign exchange row (see Table 1).

Replacing [15] and [A.5] in [A.4] we obtain

$$aprf = \phi^d_m\,(1 + \bar{t}_m) + \phi^d_x\,(1 - \bar{t}_x) + \Sigma_h \Sigma_j \phi^s_j\, v^*_{j\,h}\, apr^v_h \qquad [A.6]$$

and considering that ϕ^s_j is independent from *h*, we have that

$$aprf = \phi^d_m\,(1 + \bar{t}_m) + \phi^d_x\,(1 - \bar{t}_x) + \Sigma_j \phi^s_j\, \Sigma_h v^*_{j\,h}\, apr^v_h \qquad [A.7]$$

Recalling that $j = g, k$, [A.7] is expression [14] for the *aprf*.

* * *

Endnotes

* Inter-American Development Bank. Opinions expressed in this paper are those of the author and do not intend to represent positions of the Inter-American Development Bank. Comments by Roberto Fernández, John Weiss, and two anonymous referees are gratefully acknowledged.

1. For a discussion of the meaning of "efficiency" in applied welfare economics, see Mishan (1980; 1981, Ch. 37 and 41; 1982), Sen (1987), and Londero (1987, 1992a).

2. Powers (1981) and Londero (1987, 1992b) provide a more detailed presentation.

3. Note that the traditional input-output notation has been transposed.

4. In a strict sense, and using imports as an example, $\Delta m_g/\Delta f = (\partial m_g/\partial eer)(\partial eer/\partial f)$. Londero (1987, Ch. 3) provides a derivation of expression [2].

5. For a good analysis of the *eer* see Edwards (1988, 1989).

6. In formula [4] it is also assumed that domestic prices for distribution margins do not differ significantly from their efficiency prices. See Londero (1987, sec. 3.7).

7. Remember that here, a row corresponds to a column in the conventional input-output table.

8. Not as proportions of its domestic price [e.g., $p_k = FOB_k\, eer\,(1 - t_k)$], because foreign exchange valued at the *eer* is what the sector "producing" the foreign exchange demands backwards to the sectors producing traded goods.

9. Londero (1987, Ch. 11) provides further discussion of these issues.

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10. These and other calculations were made using the microcomputer program CALPAN. See Londero and Soto (1991).

11. It could also be interpreted as two rows containing a weighted average of import substituting and export cost structures where the weights are $\phi^s_g / \Sigma_g \phi^s_g$ and $\phi^s_k / \Sigma_k \phi^s_k$, respectively. This approach is similar to that of "conversion factors" and it can be dealt with in the matrix in a similar manner; see Londero (1992b).

12. The valuation of the traded goods, (5) and (6) in this example, is done using the *aprf*, and will be discussed in the following section.

13. Note that to simplify presentation, we use unique average trade taxes $\bar{t}_m$ and $\bar{t}_x$. However, product participations in the reductions of domestic consumption and in the increases in production will be different (i.e., $\phi^d_g \neq \phi^s_g$, and $\phi^d_k \neq \phi^s_k$). Consequently, in practice there will be one average trade tax for reductions in the domestic consumption, defined in [13], and another one for production increases.

14. Londero (1987) provides a detailed presentation on quantifying distributional effects.

15. Regarding $\bar{t}_m$ and $\bar{t}_x$, in practice, only an estimate of the *ad valorem* equivalent corresponding to the *oer* is normally available. If specific (or other non *ad valorem*) taxes or subsidies were significant, such estimate may need to be corrected.

16. For the sake of simplicity, the same coefficient is applied to the foreign exchange and the trade taxes.

17. The reader may verify it by calculating $\mathbf{V}^*$ from Table 2 and adding the coefficients for f^* and t^*.

18. See Londero (1992c, pp. 121-22).

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