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THE COSTS OF PROTECTION : THE OLD AND NEW ARGUMENTS

by

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1. INTRODUCTION

This paper has three basic aims. The first is to provide a short derivation of the general formula for quantifying the costs of protection. The second is to demonstrate that widely used theoretical simplifications of the general formula, and faulty techniques of empirical application, may have led to gross underestimates of the costs of protection, especially for a small developed economy such as Australia. The third objective, which is closely linked with the second, is to suggest the direction in which statistical work will have to be taken to provide a basis for satisfactory estimates.

The motivation for the paper is given by the recent Report of the Committee to Advise on Policies for Manufacturing Industry (hereafter, the Jackson Report). The Committee put research into the costs of protection as a top priority area. They wrote :

> "We are acutely aware of the great uncertainty about the benefits and costs in the Australian situation, of structural change induced by lower tariffs. There is a clear and urgent need for more work to be done." (Jackson Report, p. 171.)

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* I could not have written this paper without the enthusiastic encouragement of Alan A. Powell.

This paper attempts to make a contribution by identifying what sort of work needs to be done. Also, we will identify the sort of work which need not be done. Our argument will suggest that it would be pointless to apply a model which failed to recognize intra-industry specialization and economies of scale. Such a model is virtually certain to generate a paultry estimate for the costs of protection, whatever the true situation might be. As a corollary, we can conclude that estimates based on such models should be entirely ignored. This would apply to the Evans study, Evans [1972], which was cited by the Committee as the major Australian work on the costs of protection, and to many studies in other countries.[1]

The paper is organized as follows. In the next section, we derive the costs of protection formula. Only tariff protection is considered. Our underlying assumption is that other forms of protection have tariff equivalents. Then in sections 3 - 6 we consider four sources of the costs of protection: the terms of trade effect, the efficiency effect, the consumption gain and the production gain. Under each heading we set up what appears to be the conventional argument, and assess it in terms of some alternative arguments. In section 7 we illustrate the potential importance of some of the new arguments by use of a numerical model. Section 8 is a short summary of the principal conclusions.

1. This is not to denigrate Evans' extremely valuable work. His original model was not designed for measuring the costs of protection, as he frankly recognized. See Evans [1972, p. 111] .

A second conclusion which arose from our investigation of the aggregation question, was that cost of protection studies should pay attention to scale parameters for groups of closely related production activities. When resources can move easily from one activity to another, and there are economies of scale in both, a tariff reform may induce a complete resource transfer between them. Our model in section 7 suggested that the resulting welfare gains could be very large.

A final point concerns tariff bargaining. In section 3 we reviewed the Canadian argument on the terms of trade effect. It was suggested that a small country could gain by using its own tariff reductions to persuade its larger trading partners to reduce theirs. The importance of this argument is underscored when we consider intra-industry specialization. Small industrial economies need export markets to be able to exploit scale economies. It would appear, therefore, that they should be leaders in the promotion of world trade liberalization.

8. CONCLUSION

The key words in this paper are disaggregation, intra-industry specialization and scale economies. Our conclusion is that empirical analyses which do not treat these phenomena simultaneously cannot reveal anything useful about the costs of protection in small developed economies.

The discussion was organized under four headings, the terms of trade effect, the efficiency effect, the consumption gain and the production gain. Under each heading, we have outlined what appears to be the dominant approach in empirical work. We found that the first two terms, the terms of trade effect and the efficiency effect, are normally assumed to be zero. In both cases, we suggested that for a small developed economy the two effects are probably positive and may be large. On the third and fourth terms, the consumption and production gains, we found that existing analyses generally rely on an aggregative elasticities approach. This led us to investigate aggregation effects, and brought us to the conclusion that aggregation can lead to gross underestimates of both the consumption and production gains.

This conclusion is perhaps obvious. The classical argument for free trade is that there are gains from the reallocation of resources between production activities and the reallocation of expenditure between consumption activities. The argument can only be given a fair test in a model which adequately recognizes the multitude of alternative activities both in production and consumption.

2. THE COSTS OF PROTECTION IN FOUR PARTS

The costs of protection are usually analysed with reference to a version of the following model.[1]

1. Community consumption behaviour is described as though the aggregate consumption vector is chosen to maximize a utility function subject to the aggregate budget constraint, i.e., actually observed consumption

$$C \text{ maximizes } U(C)$$

subject to

$$P'C = Y ,$$

where C is the aggregate community consumption vector, P is the vector of domestic prices, and Y is the aggregate community expenditure level.

The utility maximizing assumption implies that there exists $\lambda > 0$ such that

$$\nabla U(C) = \lambda P , \tag{2.1}$$

where $\nabla U(C)$ is the vector of first partial derivatives of U, i.e., the marginal utilities.

1. The style of presentation here is closest to Meade [1955] and Johnson [1960, 1965] . However, the numerous analyses (e.g., Corden [1957] , Stern [1964] , Wemelsfelder [1960] and Basevi [1968]) based on consumer and producer surplus diagrams are an alternative presentation of the same thing.

2. The community budget, Y, is the sum of the value of community output and tariff collection.

$$Y = P'Z + t'M \quad , \tag{2.2}$$

where Z is the vector of industry outputs,[1] and t' is the vector of tariff rates per unit of imports and M is the vector of imports. (Negative components of M are to be interpreted as exports and the associated t's are export subsidies.)

3. Domestic prices are related to world prices by

$$P = \bar{P} + t \quad , \tag{2.3}$$

where $\bar{P}$ is the vector of export and import prices expressed in domestic currency units. For convenience, we have ignored transport and insurance costs. (In the case of non-traded goods, we can set $t_i = 0$ and allow $\bar{P}_i$ to be determined by domestic demand and supply.)

4. There is no intra-industry trade so that

$$M = C - Z \quad . \tag{2.4}$$

5. The gains from a small change, dt, in the tariff vector are measured by the amount, dG, by which the community could be "taxed" by an external authority whilst being left at the initial level of welfare. Hence

1. We will imagine that there are no intermediate inputs. Intermediate inputs introduce no important difference to the discussion in this paper.

The two main implications of table 2 for empirical studies of the costs of protection are as follows. First, scale economies may be of vital importance, and should not be ruled out by prior restrictions. In the experiments, we adopted what we guess to be quite conservative scale parameters for much of Australian manufacturing. They implied that average costs were 1.25 or 1.5 times marginal costs in processes within the protected industry. However, only detailed research could confirm or reject this speculation. Second, the table shows that even if economies of scale are recognized, a model may not be very informative if it fails to adequately identify the possibilities for resource shifts between processes. The (b)-row results reflect the gains from shifting resources between "wheat" and "cars." These gains are minor because different resource mixes are used in the two broadly defined industries, and the possibilities for resource transfers are limited. The major gains are from the complete resource transfer between processes within the "motor industry."

gain from removing the 33% tariff on "cars" is between 2.3 and 2.6% of national income. This is consistent with the results which usually emerge for the conventional elasticities model presented in subsection 6.1. It would appear that the recognition of economies of scale does not by itself have important implications for the measurement of the production gain. Similarily, if we allow for intra-industry specialization in the absence of scale economies, we may not generate any marked deviation from conventional results. In experiment 1, where there are no scale economies ($\gamma_2 = \gamma_3 = 1$), the production gain is 2.3%, both when the intra-industry specialization option is available (row (c)) and when it is not available (row (b)).[1] The dramatic results come when we introduce economies of scale and intra-industry specialization simultaneously. For example, in experiment 5, the 33% tariff on "cars" generates a welfare cost of 24.5% of the national income.

The results in the right half of table 2 are similar to those on the left, but the percentage gains from moving to free trade are smaller because of a negative efficiency effect. The profit maximizing monopolist restricts his output below the GNP maximizing level, and the elimination of protection induces him to reduce it still further. However, the production gains arising from the switch from activity 2 to activity 3 tend to swamp the negative efficiency effect.

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1 With $\gamma_2 = \gamma_3 = 1$, (7.3) and (7.9) imply that the rate of transformation between Z_2 and Z_3 is the same in domestic production and in international exchange. Hence there are no gains from reallocating resources between Z_2 and Z_3.

(2.5) $$dY^* = d(P'Z + t'M) - dG \quad ,$$

where dY^* is the change in community spending arising from the combined effects of the change, dt, in the tariff vector, and the welfare-compensating "tax," dG. Also,

(2.6) $$dY^* = P'dC + (dP)'C \quad ,$$

where dC and $(dP)'$ are the vectors of changes in C and P associated with the compensated tariff reform. Finally, since community utility is unchanged, we can write

$$dU = (\nabla U)'dC = 0 \quad .$$

Hence, via (2.1), we have

(2.7) $$P'dC = 0 \; .$$

On combining (2.5) - (2.7) we obtain an expression for the welfare gain from the tariff reform,

(2.8) $$dG = d(P'Z + t'M) - (dP)'C \; .$$

By using (2.3) and (2.4), we see that (2.8) implies

$$dG = -[(dP)' - (dt)']M + P'dZ + t'dM \quad ,$$

which may be rewritten as :

(2.9)
$$\begin{aligned} dG = &- (d\bar{P})'M && \text{(terms of trade effect)} \\ &+ P'dZ && \text{(efficiency effect)} \\ &+ t'dC && \text{(consumption gain)} \\ &- t'dZ && \text{(production gain)} \quad . \end{aligned}$$

3. THE TERMS OF TRADE EFFECT

The first term on the right side of (2.9) is often assumed to be zero. It is argued that a tariff reform by a single country will not significantly affect world prices, and hence $(d\bar{P})'M = 0$. However, in one study, the terms of trade effect for the U.S. was estimated to be negative although rather small.[1] The expansion of U.S. imports, associated with a reduction in tariffs, was expected to raise their c.i.f. prices while an increase in exports could only be achieved by lowering U.S. f.o.b. export prices.

Of perhaps more relevance to small developed economies, is a Canadian argument.[2] According to this argument there can be an important terms of trade gain rather than loss for small countries if, concurrently with their own tariff reform, they can persuade their large trading partners to lower tariffs. The assumption is that trade with the small country does not influence prices in the large country. For example, assume that Canada supplies a small share of the U.S. market for nails, the major share of the market being domestically supplied. Assume that Canadian exports are subject to a 10% U.S. tariff. Then if nails sell for $1 per kilogram in the U.S., the Canadian exporter will receive only $ .90. But if as a result of negotiated mutual tariff cuts, the U.S. removes the tariff on Canadian nails, the Canadian exporter will receive $1 per kilogram. (In terms of our notation, $\bar{P}_i$ rises from 0.9 to 1.0, and $M_i < 0$.) On the other hand, the

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1. Basevi [1968] .

2. See Wonnacott [1975] .

and thus the changes in GNP_w indicated in the left half of table 1 are purely production gains. On the other hand, monopoly control of "cars and parts" introduces a distortion additional to the tariff. The tariff removal has an efficiency effect because it induces the economy to move closer (or further) from behaving as if it maximizes $\dot{GNP}_d$. Columns (6) and (8) show the percentage increases in GNP_w in rows (b) and (c) compared with row (a). For example, in experiment 2, the removal of the tariff in the GNP maximizing model generates a 7.0% production gain. However, if the possibility of specializing in "parts" were excluded, the computed production gain would be 2.5%. In experiment 6, both the tariff and the free trade solutions are in the (c)-row, and there are no gains. Hence the N.A.s.

The only columns remaining to be described are (3) and (7). These show the share of GNP_w earned in the "cars and parts industry"; i.e.,

$$(\bar{P}_2 Z_2 + \bar{P}_3 Z_3) \;/\; GNP_w \quad .$$

The values for $\bar{P}_2$ were chosen so that in the GNP maximizing model, the initial (i.e. row(a)) share of Z_2 in GNP_w was approximately the same in all experiments. This facilitates comparisons across experiments.

7.3 The Results

The most interesting feature of table 2 is the comparison between the welfare gains shown in the (b) and (c) rows. Concentrating on the left half of the table we see that for a two commodity model, "wheat" and "cars," the measured production experiments, the tariff induces the monopolist to operate activity 2. In experiment 6 he chooses activity 3.

The (b)-rows in the GNP and profit maximizing parts of the table are solutions when

$$\bar{P}_1 Z_1 + \bar{P}_2 Z_2$$

and $$\bar{P}_2 Z_2 - W(1 - L_1)$$

are maximized. Hence, they are the free trade solutions for a model which excluded activity 3. The (c)-row will always be the free trade solution when activity 3 is included - under (7.3) - (7.6), (7.9) and free trade, activity 2 will never be preferred to activity 3 with either set of behavioral assumptions when $\gamma_2 = \gamma_3$.

The welfare effects of removing the tariff on activity 2 are indicated in columns (5) - (6) and (9) - (10). Columns (5) and (9) give the values of GNP in world prices

i.e. $$GNP_w \equiv \sum_i \bar{P}_i Z_i$$

We note that [1]

$$dGNP_w = \sum_i \bar{P}_i \, d Z_i$$

$$= \sum_i p_i \, d Z_i - \sum_i t_i \, d Z_i \,.$$

Hence the change in GNP_w induced by the removal of the tariff is the sum of the efficiency effect and the production gain, (see (2.9)). In the GNP maximizing model, the efficiency effect is zero

[1] We are assuming that international prices are given; i.e.,there is no terms of trade effect, see section 3.

c.i.f. price of Canadian imports of bolts, say, from the U.S. is unaffected by the Canadian tariff concessions. (In terms of our notation, $d\bar{P}_i = \bar{0}$, where $M_i > 0$.)

The Canadian argument emphasizes the advantages of free trade areas, customs unions and tariff bargaining to small countries. For Australia, it might be particularly beneficial to be involved in a tariff round on manufactured products with the large industrial blocks, U.S., Japan and the E.E.C..

4. THE EFFICIENCY EFFECT

The second term, the efficiency effect, is also often deleted. Producers are assumed to choose Z so as to maximize

(4.1) $$P'Z$$

subject to the scalar constraint

(4.2) $$f(Z) = 0 ,$$

where (4.2) describes the country's production possibilities. From (4.1) and (4.2) we know that there exists ρ such that[1]

$$P = \rho \nabla f .$$

Next, we note that (4.2) implies

$$(\nabla f)' dZ = 0 , \text{ and thus}$$

(4.3) $$P' dZ = 0 .$$

It is important to recognize the assumptions on which (4.3) is based. Producers will maximize the value of national output if they are profit maximizers and price-takers, and are in an environment of pefect factor markets, complete information and no externalities. Clearly these assumptions are not realistic. This would not matter in the measurement of the cost protection if we could be confident that market failures were

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1. We will ignore the possibility of corner solutions.

Similarly, the profit maximizing solution occurs at the value for L_1 which maximizes

$$J_2(L_1) \equiv \max (P_2 Z_2 - W(1 - L_1), P_3 Z_3 - W(1 - L_1)).$$

In the left part of the table each of the (a) - rows shows various characteristics of the economy for the value of L_1 which maximizes

$$\bar{P}_1 Z_1 + (\bar{P}_2 + t_2) Z_2 ,$$

(i.e. GNP_d when activity 2 is used). The (c) - rows refer to the situation where L_1 maximizes

$$\bar{P}_1 Z_1 + \bar{P}_3 Z_3 ,$$

(i.e. GNP_d when activity 3 is used).

Hence the tariff solution occurs in either rows (a) or (c), depending on which has the larger value for GNP_d, column (4). In each of the first five experiments, the (a)-entry is larger implying that the tariff is sufficiently high for activity 2 to be chosen rather than 3. The sixth experiment is included as an example where, despite the tariff, activity 3 is chosen.

In the right part of the table, the (a)-rows exhibit the solution when

$$(\bar{P}_2 + t_2) Z_2 - W(1 - L_1)$$

is maximized, while in the (c)-rows

$$\bar{P}_3 Z_3 - W (1 - L_1)$$

is maximized. The profit maximizing version of the tariff solution occurs in row (a) is its entry in column (8), "profits", exceeds the corresponding entry in row (c). In each of the first five maximize the domestic prices value of GNP, i.e.; they choose Z_1, Z_2 and Z_3 to mazimize $GNP_d \equiv \sum_i P_i Z_i$ subject to (7.2), (7.3) and (7.7). However, in the presence of scale economies, it is not clear what micro behavioral assumptions are necessary to support the adoption of GNP maximization. In the right half of the table, we have assumed that the "motor vehicles and parts industry" is run by a monopolist and that the "wheat industry" is competitive. Wages equal the value of labour's marginal product in "wheat," i.e.,

$$(7.11) \qquad W = \gamma_1 P_1 L_1^{\gamma_1 - 1},$$

and the monopolist chooses Z_2 and Z_3 to maximize

$$\Pi = P_2Z_2 + P_3Z_3 - W(L_2 + L_3)$$

subject to (7.3), (7.7) and (7.11). Hence the "motor vehicles and parts" producer exercises his monopoly power in a slightly unusual way. He is a price taker in his product market, but he recognizes that output expansions force factor prices against him. Therefore, despite increasing returns to scale, his marginal cost curve eventually has a positive slope, and his profit maximizing problem has a finite solution.

The computations were performed by varying L_1 in increments of .001 from 0 to 1. For each value of L_1, we computed the wage rate (according to (7.11)) and the output of "wheat" (according to (7.2)). Next, we used (7.3) to compute values for Z_2 and Z_3 under the assumptions that L_2 and L_3 were $(1 - L_1)$. It is obvious that activities 2 and 3 will never need to be operated simultaneously under either GNP or profit maximizing. Hence, the GNP maximizing solution occurs at the value for L_1 which maximizes $J_1(L_1)$ where J_1 is defined by

$$J_1(L_1) \equiv \max \; (P_1Z_1 + P_2Z_2, P_1Z_1 + P_3Z_3)$$

neutral with respect to tariff reforms. However, recent contributions to the literature on international trade suggest that one of the main benefits of freer trade comes via improvements in the efficiency of markets.[1] There are three main arguments and they can be classified under the headings market structure effects, rent seeking and X-inefficiencies.

4.1 Market Structure Effects

There is little doubt that highly protected Australian firms have output levels well below minimum efficient scale. This might not be surprising in view of the limited size of the Australian market. However, a phenomenon that does require explanation is the coexistence of several firms of less than optimal size in one industry. This is inconsistent with the assumption that producers use the economy's resources to maximize the value of output, and it makes us wonder why price competition hasn't eliminated some firms, leaving the remaining firm(s) with sufficiently large sales volumes to allow more complete exploitation of economies of scale.

Answers are offered by various theories of oligopolistic behaviour. For example, import price plus tariff $(\bar{P}_i + t_i)$ may provide a convenient industry pricing signal. Each firm recognizes that attempts to increase market share by price cutting could trigger a price war, with uncertain and possibly disastrous results. Aversion to price competition will be strengthened if all the local companies are subsidiaries of large foreign corporations. In this case, each firm will be able to draw on the resources of the parent company, so that a price war could be a very long and expensive operation, even for the eventual winner(s). Foreign ownership may also inhibit efficiency-promoting mergers, while fear of government anti-monopoly policy may lead all firms to feel that it is in their best interests to tolerate some competition.

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1. A particularly helpful reference is Corden [1975, Ch. 8], and this section relies heavily on it.

Reduction of tariffs would confront local producers with competition from large scale foreign producers. Some inefficiently small local producers will be forced out of business, while remaining firms must achieve scale economies, perhaps by reducing product variety and lengthening production runs.

Without empirical research we cannot know how important tariffs are in perpetuating market structure inefficiencies or what the welfare costs might be. However, it would not be surprising to find that they were large in comparison to the traditionally measured costs of protection. The efficiency gains described in this sub-section refer to improvements in the use of all the resources in an industry, not just the resources which are driven into alternative uses according to international comparative advantage.

4.2 Rent Seeking

There will always be some groups in the community who will perceive benefits for themselves arising from the existence of barriers to trade. In Australia, manufacturers and trade unionists are the obvious examples. (This is not to agree that protection is in fact serving their best interests. All that is important for the following argument is the existence of some well organized groups which think that they gain from protection.) On the other side, there will be groups who perceive benefits from the elimination of tariffs, consumer organizations, exporters and neoclassical economists being three examples.

Each side may be prepared to use resources to influence government policy. There is an incentive to seek or maintain the perceived rents (rewards above opportunity costs) associated with protection. For

TABLE 2 : MODEL SOLUTIONS

(1) Parameter Values $\tau_2 = .33, \gamma_1 = .5$	(2) No.	GNP Maximization (3) Z_2, Z_3 share in GNP_w	(4) GNP_d	(5) GNP_w	(6) Percentage Gain	Profit Maximization (7) Z_2, Z_3 share in GNP_w	(8) Profits in Z_2, Z_3	(9) GNP_w	(10) Percentage Gain
$\gamma_2 = \gamma_3 = 1.0$	1(a)*	.727	1.667	1.222		.506	.427	1.238	
$\theta_2 = 1.0, \theta_3 = .5$	1(b)*	.600	1.250	1.250	2.3	.395	.147	1.199	-3.1
$\bar{P}_2 = 1.0$	1(c)*	.600	1.250	1.250	2.3	.395	.147	1.199	-3.1
$\gamma_2 = \gamma_3 = 1.25$	2(a)	.725	1.500	1.101		.450	.240	1.113	
$\theta_2 = 1.0, \theta_3 = .5$	2(b)	.581	1.129	1.129	2.5	.293	.029	1.068	-4.0
$\bar{P}_2 = .9$	2(c)	.528	1.178	1.178	7.0	.389	.096	1.157	4.0
$\gamma_2 = \gamma_3 = 1.25$	3(a)	.725	1.500	1.101		.450	.240	1.113	
$\theta_2 = 2.5, \theta_3 = .5$	3(b)	.581	1.129	1.129	2.5	.293	.029	1.068	-4.0
$\bar{P}_2 = .9$	3(c)	.674	1.353	1.353	22.8	.464	.213	1.284	15.4
$\gamma_2 = \gamma_3 = 1.5$	4(a)	.730	1.395	1.022		.403	.112	1.027	
$\theta_2 = 1.0, \theta_3 = .5$	4(b)	.578	1.048	1.048	2.6	.000	.000	1.000	-2.7
$\bar{P}_2 = .84$	4(c)	.477	1.138	1.138	11.3	.373	.066	1.127	9.7
$\gamma_2 = \gamma_3 = 1.5$	5(a)	.730	1.395	1.022		.403	.112	1.027	
$\theta_2 = 1.5, \theta_3 = .75$	5(b)	.578	1.048	1.048	2.6	.000	.000	1.000	-2.7
$\bar{P}_2 = .84$	5(c)	.618	1.272	1.272	24.5	.465	.078	1.184	15.3
$\gamma_2 = \gamma_3 = 1.5$	6(a)	.736	1.408	1.029		.410	.120	1.033	
$\theta_2 = 2.0, \theta_3 = .75$	6(b)	.587	1.056	1.056	N.A.†	.000	.000	1.000	N.A.†
$\bar{P}_2 = .85$	6(c)	.705	1.410	1.410	N.A.†	.561	.178	1.327	N.A.†

† Not applicable.

* (a) Activities 1 and 2 are used. 2 is protected. Tariff solution for experiments 1 - 5.
(b) Activities 1 and 2 are used. No tariff.
(c) Activities 1 and 3 are used. No tariff. Freetrade solution for all experiments.

once we consider a model in which major intra-industry resource allocation distortions are not ruled out?

7.2 The Computations

Table 2 presents model solutions for 6 sets of parameter values. Hopefully these illustrate the model's more important properties, although it must be recognized that an infinite variety of other experiments are possible.

In all experiments reported in Table 2,

$$(7.10) \qquad \bar{P}_1 = 1.0.$$

This merely provides a normalization for the monetary unit. It also makes $\bar{P}_2$ a convenient parameter for fixing the international rate of exchange between "wheat" and "cars" and "wheat" and "parts." (The rate of exchange between cars and parts is fixed by (7.9).) The second common feature of the experiments is that $\gamma_1 = .5$. If labour earns its marginal product, then our assumption implies that labour inputs represent half the costs in the "wheat industry." A third feature is that in all experiments, the "initial" situation is one in which activity 2 is protected by a 33% ad valorem tariff, i.e. t_2 is set so that

$$\tau_2 = t_2/P_2 = t_2/(\bar{P}_2 + t_2) = .33 .$$

There are no other tariffs, and in the "final" situation the tariff on activity 2 is removed.

Solutions were computed under two different behavioral assumptions. In the left half of the table we have ruled out efficiency effects (see section 4) by assuming that producers

example, IAC tariff inquiries absorb the time of highly paid labour from the participating firms. This fact was recognized by the Jackson Committee when they recommended a reduction in the duration of IAC inquiries to (among other reasons) "reduce the costs to all parties."[1]

While the costs of tariff administration and tariff lobbying must be counted as costs of protection, it is reasonable to suppose that in Australia they are rather minor. The I.A.C. budget for 1974-75 represented about 1/100 of one per cent of GNP. The costs to firms of preparing submissions to I.A.C. inquiries is unknown. However, these costs must certainly be rather small in comparison to the rent seeking costs identified in some other countries. The very open, public nature of tariff making in Australia precludes the necessity for entrepreneurs to place relatives in the public service or to maintain offices in the capital city so as to be constantly in touch with key public officials.[2]

4.3 X-efficiency

It is normally assumed that firms will choose their inputs to minimize the cost of their outputs. However, it has been suggested that protection might encourage resource wastage within firms, i.e., X-inefficiencies. The argument is far from straight-forward, and at this stage it is not well developed even in the theoretical literature. Perhaps the most relevant possibility for Australia is the idea that "made-to-measure" tariffs protect "lazy" management. Lack of local effort becomes a reason for tariff increases. However, the empirical importance of this phenomenon is not known, and the

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1. Jackson Report, p. 172.
2. See Krueger [1974] .

theoretical implications are cloudy. For example, if tariffs cause slackness amongst the management of import-competing firms, then perhaps free trade, which would make life easier for exporters, would cause slackness in export industries. Also, it is not obvious that "slackness" is a resource wastage. Perhaps it should be considered a form of management leisure.

i.e. world prices for "cars" and "parts" are proportional to the labour requirements per unit of output when output levels have reached minimum efficient scale. We assume that in the major exporting countries, scale economies in the manufacture of "cars" and "parts" are fully used.

To summarize, we have an economy in which there are three activities. Two of them are closely related in the sense that they use exactly the same resource mix, namely labour alone. Under usual industry definitions, these two activities would probably be aggregated in an industry called, for example, "motor vehicles and parts". The remaining activity, "wheat," uses labour, but labour must be combined with a wheat-specific factor, land. Within the "motor vehicles and parts" industry, there are increasing returns to scale in each activity. Hence for a given resource commitment, the transformation frontier between Z_2 and Z_3 is convex from below. On the other hand, transformation frontiers between Z_1 and Z_2 or Z_1 and Z_3 may have the conventional shape over much of their domain. This reflects differences in resource requirements between "wheat" and "motor vehicles and parts." The final noteworthy feature of the model is the assumption concerning the θ_i s. Activity 2 might be thought of as the operation of a complete motor industry, with a unit of output consisting of a "typical" basket of models. Activity 3 could then be thought of as the production of a single model. By using appropriate values for the θ_i s we can introduce the idea that a small economy might have sufficient resources for the efficient operation of activity 3, but not activity 2. Then, from the point of view of the costs of protection, our interest will be in the possibility of the tariff structure inducing the economy to operate activity 2 rather than 3. Do the costs of protection look more significant

(7.4) $\gamma_i > 1, \quad i = 2, 3$

(7.5) $a_i = \theta_i^{\gamma_i - 1}, \quad i = 2, 3$

and (7.6) $\theta_2 > \theta_3$

(7.3) and (7.4) imply increasing returns to scale in activities 2 and 3 until labour inputs reach critical levels θ_2 and θ_3. Thereafter there are constant returns to scale. θ_2 is greater than θ_3, see (7.6), imposing the idea that a fully efficient scale of production is reached at a smaller commitment of resources in the production of "parts" than in "cars." (7.5) sets the a_i so that the production functions are continuous (although not differentiable) at the labour input which exhausts the scale economies.

Labour units are chosen so that the economy resource constraint can be written as

(7.7) $\sum_{i=1}^{3} L_i = 1$

Domestic prices are determined by

(7.8) $P_i = \bar{P}_i + t_i$

where P_i is the domestic price of commodity i, $\bar{P}_i$ is the world price and t_i is the tariff.[1] Finally world prices for "cars" and "parts" satisfy

(7.9) $\bar{P}_2 / \bar{P}_3 = a_3 / a_2$,

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[1] If good i is exported, t_i should be thought of as an export subsidy, possibly at the rate zero.

5. THE CONSUMPTION GAIN

The third term, the consumption gain, has been analysed theoretically and measured empirically by numerous authors.[1] There appears to be unanimous agreement that for most countries it represents less than 1 or 2 per cent of GNP, even for a major tariff reform. In this section we will attempt to explain this finding and suggest how a more comprehensive analysis may well reverse it.

5.1 An Elasticities formula for the Consumption Gain

The first step in determining the likely size of the consumption gain is to relate it to familiar economic parameters, in this case, consumer demand elasticities. We start by writing

(5.1) $dC = \hat{C}c$ and

(5.2) $c = \eta p + Ey$,

where C is the consumption vector and the superscript ^ denotes diagonal matrix. c is the vector of proportionate changes in consumption. The typical element of c is dC_i/C_i . η is the matrix of own and cross elasticities of demand: η_{ij} is the cross elasticity of demand for good i with respect to changes in the price of good j . E is the vector of expenditure elasticities and p and y are respectively the vector of proportionate changes in prices and the proportionate change in expenditure level.

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1. See in particular Johnson [1960, 1965].

For a "compensated" tariff reform,

$$y = (dP)' C/Y \qquad \text{(see (2.6) and (2.7))},$$

$$\text{i.e. } y = \alpha' p ,$$

where α is the vector of budget shares, i.e. $\alpha_i = P_i C_i / Y$ for all i. Hence, the consumption gain is

(5.3) $$t' dC = t' \hat{C} \bar{\eta} p ,$$

where $\bar{\eta} = [\eta + \hat{E} \tilde{\alpha}']$ and $\tilde{\alpha}'$ is the square matrix having every row equal to α'. $\bar{\eta}$ is the matrix of compensated own and cross elasticities of demand.

Next we express the consumption gain as a fraction of GNP, obtaining

(5.4) $$\frac{t' dC}{Y} = (t' \hat{P}^{-1}) \hat{\alpha} \bar{\eta} p .$$

(5.4) could be used to indicate the size of the consumption gain for any small tariff change. For a small uniform reduction in all ad valorem rates, we will assume that

(5.5) $$p = - \phi \tau ,$$

where τ is the vector with typical element t_i / P_i and ϕ is the proportion by which tariffs are reduced. (5.5) rules out the possibility of changes in the prices of non-traded goods. (Alternatively, the reader may prefer to think in terms of a model in which all goods are traded). However, from (2.9), it is clear that changes in the prices of non-traded goods are only relevant in the measurement of the

7. THE GAINS FROM FREE TRADE WITH INTRA-INDUSTRY SPECIALIZATION AND SCALE ECONOMIES: AN ILLUSTRATION

7.1 The Model

The implications of intra-industry resource re-allocation and scale economies for the calculation of the costs of protection in a small economy can be illustrated by a simple model. Imagine an economy in which there are three production activities. The first production activity, which we will call "wheat" production, uses its own specialized factor (say land) and a general factor, say labour. The production function for "wheat" is

(7.1) $$Z_1 = A N^{\gamma} L_1^{\gamma_1}$$

where Z_1 is the output of wheat, L_1 is the input of labour, N is the input of land and A, γ and γ_1 are positive parameters, with $\gamma_1 < 1$. We assume that land is in fixed supply and that units are chosen so that (7.1) may be written simply as

(7.2) $$Z_1 = L_1^{\gamma_1} .$$

The second activity is production of "cars" and the third activity is the production of "parts".[1] The production functions for these two activities are

(7.3) (a) $$Z_i = L_i^{\gamma_1} \quad \text{for } L_i \leq \theta_i, \quad i = 2, 3,$$

(b) $$Z_i = a_i L_i \quad \text{for } L_i > \theta_i, \quad i = 2, 3,$$

where Z_2 is the output of "cars," Z_3 is the output of "parts," the L_i are labour inputs, and the γ_i, a_i and θ_i are positive parameters with

1. For "cars" the reader might think in terms of a complete automobile industry producing and assembling a full range of 4-, 6- and 8-cylinder cars; the "parts" industry could be thought of as some small subset of production activities within the "cars" industry.

specialization. Producers must reduce product variety to exploit the economies associated with longer production runs. Domestic demand for variety is then satisfied by imports, while domestic producers maintain low costs by expanding into export markets.

In the next section, we argue that intra-industry resource re-allocation, based on exploitation of scale economies, could have major implications for the measurement of the production gain. In fact, it seems most unlikely that the production gain can be even approximated in a model which excludes these phenomena.

consumption gain to the extent that they induce changes in the consumption of tariff bearing tradeables. No serious error is likely if we simply ignore the changes in the prices of non-traded goods.[1] Under (5.5), (5.4) becomes

$$\frac{t'dC}{Y} = -\phi\,(\tau'\,\hat{\alpha})\,\bar{\eta}\,\tau \,, \qquad (5.6)$$

and at this stage, we can introduce various typical assumptions about demand systems.

5.2 Johnson's Assessment of the Consumption Gain

The first attempt at analysing a formula similar to (5.6) was by Johnson [1960]. He looked at two alternative simplifications. In the first, he in effect assumed that $\bar{\eta}$ is a diagonal matrix.[2] Then (5.6) implies that

$$\frac{t'dC}{Y} = -\phi \sum_i \tau_i^2\,\alpha_i\,\bar{\eta}_{ii} \;. \qquad (5.7)$$

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1. Our implied assumption is that there is no substitution in consumption between tradeables and non-tradeables; i.e., the utility function is of the form

$$U(C) = \min \left\{U^T(C^T)\,,\; U^N(C^N)\right\} \quad \text{where } C^T \text{ and } C^N \text{ are}$$

subvectors of C referring to the consumption of tradables and non-tradables.

2. This assumption violates the homogeneity condition. We would expect $\sum_j \bar{\eta}_{ij} = 0$. Johnson argued that the inclusion of the off diagonal terms, which would be mainly positive, would further reduce his estimates of the consumption gain.

If the average values for the τ_i and $\bar{\eta}_{ii}$ are .25 and -1.5 respectively, and about 1/3 of the consumer budget consists of protected commodities, then (5.7) implies that a 1% reduction in the ad valorem tariffs (ϕ=.01) would generate a percentage consumption gain of about .03, $\{=(.25)^2(1.5)(.33)\}$.[1] A 100% reduction in tariffs, i.e. free trade, would generate a consumption gain of about 1.5%. (Notice that the first percent reduction in the tariff carries a gain of .03% while the last carries a gain of almost zero.) Johnson considered 1.5, .25 and .33 to be realistic upper bounds for average values of $|\bar{\eta}_{ii}|$ and τ_i , and the protected share, and hence he concluded that the consumption gain is almost certainly small.

Johnson's second simplification of (5.6) was made by assuming that the utility function is Cobb-Douglas. This is a special case of the additivity assumption and will be covered in the next subsection.

5.3 The Consumption Gain under Additivity : A Blind Alley to be Avoided

Since Johnson's article, there has been a revolution in empirical work on demand systems.[2] Much of this work has been based on the assumption of an additive utility function.[3] The question arises,

1. Johnson took into account the variance of the τ_i across all i . However, this complication did not affect his conclusions and will be omitted here.
2. See A.A. Powell [1974] for a survey.
3. The theoretical foundations were laid by Frisch [1959] and Houthakker [1960].

"The evidence is that most of the specialization resulting from free trade between developed countries tends to occur within manufacturing industries rather than between them."[1]

The writers who have studied intra-industry trade have also emphasized the importance of scale economies. This raises a second doubt about the analysis of sub-section 6.1.

6.3 Intra-Industry Specialization and Scale Economies : A Violation of the Convexity Assumption

The second key assumption in sub-section 6.1 was that the production possibilities form a convex set. Again, this assumption reflects a very aggregative view of the economy. If we consider "manufacturing" and "primary," then we can rationalize a conventional shaped transformation frontier. As more primary products are produced, increasing amounts of labour and capital must be applied to various fixed factors (mines and land) to generate further primary production. Hence, increasing amounts of manufactured output must be sacrificed. The argument can be maintained at a slightly less aggregative level by referring to fixed availabilities of different types of labour skills or capital, but by the time we reach four and six-cylinder cars, it is clear that scale economies are likely to be dominant. For a given resource commitment to auto manufacturing, the transformation frontier between 4 and 6-cylinder cars will be convex from below, rather than concave.

It is scale economies which provide the most plausible explanation for the dominance of intra-industry flows under free trade. Each trading country "knows" the best technology and has the appropriate resources for producing either 4 or 6-cylinder cars. However, trade liberalization forces

1. Other major references on intra-industry trade include Grubel [1967], Wonnacott and Wonnacott [1967] , Lermer [1973] and Grubel and Lloyd [1975].

that production gains arise principally from resource shifts between say "manufacturing" and "primary industry." No significance is attached to shifts between, for example, producing four and six-cylinder cars. Some justification might be made for excluding intra-industry resource reallocation from the calculation of the production gain if commodities within the same broadly defined industry are protected at a uniform ad valorem rate. In this case, it might be argued that tariffs do not distort resource allocation within industries.[1] However, in Australia the assumption of uniform intra-industry tariffs is clearly counter-factual when applied to industries such as "manufacturing," or even to input-output classifications such as "motor-vehicles and parts."

A second possible reason for excluding intra-industry resource reallocations would be that they are empirically unimportant. But just the opposite appears to be true, even when quite disaggregated industry definitions apply. For example, after analysing evidence for the EEC from 91 industries, Balassa [1966, p. 471] concluded

> "The results point to the importance of intra-industry specialization in trade among industrial countries and provide support to the hypothesis that trade liberalization would result in intra-industry rather than inter-industry specialization."

Similar conclusions have been reached by the Canadian writers. Wonnacott [1975, p. 23] notes that

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1. The argument would have to exclude the phenomena discussed in sub-section 4.1.

is there any chance that econometric estimates of $\bar{\eta}$, based on the additivity assumption, could weaken Johnson's claim that the consumption gain is small? If the answer is no, which appears to be the case, we will have a useful conclusion - there would be no point in a detailed econometric study of the consumption gain in which demand system was specified via an additive utility function. It may be true that the consumption gain is very small, but such a study could reveal nothing else, and if the consumption gain is very small, it is not important to know exactly how small.

Additivity implies that

$$(5.8)^{1} \qquad \bar{\eta}_{ij} = -\frac{E_i E_j \alpha_j}{w} + \delta_{ij}\frac{E_i}{w}$$

where $\delta_{ij} = 1$ for $i = j$ and zero otherwise, and w is a parameter, often called the Frisch parameter.

On substituting (5.8) into (5.6) we obtain

$$\frac{t'dC}{Y} = \phi\left(\frac{1}{-w}\right)(\tau\ \hat{\alpha})\left[\hat{E}(I - \tilde{\beta}')\right]\ \tau\ ,$$

i.e.

$$(5.9) \qquad \frac{t'dC}{Y} = \phi\left(\frac{1}{-w}\right)\tau'\ \hat{\beta}\ (I - \tilde{\beta}')\ \tau\ ,$$

where β' is the row vector whose typical element, β_i, is the marginal propensity to consume good i, i.e., $\beta_i = \alpha_i E_i$ and $\tilde{\beta}'$ is the square matrix, every row of which is the vector β'.

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1. Derivations are in Frisch [1959], Houthakker [1960], Powell [1974] and numerous other places.

(5.9) can be rewritten as

$$(5.10) \qquad \frac{t'dC}{Y} = \phi\left(-\frac{1}{w}\right)\left\{\sum_i \tau_i^2 \beta_i - \left(\sum_i \tau_i \beta_i\right)^2\right\}$$

(5.10) expresses the consumption gain in an easy form for assessing its likely order of magnitude. For example, assume that commodities making up half the marginal dollar of expenditure are protected by a 50% ad valorem tariff. Then

$$\left(\sum_i \tau_i \beta_i\right)^2 = (.25)^2 = .0625$$

and

$$\sum_i \tau_i^2 \beta_i = (.5)^2\ .5 = .1250 \ .$$

Assume that w has a typical value, say $w=-2$.[1] Then the consumption gain from a 1% reduction in the tariff rates (i.e. $\phi=.01$) is equivalent to a .03125 per cent increase consumption expenditure. The consumption gain from a 100% reduction in the tariff is given by

$$\text{Cons. G} = \int_0^1 -\frac{1}{w}\left\{\sum_i(\tau_i(1-H))^2\beta_i - \left(\sum_i \tau_i(1-H)\beta_i\right)^2\right\} dH \ ,$$

1. Powell [1966, p. 274] estimated w for Australia as -2.35. He commented "I have experimented with U.S., Canadian, Chilean consumption data, obtaining estimates of w consistently in the interval -1.5 to -2.5". Frisch [1964, p. 422] mentions studies for Great Britain, Norway and the Netherlands in which values close to -2 were obtained for w. Barten [1964] also obtained an estimate of close to -2 in his study of the Netherlands. This is especially interesting because he was using a different theoretical approach from Frisch and Powell.

Then if we treat ψ and the V_j as constants, we can integrate (6.4), and find that a 100% reduction in tariffs would generate a 2.08% (i.e., 6.25/3) production gain. However, 2% will be an overestimate. As we reduce the tariffs, the share of the protected goods in the national income and the associated V_j's will fall.

6.2 Aggregation, Intra-Industry Trade and the Computation of the Production Gain

A key assumption in the last sub-section was concerned with the coefficient ψ. In our numerical example we set ψ equal to 1. This was based on conventional ideas concerning supply elasticities. However, the argument of sub-section 5.4 can be reapplied, perhaps with even greater force.

Supply elasticities depend on the degree of commodity aggregation. If we treat the economy as though it produces only one product, the supply elasticity will be zero and there will be no production gain. If we consider a two good model, say "manufactures" and "primary industry," then we will probably assign a low value to the elasticity of transformation between our two goods. This will be consistent with "observed" low supply elasticities for these vast aggregative groups. Again, computed production gains will be small because the computed resource shifts will be small. But if we moved to a very disaggregated model, we could recognize that resources can shift easily between certain pairs of activities, e.g., the manufacture of 4-cylinder and 6-cylinder cars. At this level of disaggregation, supply elasticities would be very large.

This raises the question of what is the appropriate level of disaggregation for studying the production gain. By using low values for supply elasticities, based on broad aggregative industry definitions, we are implying

Formula (6.3) may be compared with (5.9). It reduces to a convenient form, similar to (5.10), i.e.,

$$(6.4)\qquad \frac{-t'dZ}{Y} = \phi\,\psi \left\{ \sum_i \tau_i^2 V_i - \left(\sum_i \tau_i V_i\right)^2 \right\},$$

and just as (5.10) suggested the likely maximum size of the measured consumption gain under conventional demand elasticity assumptions, (6.4) can be used to assess the probable maximum size of the measured production gain under conventional supply elasticity assumptions. For example, if commodities accounting for approximately half the value of the national output are protected by a 50% ad valorem tariff, then

$$(6.5)\qquad \frac{-t'dZ}{Y} = \phi\,\psi \left\{ .1250 - .0625 \right\}$$
$$= \phi\,\psi\,(.0625)\;.$$

A "high" value for ψ is 1. Notice that ψ is a weighted average of the k_i and that k_i is approximately the own supply elasticity for good i. Hence ψ can be interpreted as a weighted average of own supply elasticities. Costs of protection studies have generally used low own supply elasticities. For example, Stern's [1964, p. 463] supply elasticities were in the range 0 to 0.5. For Wemelsfelder [1960, p. 99] the implied own supply elasticity for protected "industrial end-products" was approximately 1. Similarly, Lipsey [1975, p. 675], implied a typical supply elasticity of 1. If we adopt the value $\psi = 1$, then (6.5) implies that a 1% reduction in all tariffs (i.e., $\phi = .01$) would produce a production gain equivalent to a .0625% increase in GNP.

which reduces to approximately[1]

$$(5.11)\qquad \text{Cons. G} \approx \left(\frac{1}{-w}\right) \left\{ \sum_i \tau_i^2 \beta_i - \left(\sum_i \tau_i \beta_i\right)^2 \right\} \left[\frac{(1-H)^3}{-3} \right]_0^1$$
$$= (1/3)\left(\frac{1}{-w}\right) \left\{ \sum_i \tau_i \beta_i - \left(\sum_i \tau_i \beta_i\right)^2 \right\}.$$

Thus, continuing with our example, we see that the consumption gain from totally eliminating the tariffsis equivalent to a 1.042 per cent increase in consumption expenditure.

It seems safe to conclude that for most countries, the value for the consumption gain from the movement to free trade, if measured with reference to a demand system generated from an additive utility function, would represent no more than a very small percentage of the GNP. In this subsection we have analysed the consumption gain under the assumption of an additive utility function with a typical Frisch parameter. Even with very high and non-uniform tariffs (50% ad valorem on the commodities accounting for half the marginal dollar of expenditure), the consumption gain was equivalent to barely 1% of consumption expenditure.

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1. (5.11) is an approximation because the β_i and w have to be treated as constants, i.e.,we have assumed that they are insensitive with respect to compensated price chances. The popular linear expenditure system has the property of constant β_is . It also generates a constant w (constant with respect to compensated price changes) if all the expenditure elasticities are 1 .

5.4 The Consumption Gain and Commodity Aggregation

Despite the analysis of the last two sections, the consumption gain should not be declared a dead issue. All that has been demonstrated is that the consumption gain arising from the reallocation of expenditure between broadly defined commodity groups is likely to be small. Nothing has been proved about the gains from reorganization within the broadly defined groups. Both Johnson's work and the work in section 5.3 implied a high level of commodity aggregation. Johnson's figure of 1.5 for $|\bar{\eta}_{ii}|$ would almost certainly be too low if the commodity classification were very fine, distinguishing for example pure wool and synthetic sweaters as separate commodities. Similarily, the additivity assumption is applicable only with aggregative commodity groups, "clothing", "food", "durables" etc.[1]

The potential importance of disaggregation for the measurement of the consumption gain can be illustrated by an example. Imagine a two commodity model, say sweaters (good 1) and food (good 2). Assume that utility function is

(5.12)[2] $$U(C_1\ ,\ C_2) \ = \ \min(C_1\ ,\ C_2)\ .$$

(5.12) implies that sweaters and food are very poor substitutes. In fact

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1. With additivity, it is not possible to recognize that wool-sweaters and synthetic sweaters are better substitutes than wool-sweaters and cars.

2. Some inessential parameters have been omitted.

elasticities, ε, is defined by

(6.2) $$\varepsilon_{ij} \ = \ \delta_{ij}k_i - k_i\, V_j \quad ,$$

where $\delta_{ij} = 1$ for $i = j$ and 0 otherwise, k_i is the positive parameter defined by $k_i = 1/(h_i - 1)$ and V_j is a share coefficient, closely related to the share of product j in the GNP, and defined by

$$V_j \ = \ P_j\, Z_j\, k_j \Big/ \sum_i P_i\, Z_i\, k_i \quad .$$

The role of the matrix ε in the analysis of the production gain is similar to that of the matrix of compensated own and cross demand elasticities, $\bar{\eta}$, in the analysis of the consumption gain. An expression for the production gain, closely analogous to (5.3) is

$$-\, t' dZ \ = \ -\, t'\, \hat{Z}\, \varepsilon\, p \quad .$$

Then following the notation in (5.5) and adopting (6.2), we find that the production gain, expressed as a fraction of GNP, associated with a small uniform tariff reduction is

(6.3) $$\frac{-\, t' dZ}{Y} \ = \ \phi\, \psi\, \tau'\, \hat{V}\, (I - \tilde{V}')\, \tau \quad ,$$

where $\psi \ = \ (\sum_j P_j\, Z_j\, k_j) \big/ Y$, V' is the row vector whose typical element is V_j, $\tilde{V}'$ is the square matrix each row of which is V' and $\hat{V}$ is the diagonal matrix formed from V' .

6. THE PRODUCTION GAIN

The fourth term, the production gain, has been analysed in much the same way as the consumption gain. However, less is known about systems of supply elasticities than systems of demand elasticities, and consequently there has been less certainty about the size of the production gain. The usual conclusion is that the production gain is more important than the consumption gain, but still represents a very small share of the GNP.

6.1 An Elasticities Analysis of the Production Gain

Almost all assessments of the production gain have used supply elasticities. Hence they have been based on the assumption that supply functions exist and are differentiable.[1] This has been supported by the idea that the economy's product transformation frontier is differentiable and that the production possibilities form a convex set, i.e., the transformation frontier is concave from below. For example, we might assume that

$$(6.1) \qquad f(Z) = \sum_i Q_i Z_i^{h_i} - 1 = 0 \quad ,$$

where the Q_i and h_i are positive parameters, and each of the h_i is greater than 1.[2] Then provided that producers choose the Z_i to maximize $P'Z$ subject to (6.1), it can be shown that the matrix of own and cross supply

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1. Differentiability is a convenient assumption, but is not fundamental. Linear programming models, in which the supply relations are correspondences rather than functions, give similar production gain results, e.g., see Evans [1972], Dixon [1975, p. 39] .

2. (6.1) is a generalization of Powell and Gruen's constant elasticity of transformation (CET) frontier. With CET, $h_i = h$ for all i. See Powell and Gruen [1968] .

the elasticity of substitution between them is zero and $\bar{\eta}$, the matrix of compensated elasticities has only zero elements. In such a model, the measured consumption gain from a movement to free trade will be zero. Now imagine that a more detailed model is constructed. We will assume that the original model was correct in assigning a zero substitution elasticity for sweaters-food. However, in the new model sweaters are split into two groups wool-sweaters and synthetic sweaters, and the utility function becomes

$$(5.13)^{1} \quad \begin{cases} \text{(a)} \quad U(C_1 , C_2) = \min(C_1 , C_2) \\ \text{where} \\ \text{(b)} \quad C_1 = (C_{11}^{-\rho} + C_{12}^{-\rho})^{-1/\rho} \end{cases}$$

and C_{11} , C_{12} are the consumptions of woollen sweaters and synthetic sweaters respectively, and $\rho > 1$ is a parameter.

(5.13) (a) implies that utility depends on an index of the consumptions of different types of sweaters, the index being (5.13) (b). The two different types of sweaters may be very good substitutes in generating a unit of sweater consumption. The elasticity of substitution between them is

$$\Theta = 1/(1+\rho)$$

We assume that there is a tariff on the import of synthetic sweaters and that woollen sweaters and food are duty free. Then the consumption gain from removing the tariff can be found as follows.

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1. Again some inessential parameters have been omitted.

First we write

$$Y = Y_1 + Y_2 \quad ,$$

where Y is the initial (with tariff) level of consumer expenditure, Y_1 is the initial total spending on sweaters and Y_2 is the initial expenditure on food. Second, we note that a compensated tariff reform must leave C_2, and spending on food unchanged (see (5.13) (a)). Hence, the consumption gain from removing the tariff on synthetic sweaters is simply the consumption gain which would arise in a two commodity model in which the initial expenditure level is Y_1 and the utility function is (5.13) (b) with C_1 interpreted as utility. This two commodity model is precisely the one analysed by Johnson [1965]. Therefore we can use his results to obtain the consumption gain in our three commodity model.

Table 1 shows various calculations of the consumption gain, expressed as a

Table 1 : The Consumption Gain as a percentage of free trade expenditure on Sweaters

$r \backslash \sigma$	.25	.50	1.00	3.00
.20	.89	1.90	4.28	15.67
.30	1.19	2.48	5.30	15.52
.40	1.39	2.83	5.75	14.13
.50	1.48	2.94	5.72	12.16

Source: Modified from Table 1C, Johnson [1965, p. 362].

percentage of the free trade expenditure on sweaters, arising from the removal of a 50% tariff on synthetics (i.e. $\tau_{12} = .5$).[1] The parameters σ and r are respectively the substitution elasticity between synthetics and woollens and the free trade share of woollens in consumer spending on sweaters.[2]

Johnson directed attention to the small numbers on the left of the table. However, if we think in terms of a fine commodity classification, substitution elasticities of three or more may be quite appropriate. When we look at the extreme right column, we see that if the elasticity of substitution between synthetic and woollen sweaters were 3, and consumer spending under free trade were split evenly between the two broad categories sweaters and food, then the consumption gain from removing the 50% tariff on synthetic sweaters could be almost 8% of the total free trade expenditure level (i.e., half of 15.67%). We can conclude that the consumption gain could be large for a country with high tariffs which are non-uniform across groups of close substitutes. When the tariff system involves many hundreds of tariff items, with many different rates, detailed statistical analysis cannot be avoided. An aggregative approach to the measurement of the consumption gain might be quite misleading.

1. For Johnson, this is a 100% tariff since he defines the ad valorem rate as (domestic price/world price) - 1. We have been using (domestic price - world price)/domestic price.

2. r is a free parameter. Any given r could be generated under an appropriate assumption on the world terms of trade between synthetic and woollen sweaters.