This note comments on a paper by W.P. Travis that appeared in the May-June 1968 issue of the Journal of Political Economy. In the paper Travis raises objections against the effective protection concept on both theoretical and empirical grounds. In the note, the authors answer these objections and examine, among other things, the question of sectoral protection, the problems relating to substitution between value added and material inputs, the meaning of value added, and the purposes of effective rates. They also present empirical evidence on the magnitude of substitution between value added and material inputs.

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Raymond Vernon speaks of the product cycle: a new product goes through stages of experimentation until it becomes standardized and the availability of information on production methods permits the spreading of its manufacturing at home and abroad (Vernon, 1966). We observe a similar process in regard to new theories and concepts in economics, with efforts at conceptualization followed by widespread application. In the recent literature, the increasing popularity of the CES production function and the Phillips curve provide examples of this process.

The analogy can be carried further. Efforts are made to improve products and to improve economic models; moreover, superior new products and new models are introduced to replace old ones. Before they are fully accepted, however, they go through a period of criticism and appraisal. Travis' article is part of this process for the theory of effective protection although he wants to "throw out the baby with the bath water" -- the essence of his view is that the concept is a theoretically and empirically useless tool for tariff analysis and should be abandoned. We will consider his criticisms in this paper.

Product Protection vs. Sectoral Protection

Travis' objections to effective rates pertain to conceptual and measurement issues although the two are often not clearly distinguished. This is apparent from his discussion of product protection vs. sectoral protection. Travis submits that "effective rates apply to sectors, not products" and "the first problem in interpreting effective rates of protection and their averages arises precisely in choosing what to call a 'sector'" (p. 444). This problem is said not to exist in regard to nominal tariffs which apply to products rather than to sectors. But effective rates can also be calculated for individual products; at the same time, in measuring product protection -- whether
nominal or effective -- we face the problem that there is no universally applicable definition of products.

On the conceptual level, it is not clear to what detail products should be differentiated. For example, should we consider raw cotton as one product or should we distinguish between long staple and short staple raw cotton, or should we go further and speak of Acala, Mexicali, Sertao, Karnak varieties, Strict Middling, Middling, Good Middling grades and $\frac{1}{8}$ through, $\frac{1}{2}$ staple in 1/32" variations? Such problems assume especial importance in regard to differentiated products; yet, these account for the bulk of manufactures traded.

According to Travis, "the definition of the product ... can be taken from the tariff classification itself" (p.4100). However, the tariff classification and thus the definition of products varies among countries, depending on how important the "product" is for the national economy. There are also invariably many catchall categories in the tariff classification, such as "textiles n.e.s." (not elsewhere specified) which introduce further ambiguity. Finally, if a tariff combines specific and ad valorem duties, the same tariff item may imply widely diverging rates of product protection, depending on the value-to-weight ratios of the commodities the item comprises.

These definitional problems lose much of their importance when it is recognized that any classification system derives its meaning and its legitimacy not from its correspondence to some abstract ideal but rather from its contribution to a specific analytical purpose. In this perspective, dealing with the plethora of several thousands of rates in a tariff schedule, without the aid of a systematizing device is self-defeating. While the analysis of selected products and their nominal, as well as their effective, rates can on
occasion be useful, empirical investigations of protection cannot forego dealing with sectors.

Vertical Integration and Protection

Pursuing the classification issue further, Travis claims that "the concept of effective protection is superfluous even on its own grounds, for none of its assumptions rule out the legitimacy of classifying industries or sectors according to their products, as if each product, whatever 'its stage of fabrication', were produced in a single enterprise from the ground up" (pp. 459-60). He asserts that by considering all products as end-products and all production processes as vertically integrated, the price of the commodity will equal the sum of direct and indirect domestic value added, and this "leads us back to the nominal duty which clearly indicates who is being protected, though 'they' may operate in different domestic industries cooperating to produce the protected product" (p. 455).

Such an equality of nominal and effective rates, however, holds only if there are no non-competitive imports at all in the economy, a condition which is not fulfilled in the real world. If non-competitive imports exist, the total value added per unit of output in some sectors will be less than the price of the commodity in question, the difference being the value of the direct and indirect non-competitive imports. Thus, pursuing Travis' argument to its logical conclusion, the nominal tariff would appear to "protect" foreign as well as domestic producers.

Moreover, vertical integration assumes that comparative advantage refers only to the final product yet an appropriate definition should be couched in terms of processing activities; the sum of direct and indirect costs would
be an appropriate indicator only if trade in intermediate goods were excluded. Instead of considering the comparative advantage of a country in the production of clothing, for example, we have to separately indicate its advantages and disadvantages in cotton growing, spinning, weaving and clothing manufacturing. This observation is valid even if several stages of manufacturing are de facto integrated provided these stages are technologically separable since producers, and thus the national economy, retain the choice between imports and domestic production at each stage.

The introduction of tariffs will induce resource flows from activities with low or negative effective protection to those with high effective protection, and a country applying protective measures will engage in activities which are not profitable under free trade. But nominal tariffs on the final product will not indicate the direction of the resource flow, since the price-raising effects of tariffs on the product may be outweighed by the cost-raising effects of duties on inputs.

Nor will the nominal tariff on the final product indicate, as Travis alleges, "who is being protected". It merely tells us that all stages of fabrication of a product, taken collectively, receive a certain subsidy. In turn, the effective protection measure provides information on the distribution of the subsidy among the various stages of fabrication. It follows that, in the presence of trade in material inputs, we have to discard Travis' suggestion of classifying commodities as if they were produced in a single enterprise "from the ground up".

**Substitution and Protection**

According to Travis, "The second serious problem in interpreting the meaning of the effective rate of protection arises from the possibility of
substituting one input for another and, in particular, of substituting intermediate for primary inputs" (pp.44'-46). He further asserts that "the assumption of fixed intermediate input coefficients biases upward the estimate of the average effective rate of protection. This bias accounts for Balassa's (1965) and Basevi's (1966) finding that the effective rate exceeds the nominal duties" (p.446). Apart from the lack of empirical evidence offered, this statement reflects a confusion concerning the direction of the bias in the event of input substitution.

The direction of the bias due to substitution between primary factors and material inputs can be easily understood if we consider the measurement of the effective rate of protection as an index-number problem. The employment of free trade (pre-substitution) input-output coefficients entails an underestimation of the effective rate of protection since it takes no account of the gains obtainable through substitution in response to changes in relative prices of the product and its material inputs. Conversely, the use of post-protection (post-substitution) coefficients will overestimate the effective rate. Accordingly, if there is substitution, Balassa's use of free trade coefficients entails an underestimation, and Basevi's use of domestic coefficients an overestimation of the extent of protection. Similar considerations apply to substitution among material inputs while substitution among primary factors does not introduce a bias in the estimates.

Travis also asserts that if "each industry's production function is Cobb-Douglas in all its inputs, the averages of the two measures of protection cannot diverge" (p.46). But such a result is obtained only if we define effective rates as a ratio of post-protection to pre-protection money value added per unit. This definition is incorrect since, in the presence
of substitution, the change from pre-protection to post-protection value added results from two elements: (a) a change in the quantity of primary factors per unit of output, and (b) a change in the price of the bundle of primary factors. An appropriate concept of the effective tariff should take into account only the second of these elements while excluding the first. Only thus will it be comparable to the nominal tariff which represents a price change and not a quantity change. Now, it is easy to see that the equality of nominal and effective rates Travis claims for the Cobb-Douglas case ceases to hold if the change in the quantity of primary factors is appropriately excluded from the measurement.

It also follows that, in the event a Cobb-Douglas function is applied, Travis is wrong in arguing that Balassa's use of free trade coefficients derived chiefly from data of Belgium and the Netherlands for other countries is "formally equivalent to Basevi's, although Basevi deflated his coefficients by the tariff in order to state them at 'free trade' prices" (pp.447-448). This allegation is incorrect whatever the form of the production function as long as there is substitution between inputs. The two procedures will give identical results only in the absence of substitution but then no change in the quantity of primary factors per unit of output will take place and hence the aforementioned two definitions of effective protection will also be equivalent.

Travis further objects to Balassa's procedure on the grounds that "relative prices in a country with low or zero duties are affected by the protection applied by its partners, and relative prices are equally distorted regardless of who imposes the restrictions" (p.448). While this objection would apply to the conventional two-country model where neither country is a price taker, it is invalid in the multi-country case considered by Balassa. The
input-output coefficients observed in a low-tariff country, such as Belgium or the Netherlands, may be assumed to represent the free trade coefficients in other countries with similar factor prices, if we take the protective measures applied in other parts of the world as given.

The coefficients will also be applicable to countries with different relative prices of primary factors provided there is no substitution between primary factors and intermediate inputs. It should be added that substitution among primary factors does not give rise to error since, with the prices of traded goods equalized under free trade, value added should be the same irrespective of factor substitution. Furthermore, with the prices of intermediate inputs being identical everywhere under free trade, substitution among them cannot take place.

In turn, as indicated above, in the presence of substitution between primary factors and intermediate inputs or among the intermediate inputs themselves, the use of free trade coefficients from any source entails a downward bias in the estimate of effective protection. Thus, the importance of the substitution issue for the choice of the input-output coefficients, as well as for the magnitude of the error due to the assumption of constant coefficients in empirical studies, lies in the actual variability of the coefficients. We will return to this problem in the last section of the paper.

Protection of Factors vs. Protection of the Composite Factor Unit

These considerations can also be helpful in dealing with Travis' contention that "the root fallacy in the concept of effective protection is that it seeks to show how the price of value added is affected by the tariff, when in fact there is no such thing as the price of value added, for value added
has no natural unit" (p.448). He then suggests that "one plausible way to interpret the effective rate of protection might be to treat value added as a factor price" (p.450) only to reject this solution on the grounds that it would assume that "all intermediate, but no primary, inputs are instantaneously reallocable among sectors" (p.450).

But there is no need for such an assumption for the applicability of the concept of effective protection, nor has it been made by students of the problem. Instead of factor immobility, the assumption underlying the theory of effective protection is that primary factors are mobile internally (but not internationally), and increases (decreases) in the remuneration of primary factors in particular industries, due to the imposition of tariffs and other trade barriers, will tend to induce the movement of primary factors into (out of) these industries. It is not necessary then to assume that value added has a natural unit, but we can analyze changes in the remuneration of primary factors, taken together.

Substitution between individual primary factors and material inputs in response to the imposition of tariffs will not affect these conclusions, as long as the elasticity of substitution between pairs of primary factors and material inputs is the same as between the bundle of primary factors and material inputs. If, however, this assumption cannot be made, the measured effective rates will be subject to bias, and may not correctly indicate the direction of the resource flow. The magnitude of this bias will depend on differences in substitution elasticities between pairs of primary factors and material inputs and the relative factor intensities of the individual commodities.

More generally, it should be recognized that whether value added has a natural unit or not is irrelevant for the analytical usefulness of the concept. There are no "natural" baskets of consumer goods or "natural" measures
of the stock of capital, yet we have not abandoned price indices or ceased to measure capital because of this deficiency. In both cases somewhat arbitrary conventions have served to bridge the gap between theory and practical application with the net result that economic policy is probably better off with these imprecise measures than without them. Travis, himself, has occasionally been tempted into making accommodating compromises with the "no-aggregation" principle; for instance, he measured the substitution of raw materials for primary factors, and treated both of these two categories as a single entity (for a discussion of this calculation, see below).

Travis finally turns to the question of distinguishing protection to individual factors from protection to groups of factors. But this distinction does not in itself establish the superiority of factoral protection over the effective protection measure. In certain situations we may wish to know how the remuneration of individual factors changes due to the imposition of tariffs. In other situations we may wish to know how factor remuneration in individual industries is affected by the imposition of tariffs. Neither of these purposes can be said to be superior to the other. Factoral and effective rates of protection are merely two different measures and their usefulness will depend on the particular situation.

Two points in Travis' exposition of factorial protection deserve special attention. First, Travis' equation (7) is not an empirically useful way of measuring factoral protection even in small countries where the external terms of trade can be assumed as given. This is due to the heterogeneity of factors across countries. A more useful way of making such a calculation would entail estimating factoral remunerations under free trade and comparing them with the respective protected levels. Second, Travis' equation (4) is merely an identity
and equation (6) reverses the causal chain linking wages and prices assumed in effective protection literature. If the external terms of trade are given (a plausible assumption for small countries) then wages are a function of international prices and tariffs, not the other way around. This implies that equation (6) should read: \( w = W(p) \), and not \( p = H(w) \).

The Purposes of Effective Rates

Travis next inquires into the purpose of introducing effective rates. "The basic question, of course, is what is it exactly that one is trying to measure?" Balassa gives an implied answer to this question by saying that new measures are needed to compare the levels of protectionism practiced by various countries" (p.451). A careful reading of Balassa's argument does not support this claim, however. Rather than just comparing "levels of protectionism", he has shown that the protective effect of tariffs will depend on the elasticities of domestic demand and supply and the ratio of imports to domestic production and consumption (Balassa, 1965, pp.587-94). And, instead of national tariff averages, he used averages of nominal and effective tariffs for four commodity groups (1965, p.591) and subsequently for 29 product categories (1967, p.376), along with assumed values of the relevant elasticities and ratios, to estimate the possible effects of reductions in tariffs on imports.

The effective protection measure has further been used to measure the extent of discrimination against the processed goods of developing nations in developed countries (Johnson, 1965; Balassa, 1967 and 1968). Moreover, it finds application in focusing our attention to the differential inducements the system of protection provides for particular activities at various stages of transformation. Thus, it has been employed to indicate the resource pull
and resource push effects of the structure of protection within a national economy (Corden, 1966).

Finally, an obvious use of measures of protection is found in the design and evaluation of economic development plans. Since development plans are typically drawn up on a sectoral basis, it is quite natural that considerable attention would focus on how much protection a given sector does or should receive. The fact that sectoral classifications are arrived at by common agreement rather than deduced from fundamental premises seems to disturb Travis, yet such an "empirical" procedure is no less valid and useful than other systems of classification used in the empirical analysis of national economies.

The Magnitude of Substitution Between Primary Factors and Material Inputs

The most familiar type of substitution is that between primary factors, such as capital and labor. Studies which measure this type of substitution prefer to assume away the problem of intermediate products by treating value added as the final good. Clearly, the elasticities measured by these studies are of little use in shedding light on the type of substitution which concerns Travis, namely that which takes place between intermediates and primary factors as their relative prices change. Studies which look in general at the price sensitivity of input-output coefficients are also of limited use because they mix together the effects of substitution within factor classes and substitution between classes, i.e. within intermediates and between these and primary factors, and it is impossible to discern from these studies what magnitude the "between group" elasticity might attain.
Travis' only source of evidence on substitution between intermediates and value added is a calculation which he performed in a previous study (Travis, 1964). On that occasion, he compared the ratio of total raw material availability in the economy to total industrial value added for three industrial countries and obtained the results summarized below.

Table 1

<table>
<thead>
<tr>
<th>Country</th>
<th>Ratio</th>
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<tbody>
<tr>
<td>West Germany</td>
<td>.2707</td>
</tr>
<tr>
<td>Great Britain</td>
<td>.2927</td>
</tr>
<tr>
<td>France</td>
<td>.3376</td>
</tr>
</tbody>
</table>

Source: Travis 1964, p.238.

The higher ratio for France, Travis observes, is consistent with the hypothesis that France, a "protectionist" country according to Travis, has substituted raw materials for primary factors. Recognizing that the difference in these ratios may be due simply to differences in industrial structure, Travis then performed a separate set of calculations, using the 1956 French input-output table, designed to isolate the influence of this factor. After estimating raw material-value added ratios for each producing sector in the table, he multiplied each of these ratios by the corresponding level of German industrial output. If industrial structure were an influence it would have generated a much different estimate of raw material usage depending on whether French or German industrial output weights were employed. From the results of this exercise, which are reproduced in Table II below, Travis concluded that the higher raw material use per unit of value added in French industry could not be traced to the different composition of industrial output.
Table II

Raw material use per unit of value added

<table>
<thead>
<tr>
<th>Country</th>
<th>Ratio</th>
</tr>
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<tbody>
<tr>
<td>France (German weights)</td>
<td>0.2234</td>
</tr>
<tr>
<td>France (own weights)</td>
<td>0.2180</td>
</tr>
</tbody>
</table>

Source: Travis 1964, p.241

Faced then with estimates from two different time periods of the raw material-value added ratio for French industry, Travis offered the following explanation of how these estimates, which are conceptually the same, can be reconciled from an empirical point of view:

"The difference between the two coefficients, 0.2180 and 0.3376, reflects the greater increase of labor and capital prices than of raw material prices between 1950 and 1956. (Table I) is based on 1950 prices, corrected for the over-valuation of the franc at that time, whereas the input-output table ... is based on 1956 prices. ... Wages rose 65 percent with respect to raw material prices between 1950 and 1956, and this amount is consistent with the difference between the two estimates".

Source: Travis 1964, p.241. (Italics ours)

On the basis of this analysis, Travis argues that the fact that the French use considerably more raw material per unit of value added is suggestive, if not conclusive, evidence that her protectist policies have encouraged the substitution of raw materials for the "higher" priced primary factors.

There are several difficulties in relating this particular empirical observation to his criticism concerning substitution in effective rates of protection. First, raw material-primary factor substitution is not quite the same as substitution between value added and intermediate goods which include both raw materials and semi-manufactures. Thus, even if considerable
variation appears to exist in raw material-primary factor ratios, these may be just offset by variations in semi-manufacture-primary factor ratios, leaving the intermediate-value added ratio unchanged. Second, the comparability of the figures in Table 1 is rather questionable. The numerator (raw material usage) represents an average of 1950-55 valued at 1950 prices. The denominator (value added) was derived by applying a fixed value added-to-output coefficient to indices of industrial production 1950-55 (1950 for England and Germany, 1952 for France). Thus the denominator does not reflect changes in the real value added to output ratio through those years nor the respective relative price changes of primary factors and output. Yet, prices changed at different rates in each of the three countries and among the various industrial sectors as well. Thus Travis' conclusion from Table 1 stands on rather shaky ground.

Third, the comparison of the two French ratios is questionable as well since the Table 1 ratio is derived by using the 1952 value added to output coefficient. This ratio can therefore hardly be said to have responded to the 68 percent price change observed between 1950 and 1956. We can, however, compare Table II to France's ratio for 1952 which is the only year for which Travis shows complete primary data. This is done in Table III below:

| Table III Value Added and Raw Materials in France, 1952 (in millions in 1950 prices) |
|---------------------------------|----------------------|
| 1. French value added           | 7,018                |
| 2. Availability of raw material | 2,651.3              |
| Ratio 2/1                       | .3778                |

Source: Travis 1964, p. 236, Table 22, cols. 7, 9, 13.
We now have two points of France's production function (1952, 1956) and can calculate the implicit elasticity of substitution, provided we can assume as Travis did, that there are only two factors of production -- raw materials and value added. The formula for the elasticity of substitution is:

\[ \sigma = \frac{\frac{d(-v)}{r}}{\frac{d\left(\frac{P_v}{P_r}\right)}{1}} \]

where:

- \( v \) and \( r \) are the quantities of primary factors and raw materials respectively; \( P_v \) and \( P_r \) are their prices; and \( \sigma \) is the elasticity of substitution.

Its approximation, \( \sigma' \), is:

\[ \sigma' = \frac{\frac{V_o}{R_o} - \frac{V_1}{R_1}}{\frac{V_o}{R_o}} \cdot \frac{1}{1 - \frac{P_{v1}}{P_{r1}}} \]

where:

- the subscripts 0 and 1 refer to two points on the isoquant; and
- \( P_{vo}/P_{ro} \) is defined equal to one.

Letting 0 = 1952 and 1 = 1956, we know from Travis' data that:

3. \( \frac{V_o}{R_o} \) in 1950 prices = \( 1/ .3778 = 2.647 \);

4. \( \frac{V_1}{R_1} \) in 1956 prices = \( 1/ .2180 = 4.638 \); and

5. \( (P_{v1}/P_{r1})_1 : (P_{v1}/P_{r1})_0 = 1.681/1.244 = 1.351 \)
Deflating \( \frac{V_l}{R_l} \) in 1949 by the price deflator, 1.681, we obtain:

6. \( \frac{V_l}{R_l} \) in 1950 prices = \( \frac{4.587}{1.681} = 2.729 \)

Substituting in the elasticity formula, we obtain:

7. \( \sigma' = \frac{2.647 - 2.729}{2.647} \cdot \frac{1}{-351} = .09 \)

Thus, Travis' own data on the most generous of assumptions does not support his claims of considerable substitutability between intermediate inputs and value added. Rather, it appears to yield an estimate for the elasticity of substitution which is not significantly different from zero.

This result is not surprising since other researchers have also been unable to document a high degree of substitutability in production processes. Thus Theil and Tilanus, surveying the pertinent literature, summarize their findings as follows:

"This (i.e. the influence of prices on demand for inputs) has been investigated by several authors in an empirical approach. Hatanaka ... tested the hypothesis that change in input coefficients of energy sources in the U.S.A. can be explained solely by relative price changes. He did not reject the hypothesis, nevertheless he thought it unwise to support it. Cameron ... found surprisingly little evidence of price substitution in Australian industry. Arrow and Haffenberg entirely omitted relative prices as explanatory variables in the regression equation of the technical coefficients. We must conclude that the observability of factor price influences on factor demand is still a matter of doubt". (Theil and Tilanus 1964, p.265).

Conclusion

In the concluding section of the paper, Travis summarizes his arguments in support of the claim that "the theory of effective protection is invalid" (p.159). These pertain to (1) the problem of sector classification; (2) the unit of measurement and the price of value added; (3) the assumptions
made concerning the mobility of primary factors; (4) the substitutability of inputs; (5) the verticality of the production process; and (6) the use of effective rates for the international comparison of tariff levels. In this note we have examined each of these propositions -- although not necessarily in the same order -- and have shown that Travis' arguments against effective protection are not convincing.

First, both sectoral and product definitions acquire their validity from the purposes of the analysis. No system of classification or definition is justifiable on purely theoretical grounds, nor is this even necessary. Second, whether value added has a natural unit or not is irrelevant for the analytical usefulness of the concept. Third, effective protection theory does not and need not assume that primary factors are immobile domestically. Fourth, the direction and the magnitude of the bias due to input substitution becomes an empirical question subject to measurement. Indeed, Travis' own data do not indicate an elasticity of substitution significantly different from zero. Fifth, in the presence of trade in intermediate products, the classification of products "from the ground up" is analytically erroneous in the case when some inputs are not produced domestically, and leads to errors in practical applications. Sixth, effective tariffs serve several useful functions that are not considered by Travis who deals only with the elusive issue of the international comparisons of tariff levels.

It should be emphasized, however, that problems of tariff averaging, input substitution, and the treatment of nontraded goods all create error possibilities in estimating the effective rate of protection. But this observation applies to any kind of empirical investigation in economics, and we are well-advised not to reject theoretical advances because of problems of measurement.
Footnotes

1/ Effective rates have been estimated for twenty-two primary com-
modities in Balassa, 1966.

2/ For a detailed discussion, see Balassa and Schydowsky, 1968.

3/ Nor can we explain cases where nominal rates exceed effective rates,
or effective rates are negative, by reference to the use of the "wrong" tar-
iff rates, as Travis alleges (p.447). In empirical investigations, nil tar-
iffs have been applied in calculating the effective rate of protection of ex-
port activities (Balassa, 1966); also, it is generally understood that, when-
ever the assumption that tariffs equal the excess of the domestic price over
the world market price is not fulfilled, the effective rate should be calcu-
lated from direct price observations (Balassa and Schydowsky, 1968; Lewis
and Guisinger, 1968).

4/ For proof, see Leith, 1968.

5/ This does not mean, however, that the bias in Baselvi's results
would account for the entire difference between effective and nominal rates
as Travis alleges.

6/ An excellent discussion of the substitution issue is contained in

7/ On this point, see Corden, 1969.

8/ Cf. Ramaswami and Srinivasan.

9/ This assumption has not gone unquestioned. See the comments of

10/ Other possible definitions of the arc elasticity have not given
significantly different results.
REFERENCES


