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"Measuring Protection: A Cautionary Tale"

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Measuring protection: a cautionary tale

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Abstract

The measurement of protection has been a key stumbling block for economists seeking to establish an empirical link between trade policy and growth. This note comments on a theoretically based index of protection recently developed by Anderson and Neary. The index must be calculated within the context of a specific CGE model; Anderson and Neary have found that the index is robust to changes in the elasticities embedded within their model. Is the index also robust to changes in the specification of the model? The note identifies one historical instance where the index is extremely sensitive to the specification of the model's demand side. There are important methodological lessons to be learnt from this example.

Section 1. Introduction: Measuring Protection

What is the relationship between trade policy and growth? Although the issue is fundamental, empirical evidence remains unsatisfactory. The most basic difficulty facing researchers is how to quantify the level of protection in an economy. As is well known, a classic index number problem arises: take the following trade-weighted average tariff

$$t = \Sigma_i \frac{M_i t_i}{M} \qquad (1)$$

where M_i is the import of good i, t_i is the tariff levied on good i, and M is total imports. The problem with this measure is clear: as the tariff on good i is increased, the weight on good i declines. In the extreme case, if a tariff is raised so high that imports are excluded, the weight drops to zero, and the tariff no longer contributes to the index.

Other attempts to measure the openness of national economies have been no more satisfactory. For example, some researchers have used the ratio of exports, or imports, to GDP, as a measure of openness. This measure is clearly unconvincing. The equilibrium ratio of trade to GDP might be low for a particular economy in free trade. More recently, Ed Leamer and others have developed a measure of trade openness based on a Heckscher-Ohlin empirical trade model.[1] If trade patterns for a country do not conform with the predictions of the model, this is taken as evidence of protection. The problem with this index of protection is also obvious: the

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[1] See Leamer (1988), or Edwards (1992) for an application.

Heckscher-Ohlin model may not adequately describe late 20th century trade patterns.

The problems which the lack of a suitable measure of protection has given rise to may be gauged from two surveys of the literature on trade policy and economic growth, which have appeared in recent years: Forrest Capie's Tariffs and Growth (1994), on the 1850-1940 period, and Sebastian Edward's 1993 survey article on trade policy in developing countries in JEL. Both pieces are concerned to establish the relationship, if any, between protection and growth; both are hamstrung by the basic question of how to measure the degree to which a country is protectionist. The Capie book devotes extensive space to the relative merits of such indices as the ratio of tariff revenue to imports, the trade to GDP ratio, and the effective rate of protection (for specific industries), none of which give an entirely adequate picture of the overall trade policy stance of an economy. The promise of the book's title is never fulfilled, simply because there have only been one or two, unsatisfactory, cross-country studies of the issue to date; although Capie reaches strong free trade conclusions, the book provides almost no empirical findings to back this up.

The Edwards survey reveals that more work has been done on the post-war period, but even here the use of discrete classifications of countries ('strongly outwardly oriented', and so on) makes it impossible to estimate the elasticities we are most interested in, and introduces the possibility of bias on the part of the classifier. These classifications have been adopted largely because of the growing importance of non-tariff barriers in overall trade policy. Once again, the absence of a theoretically satisfactory index of protection has hampered research in the area.

Section 2. The Trade Restrictiveness Index

In a series of papers, Anderson and Neary (1992, 1994a, 1994b) have proposed the most promising measure yet of a country's protection, based on solid analytical foundations: the Trade Restrictiveness Index (TRI). To motivate the TRI, consider the standard partial equilibrium analysis of the effects of a tariff in a small open economy (Figure 1). The quota equivalent to a tariff t is AB; i.e. it is the quota which produces the same static welfare loss (the shaded triangles) as the tariff. It makes sense to similarly define an index of protection for more general cases. A country's TRI is the uniform tariff which would have the same static welfare effect as the structure of tariffs and quotas actually in place. It follows from the definition of the TRI that its level will depend on the structure of the economy in question, which in practice boils down to the structure of the computable general equilibrium (CGE) model used to evaluate it.

Ideally, we would like to know what the 'true' model was for each country and time period. Since arriving at the true model is impossible, the danger arises that the value of the index for a particular country would be a consequence of some quirk of the country-specific model. How comparable would such indices be across periods and countries? It seems sensible to use a 'standard' model when calculating the index for different countries.

To operationalise their index in data scarce environments, Anderson and Neary propose a particularly simple and parsimonious CGE model with which to evaluate the TRI (see Figure 2). They also provide an EXCEL spreadsheet program enabling researchers to easily implement the model. The economy produces two goods, a non-traded good (NT) and an export good (EX). Production uses two types of inputs: non-traded inputs (i.e. domestic factors of production) and imported intermediate inputs (II). The production function is CES on the input side, and CET (constant elasticity of transformation) on the output side. Anderson and Neary typically take as benchmark values 0.7 for the elasticity of substitution (s), and 5.0 for the elasticity of transformation (t).

The consumer is endowed with all non-traded inputs, and receives all tariff revenue. The consumer is also endowed with enough foreign exchange to enable him to run the (exogenous) trade deficit. He consumes the non-traded good, as well as imported final goods (IF). The entire production of the non-traded good is consumed by the consumer; the entire production of the export good is exported. The model thus assumes implicitly that imported goods and exported goods both differ from domestic commodities consumed locally. The utility function is CES, with the benchmark elasticity of substitution being taken as 5.0.

The advantage of this specification is that the model can be calibrated with only two numbers (in addition to the import and trade policy data you obviously need): GDP and the value of exports. Calibration proceeds as indicated in Table 1 below. Note that the consumer gets the tariff revenue on both intermediate and final goods, and that the cost to the consumer of final goods includes the tariffs levied thereon. Therefore the consumers budget constraint is satisfied.

Some complications arise in the presence of quotas. First, the welfare effects of a quota depend on who gets the rents; and thus the TRI also depends on who gets the rents. In the spreadsheet version of their model, Anderson and Neary make the 'convenient assumption' that all rents are dissipated through competitive rent-seeking; but other assumptions could be made.

Second, the presence of quotas leads to data problems. In the case of an ad valorem tariff, we observe domestic price and quantity, and can infer the world price. Thus, given the slope of the demand curve, we can calculate the welfare loss associated with the tariff, and consequently the TRI. However, in the case of a quota, while we observe domestic price and quantity, we only know the world price if we also know the quota premium-- which is typically not the case. It is thus impossible to calculate the welfare loss associated with a quota, and by implication, it is impossible to calculate the level of the TRI. However, it is possible to calculate the change in welfare associated with a change in quotas; it is thus possible to calculate changes in the TRI.

The spreadsheet program provided by Anderson and Neary does precisely this; it allows you to track how the TRI of an economy is changing over time. (Of course, if one of the periods being compared is a hypothetical free trade period, and data on world prices of quota-constrained goods are available, then the program can be used to calculate the level of the TRI in a given period.)

At this point, the reader will have two questions. Does it matter whether you use this index or not? Is the index trustworthy?

In answer to the first question, Anderson and Neary have computed the TRI for a number of cases, and find that indeed its behaviour differs dramatically from that of the trade-weighted average tariff equivalent. Table 2, taken from Anderson and Neary (1994a), gives changes in the US protective stance vis a vis Hong Kong textiles: the complete lack of correlation between changes in the TRI and changes in the standard index is typical of their findings to date. Clearly, standard measures such as weighted average tariffs could give an extremely misleading impression of what is happening to a country's trade policy.

This note focusses on the second question: is the TRI trustworthy? How sensitive is it to the elasticities of substitution and transformation embedded in the CGE model? If changing these elasticities changed the level of the index, we would still have an index number problem, albeit of a more fundamental, 'economic' nature. The evidence to date is that the TRI is not sensitive to changes in elasticities: Table 3 gives some illustrative calculations for Colombia.

Anderson and Neary recognize that whether the TRI is robust to changes in elasticity values is an important issue. They note that the robustness found in the Colombian case has also been found in the other TRI applications that have been carried out to date; but go on to state that "Because it is only an empirical finding, of course, it needs to be replicated extensively on other data sets before it can be regarded as typical".[2]

Is this finding generally true? A historical example suggests otherwise.

Section 3. France and the UK: 19th century fortresses or free-traders?

In a strongly revisionist 1991 article, John Nye challenged the conventional view that Britain was the free-trader of 19th century Europe, while France was relatively protectionist. Nye based his argument on trade-weighted average tariffs for the two countries, as well as the evidence on individual tariff levels contained in Tables 4 and 5: he found that British average tariffs were higher than their French counterparts until the late 1870s. Nye concluded that the mistaken impression that Britain was the leading free-trader of the period, especially when compared with its nearest neighbour, is due to the fact that historians have tended to have too narrow a focus, obsessing about a small number of 'leading sectors' such as cotton textiles, rather

[2] Anderson and Neary (1994a), p. 166.

than the economy as a whole.[3]

Nye's article was in many respects deeply shocking, challenging as it did one of economic history's most established stories (or morality tales): Britain's conversion to free trade in 1846, and the huge growth in overseas trade and investment which followed. It was therefore not surprising when in 1993 Doug Irwin responded to Nye. Irwin questioned the usefulness of trade-weighted average tariffs: after 1846, and especially after the 1860 Gladstone budget, British tariffs were mainly levied for revenue purposes, and had little or no protective effect.

Irwin's argument can be appreciated by examining either Tables 4 and 5, or the summary statistics in tables 6 and 7. Tables 6 and 7, based on the information in Tables 4 and 5, give trade-weighted average tariffs for three classes of commodities: 'exotic goods', 'wines', and other goods. Exotic goods are imported goods with no domestic substitutes: sugar and coffee in France, sugar, coffee, tea and tobacco in Britain. Wines, consisting of wine, rum and brandy, are a separate category for Britain, for reasons which will become apparent.

Tables 6 and 7 show that in the 1840s and 1850s, British tariffs on exotic goods were higher than their French counterparts. British tariffs on 'other' goods were higher than in France in 1841, but lower in 1854, and virtually non-existent in 1881. Britain levied high tariffs on wine and

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[3] The tables confirm that in industries like textiles, the French were more protectionist than the British.

spirits throughout the period.

The result of high tariffs on exotic goods and wines was British average tariffs which were higher than in France: this is essentially Nye's point. However, Irwin argues that the duties on exotic goods and wines were not protective, as there were no domestic substitutes for these goods. Nye had argued that wine and beer were substitutes; Irwin replied that tariffs on wine were simply the equivalent of excise taxes on domestic beer, and that they therefore had no protective effect.

The Nye-Irwin debate clearly hinges on the specification of demand, and in particular on how exotic goods are treated. It is these goods which face the highest tariffs, with the British tariffs on exotic imports, in particular tobacco, being far higher than in France. Moreover, several of these tariffs increased in Britain over the period, in contrast to the general pattern of tariff reductions.

It should also be remembered that the TRI is a measure of the overall distortion implicit in a country's trade regime. This implies that a country with a more widely dispersed tariff structure will have a higher TRI, ceteris paribus (since a greater dispersion of tariffs implies greater discrimination between commodities).

This latter feature of the index implies that the British TRI level will be extremely high indeed, if all imported goods are treated symmetrically. The generic Anderson-Neary model of Figure 2 does precisely this. However, it seems unreasonable to assume that the domestic elasticity of substitution between tea and domestic products should be as high as that between, say, American grain and domestic products. What if different categories of imports are treated asymmetrically?

For example, Irwin might argue that the model should distinguish between exotic and other goods, letting the latter substitute with domestic goods, but not the former. This structure might be represented by Figure 3, indicating a 2-level utility function. At the top level, exotic goods enter in fixed proportions with all other goods (the elasticity of substitution between the two groups is set to zero). At the second level, other imports substitute with the domestic good in the normal fashion.

Table 6 gives calculated values for the French TRI, assuming that quota premia on textiles were either 30% or 50% (the range indicated by Nye as being reasonable).[4] The TRI is calculated using MPSGE/GAMS. First the benchmark equilibrium is reproduced; a counterfactual experiment then abolishes all existing tariffs and quotas, and imposes a uniform, endogenous, tariff, whose level is determined by the requirement that welfare be equal to benchmark welfare.

The French model makes one further sensible assumption (Figure 4): colonial and foreign sugar are assumed to substitute very closely with each other (the elasticity of substitution is taken to be 10). As can be seen, the assumption made about quota rents matters very little. Based

[4] As indicated in the previous section, making assumptions about the quota premium makes it possible to calculate the level of the TRI, rather than merely the change in the TRI.

on the data given in Nye, it appears that French protection was equivalent to a uniform tariff of 17.7% in 1837-46, 11.5% in 1847-56, 4.7% in 1857-66, and 5.5% in 1867-76.

The TRI was then calculated for the UK, using the same model framework as indicated in Figure 3 (colonial and foreign sugar not being distinguished in the tariff statistics for Britain). The obvious problem, which clearly relates to the exchanges between Irwin and Nye, is whether or not to include wine, rum and brandy with the other exotic goods. Table 7 indicates, not surprisingly, that it matters hugely whether or not you do. It appears that if wine, rum and brandy are taken to have no domestic substitutes [case (1)], Irwin was right: the British TRI is lower than its French counterpart. This is even true for 1841, the period just prior to Repeal, when as Tables 6 and 7 indicate, trade-weighted average tariffs on broad categories of products were all higher in Britain than in France. This illustrates the importance of the classic index number problem, which the TRI was devised to solve.

However, if wine, rum and brandy are not treated as exotic, but are assumed to be as substitutable with British goods as imported wheat or timber, then Nye is spectacularly right. Indeed, in this case [(2)] the British TRI reaches absurdly high levels, reflecting for example a tariff of 510% on rum in 1881.

The treatment of imported alcoholic beverages thus emerges as crucial when calculating the British TRI. Neither of the extremes considered up to now (they did not substitute at all with British domestic goods; they were like any other import) may seem satisfactory. I therefore tried an intermediate approach next, illustrated in Figure 5. This involves a three-tier British utility function. In the top level, exotic goods and everything else enter in a Leontief fashion. At the second tier, wines substitute with other goods in a CES fashion. At the third level, other imports substitute with the non-traded good, with an elasticity of 5.

This formulation focusses on the elasticity of substitution between wines and other goods (domestic and imported). The question of how substitutable wine and beer were can thus be addressed in this framework. Irwin's argument that domestic excise duties on beer meant that the wine tariff was not protective cannot however be addressed; to do that we would need to break out beer from the rest of domestic production, and model indirect taxes on that sector. In the present framework, the distinction between protective and revenue tariffs boils down simply to a question of elasticities.

Table 8 calculates the British TRI for the three years, in each case letting the elasticity of substitution between wines and other goods vary between 0 and 1.5. As expected, the TRI is extremely sensitive to this elasticity, with the 1841 index varying from 15.2% to 38.9%, and the 1881 index varying from 0.7% to 56.2%. In this framework, Britain is the relatively more liberal nation if the elasticity is 0.2 or less,[5] and France is the free trader otherwise. Moreover, if the elasticity is 1.1 or higher, then Britain actually became

[5] 0.0, or possibly 0.1, for 1881.

more protectionist over the period, not less (as a result of the increased tariff on rum).

Section 4. Conclusions

The Anderson-Neary TRI represents the best option researchers have of correctly measuring protection. Moreover, since it is theoretically based, and since it can only be calculated within the context of particular trade models, the TRI forces users to think more deeply about what really constitutes protection than some other measures currently available. The fact that the TRI has proved robust to changes in elasticity values when applied to modern data seems reassuring, suggesting that it may become a valuable empirical tool for trade economists.

Unfortunately, this note has identified one instance where the TRI was absurdly sensitive to changes in both elasticities and specification. The initial aim of the exercise was to resolve an essentially qualitative debate by applying new technology to old data: this has proved impossible (which in retrospect should have been predictable). The TRI is capable of making the terms of this debate more precise, but not of resolving the debate. There are important methodological lessons arising from this. In particular, the exercise suggests that researchers need to think carefully about the structure of demand when applying the index to a particular country, rather than blindly reaching for any particular off-the-shelf model. However, it should be stressed that this exercise was carried out in the context of

19th century Europe: the issues it raises may not be as important in the 20th century, at least insofar as rich countries are concerned. Exotic commodities with no domestic substitutes, such as tea and coffee, are not as prominent in world trade as they were then; inter-industry trade between countries is more important; and there is considerably less variation in the inter-industry structure of protection than in the British case just described. For small developing countries, on the other hand, which are highly specialised in production, the cautionary tale just presented may be of greater relevance.

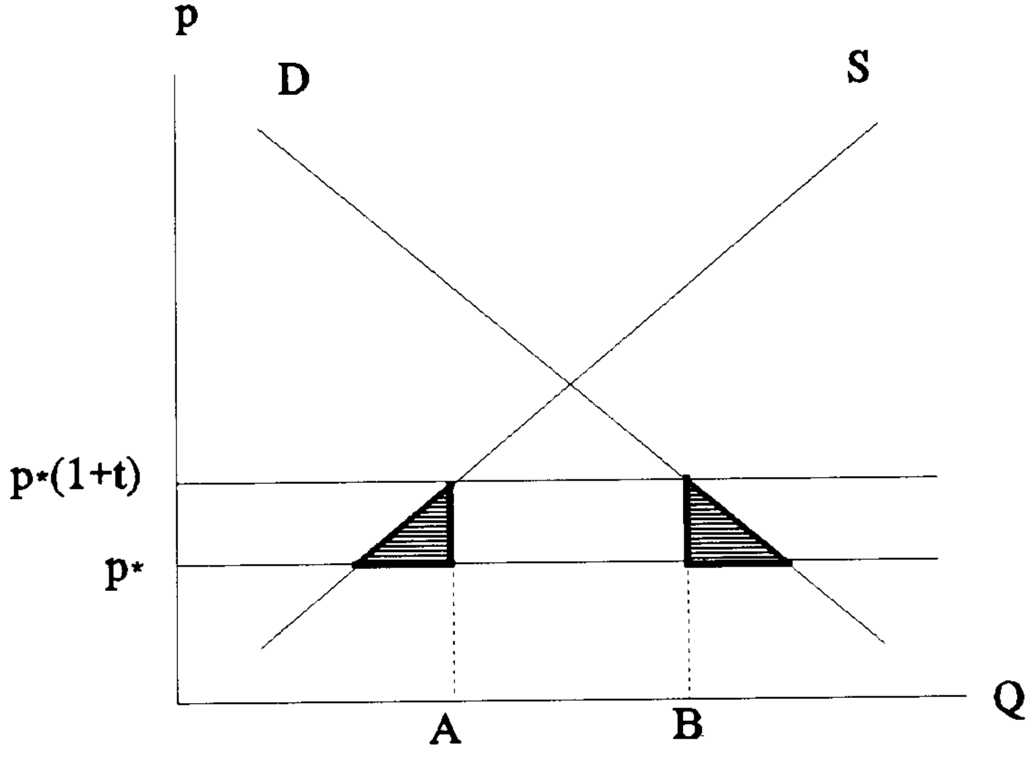

Figure 1

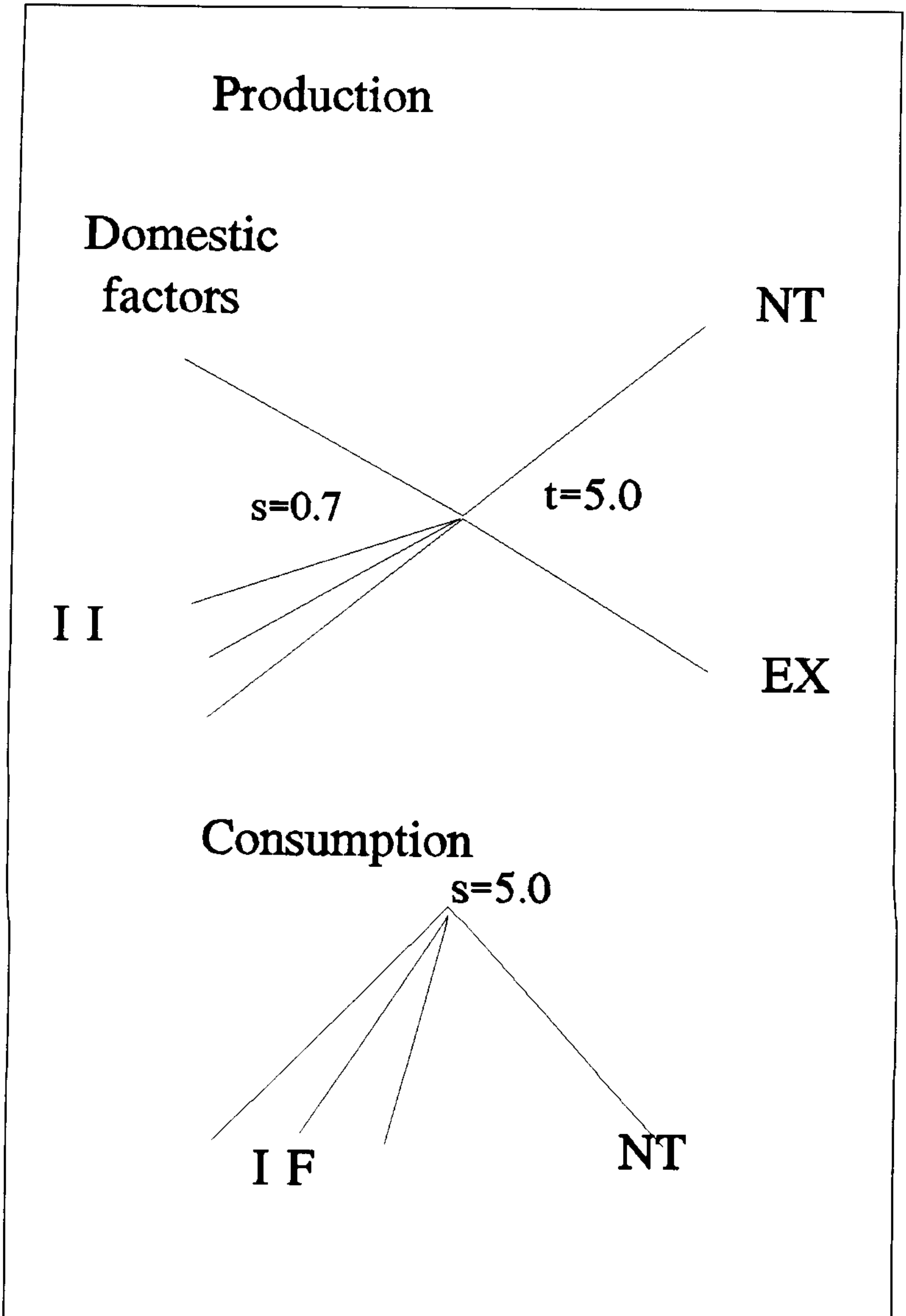
Production
Domestic
factors
NT
s=0.7
t=5.0
I I
EX
Consumption
s=5.0
I F
NT

Figure 2

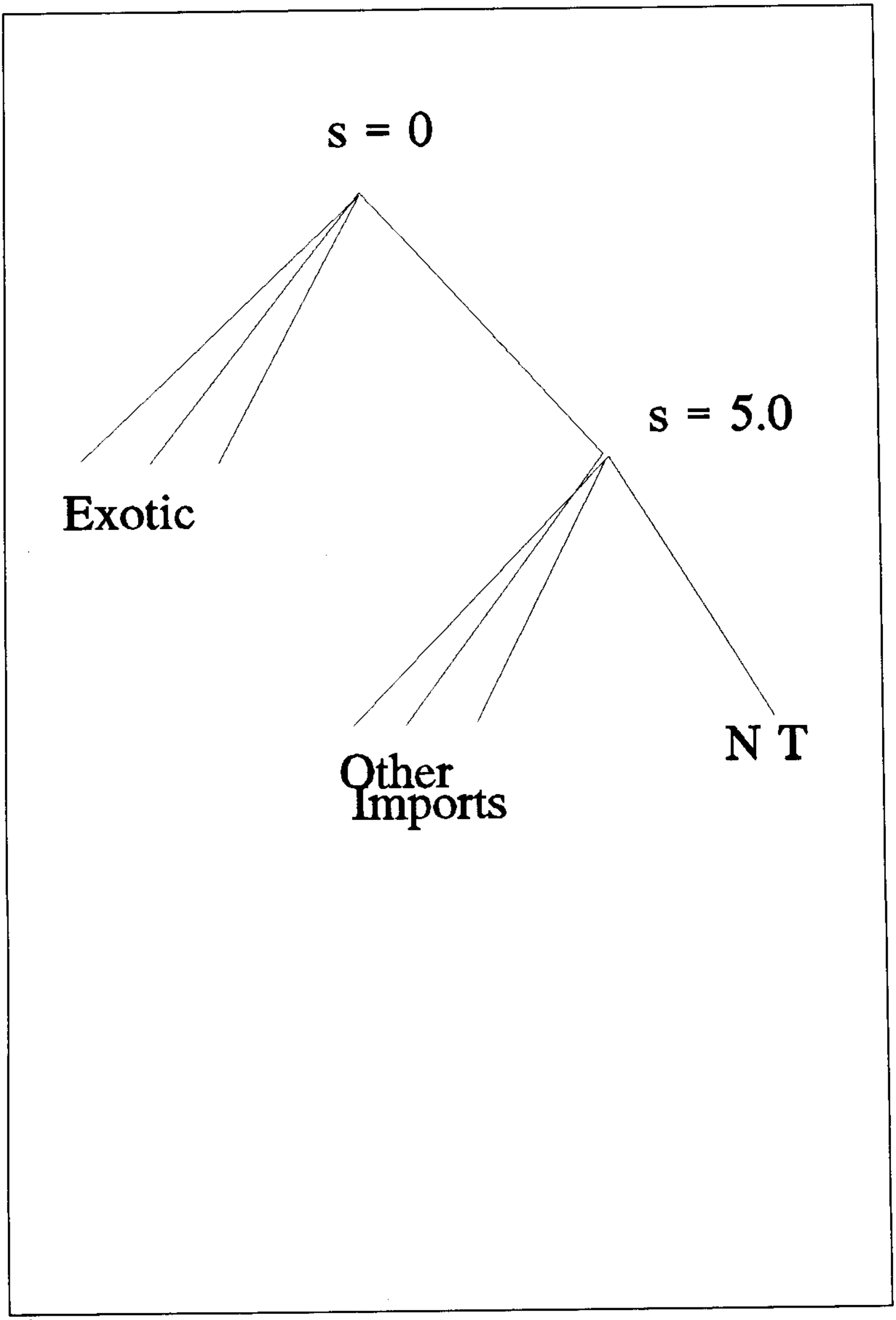

Figure 3

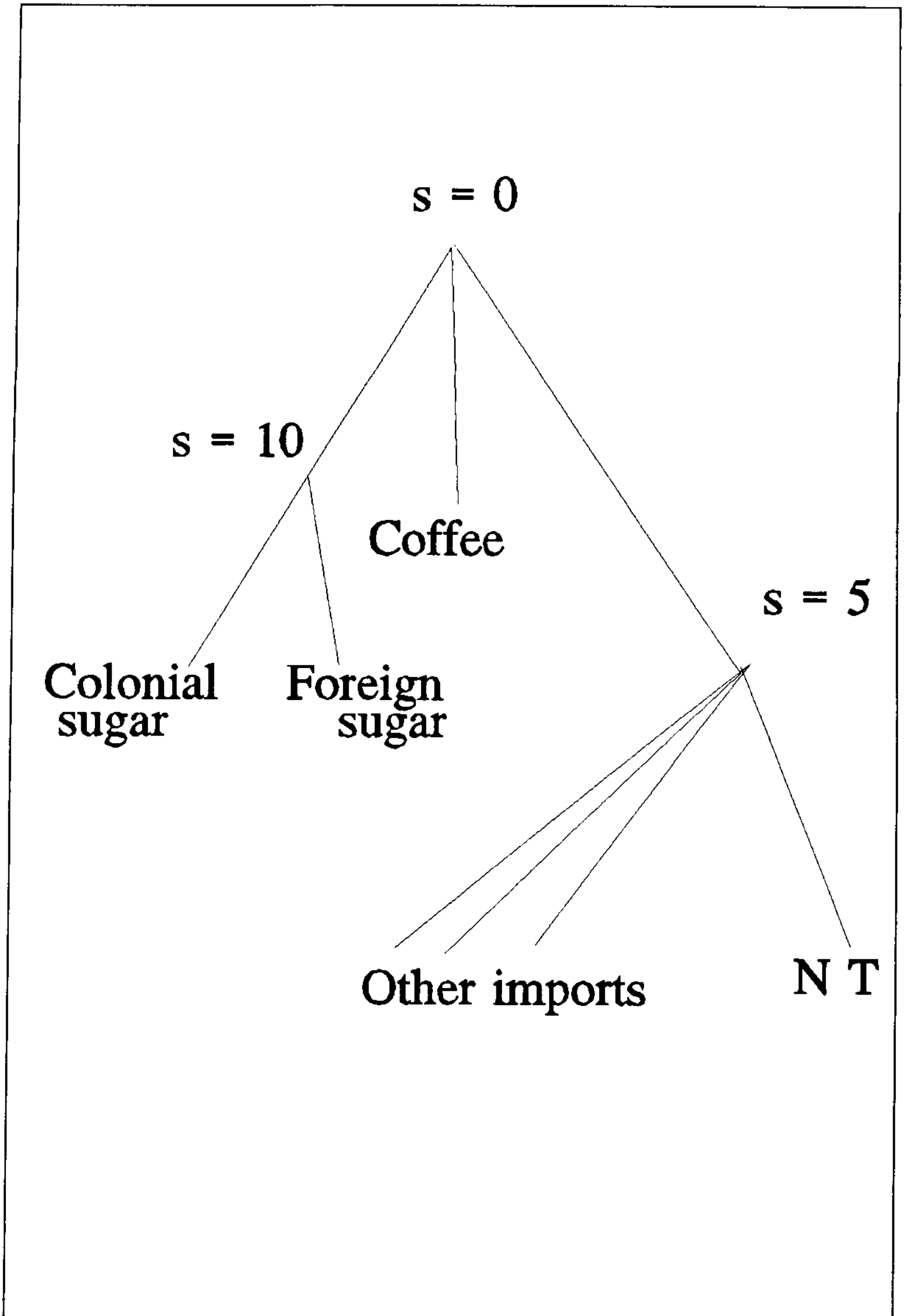
s = 0
s = 10
Coffee
s = 5
Colonial sugar
Foreign sugar
Other imports
N T

Figure 4

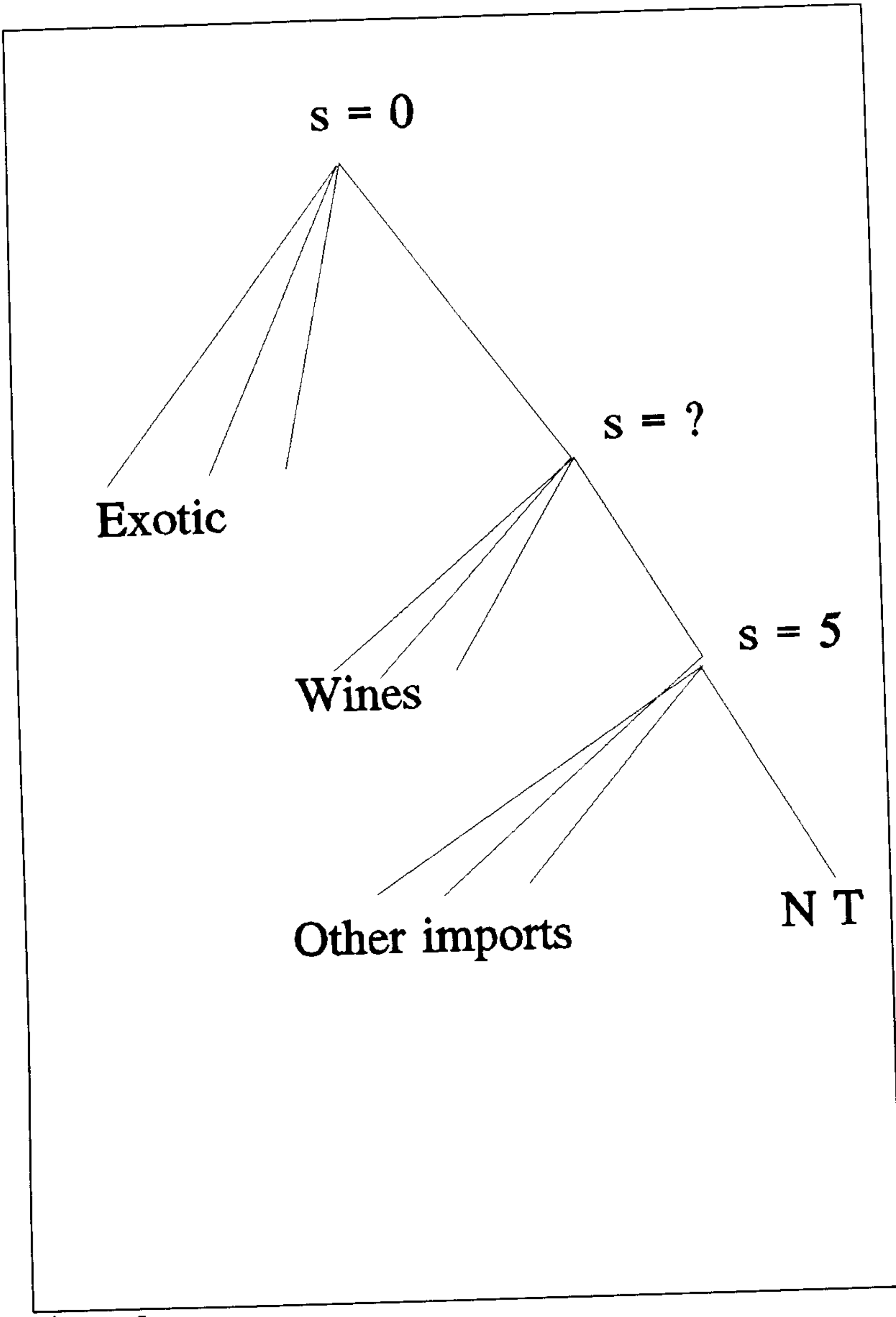

Figure 5

Table 1.

Calibrating the CGE model

roduction

nput: non-traded input	Quantity: GDP
nput: imported inputs	Quantity: INTER
tput: exports	Quantity: EXP
tput: non-traded good	Quantity: GDP + INTER + TI - EXP

nsumption

dowment: non-traded input	Quantity: GDP
dowment: foreign exchange	Quantity: TDEF
emand: non-traded good	Quantity: GDP + INTER + TI - EXP
emand: imported final goods	Quantity: FINAL

TER = value at world prices of imported intermediates

= tariffs levied on imported intermediates

P = value of exports

NAL = value at world prices of imported consumer goods

EF = INTER + FINAL - EXP (i.e. trade deficit)

Table 2. US imports of Hong Kong textiles & apparel: changes in protection

(percentage change)

Year	Change in TRI	Change in Average Tariff Equivalent
1983	1.1	84.4
1984	11.0	-8.1
1985	1.5	-39.2
1986	-3.8	42.2
1987	1.9	12.0
1988	3.6	-53.0
Cumulative	15.7	-22.9

Source: Anderson and Neary (1994a), Table 1.

Table 3. Changes in Colombian TRI, 1989-90:

Sensitivity Analysis

Elasticity of final demand	Elasticity of intermediate demand	Elasticity of transformation	Change in TRI (%)
1.5	1.0	1.5	-4.9
2.0	0.7	2.0	-4.8
2.0	0.7	5.0	-4.2
5.0	0.5	5.0	-4.4
5.0	0.7	5.0	-3.7

Source: Anderson and Neary (1994a), Table 4.

Table 4

Tariff rates and import weights, France 1837-76

Commodity	1837-46 Duty (%)	1837-46 Weight (%)	1847-56 Duty (%)	1847-56 Weight (%)	1857-66 Duty (%)	1857-66 Weight (%)	1867-76 Duty (%)	1867-76 Weight (%)
Coffee	100.8	1.7	78.5	2.2	35.7	2.9	56.3	2.4
Sugar, foreign	156.4	0.5	107.2	1.5	59.8	2.4	36.3	1.7
Sugar, colonial	71.9	6.3	62.2	4.5	55.4	3.0	61.7	1.6
Silk	0.0	7.7	0.0	11.4	0.0	11.6	0.0	11.3
Wool	22.1	4.8	17.9	4.9	1.4	8.1	0.2	7.9
Cotton	12.1	12.4	14.3	9.3	2.6	10.8	0.1	7.1
Wood	0.0	5.1	0.0	5.3	0.0	5.7	0.0	4.7
Coal	16.5	2.9	10.2	6.1	8.7	4.9	5.5	4.5
Hides	2.2	3.4	1.6	3.5	0.2	4.0	0.1	4.2
Livestock	21.8	1.1	3.8	2.0	0.6	3.0	0.4	4.0
Flax	0.0	0.6	0.0	2.1	0.0	2.1	0.0	2.4
Grains	3.3	4.7	14.6	1.7	2.1	2.0	0.1	2.1
Woollen textiles	50.0	0.1	50.0	0.1	12.4	1.0	9.9	2.0
Cotton textiles	50.0	0.1	50.0	0.1	12.7	0.4	12.1	1.4
Fats	0.0	0.7	0.0	0.6	0.0	0.9	0.0	1.3
Other	13.1	47.9	8.0	44.9	4.6	37.2	3.2	41.3

Source: Nye (1991).

Table 5

Tariff rates and import weights, U.K. 1841-81

Commodity	1841 Duty (%)	1841 Weight (%)	1854 Duty (%)	1854 Weight (%)	1881 Duty (%)	1881 Weight (%)
Coffee	96	1.4	53	0.7	18	0.3
Sugar	67	11.2	53	6.4	0	7.1
Tea	110	5.1	120	3.0	47	2.6
Tobacco	840	0.6	480	0.7	610	0.4
Wine	110	2.2	85	1.7	25	1.6
Rum	140	1.1	230	0.4	510	0.1
Brandy	320	0.6	180	0.6	120	0.4
Wheat	6	10.2	2	8.8	0	9.3
Other grain	13	1.5	2	7.5	0	5.9
Cotton	5	15.3	0	13.4	0	11.6
Staves	9	0.7	0	0.5	0	0.2
Unsawn fir	14	6.0	5	3.9	0	1.0
Other	16	44.1	7	52.2	1	59.3

Source: Nye (1991), based on McCloskey (1980).

Table 6
Tariff averages, France 1837-76 (per cent)

Tariff category	1837-46	1847-56	1857-66	1867-76
Exotic good	82.7	74.8	49.8	51.9
Other goods	10.8	7.5	3.0	2.1
Average tariff	16.9	13.0	6.9	4.9
T.R.I. (30%)	17.6	11.4	4.7	5.5
T.R.I. (50%)	17.8	11.6	4.7	5.5

Source: see text

Table 7
Tariff averages, U.K. 1841-81 (per cent)

Tariff category	1841	1854	1881
Exotic good	106.5	99.3	35.7
Wines	150.8	127.6	66.2
Other goods	12.3	4.8	0.7
Average tariff	35.0	18.5	5.8
T.R.I. (1)	15.2	6.9	0.6
T.R.I. (2)	154.1	104.7	253.9

Source: see text

Table 8
Trade restriction index, U.K. 1841-81 (per cent)
by elasticity of substitution

Elasticity	1841	1854	1881
0.0	15.2	7.1	0.7
0.1	16.4	8.7	5.4
0.2	17.6	10.3	8.0
0.3	18.9	11.7	10.3
0.4	20.2	13.2	12.6
0.5	21.6	14.6	14.8
0.6	23.0	16.0	17.2
0.7	24.5	17.5	19.7
0.8	26.0	18.9	22.3
0.9	27.6	20.4	25.3
1.0	29.3	22.0	28.6
1.1	31.0	23.6	32.3
1.2	32.9	25.2	36.6
1.3	34.8	26.9	41.8
1.4	36.8	28.7	48.1
1.5	38.9	30.6	56.2

Source: see text

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