Empirical Problems of Effective Rates of Protection: An Evaluation of Past Experience

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During the last 10 years a number of articles have been published on the concept of effective protection. Most of them were concerned with theoretical aspects of effective rates of protection (ERPs) in the usual neoclassical framework. Therefore, practitioners had little help from this literature when they wanted to use the basic ERP formula on a more complex world and with limited data supply. The insufficient discussion on the empirical problems might be the main reason, explaining why the results of actual calculations of ERPs are hardly comparable. Anyway, in nearly every empirical investigation that I know of, a different formula has been used [*see* 1,2,3,5,6,12,14,16,17 and 23]. Because the concept of effective protection has in the meantime been established as a major tool for analyzing the resource allocation of primary factors between industries and the resource costs of producing one unit of domestic currency if output and inputs are valued at free trade prices it would be worth-while to discuss the major empirical problems of ERPs in order to bring about comparability between future results.

In this article I discuss problems concerning the treatment of domestic sales and foreign sales, tariff aggregation, indirect taxes, export duties, depreciation, subsidies and non-traded goods within ERP calculations. My main purpose is to calculate different rates of protection for domestic sales and foreign sales and to use a tariff aggregation method different from those used in empirical studies up to now. The section on indirect taxes gives a short survey on the calculation of ERPs under different tax regimes. It is shown that, apart from output and input prices, indirect taxes affect the input-coefficients. Since the proposed treatment of depreciation depends on the existence and size of depreciation allowances it is argued that one set of calculations should be based on gross value added to facilitate international comparability of results. If lump sum subsidies play a considerable role as a means of protection, a combined rate of effective protection should be calculated in addition to the domestic sales and export rates, because lump sum subsidies are granted to an industry as a whole irrespective of whether it exports or produces solely for domestic markets. The next section highlights some of the more subtle differences between the concepts of effective protection and domestic resource costs. Furthermore it is shown how non-traded inputs should be treated in contrast to most of the existing studies. Formulas (27) and (28) show how ERPs should be calculated if (a certain type of) excise taxes and

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export duties are in existence and if non-traded inputs are taken into account. No adjustment is made, however, for an overvalued currency and for exchange rate changes that would occur with an abolition of the protective system.[1]

The Concept of Effective Protection

Basically, formulas of effective rates of protection are derived from a neo-classical model of an open economy with linear homogeneous production functions, fixed physical intermediate input coefficients, internationally traded goods with infinite price elasticities of foreign supply and foreign demand (small country assumption) and no changes in the trade structure due to the imposition (or abolition) of the protective system.[2] According to this model the effective rate of protection of a production activity, j, is defined as the relative difference of domestic value added, v_j, and value added measured in world market prices[3], v_j^*, per unit of output due to the imposition of a protective structure.

$$(1)\quad ERP_j = \frac{v_j - v_j^*}{v_j^*} = \frac{p_j - \sum_i \alpha_{ij} p_i}{p_j^* - \sum_i \alpha_{ij} p_i^*} - 1 \qquad \begin{matrix} j = 1, \ldots m \\ i = 1, \ldots, n \end{matrix}$$

where α_{ij} represent physical input-coefficients, p_j and p_i indicate the domestic prices of the products j and i respectively, and p_j^* and p_i^* are the corresponding world market prices.

The price differential between the domestic and the world market price of good j related to the world market price is usually defined as t_j and called the tariff rate.[4] The relationship between domestic and world market prices can then be written $p_j = p_j^*(1 + t_j)$. With the use of the price differentials, t_j, and the domestic prices it is possible to replace the world market prices in formula (1):

$$(2)\quad 1 + ERP_j = \frac{p_j - \sum_i \alpha_{ij} p_i}{\frac{p_j}{1+t_j} - \sum_i \alpha_{ij} \frac{p_i}{1+t_i}}$$

Obviously it is very difficult to obtain the actual price differentials between domestic and world market Prices. One has to carry out international price comparisons. Unfortunately, in reality only some primary and intermediate products are approximately homogenous while most of the final products are not. Therefore, in practice, nominal tariff rates are often taken instead of actual price differentials. *See*[22 and 23] on price comparisons in Pakistan.

Transformation of the Basic ERP Formula

The formula of effective protection has now to be transformed to fit to the existing data. The concern here is only with relative price changes rather than with ab-

[1]Since it is extremely difficult to evaluate these exchange rate differences and since the inclusion in the ERP formula tends to diminish ERPs proportionately and hence does not alter their structure, it seems not to be worthwhile to take them into account. An alternative and simpler method is to deflate ERPs by the average ERP of all industries producing traded goods. [*see* 16, pp. 66 71 and 93–96].

[2]On the theory of effective protection *see* e.g. Corden (1966) and Ethier (1971).

[3]World market prices are measured by c.i.f.—import prices and f.o.b.—export prices minus domestic transportation costs.

[4]Note that the "tariff rate" must not be equal to the nominal tariff rate. It might be that because of quantitative import restrictions the tariff rate is higher than the nominal tariff rate. It might also be that the tariff rate is lower than the nominal tariff rate or even be zero. In these cases the nominal tariffs are called prohibitive and redundant respectively.

solute price levels, in which case the price of the aggregate product j can be written as 1.[5] Dividing throughout by p_j, formula (2) then becomes :

$$(3)\quad 1 + ERP_j = \frac{1 - \frac{1}{p_j} \sum_i \alpha_{ij}\, p_i}{\frac{1}{1+t_j} - \frac{1}{p_j} \sum_i \alpha_{ij} \frac{p_i}{1+t_i}}$$

Since the $\frac{1}{p_j} \alpha_{ij}\, p_i$ are defined as value input-coefficients a_{ij}, formula (3) can be written as

$$(4)\quad 1+ ERP_j = \frac{1 - \sum_i a_{ij}}{\frac{1}{1+t_j} - \sum_i \frac{a_{ij}}{1+t_i}}$$

The a_{ij} can be derived from the input-output-tables. Note that we have to assume that the physical intermediate input-coefficients are constant. They should not vary with the output level of a firm, or at least not in the relevant range of production changes with which we are concerned. Also, they should not vary with price changes arising from changes in the protective system. This means that the impact of protective measures on input prices should neither lead to substitution effects between intermediate and primary inputs (labour and capital) nor to substitution between the intermediate inputs themselves. With the type of formula (4) computations were carried out for example by Balassa and Associates [3], Anderson [1], and Hiemenz and Rabenau [16 and 17].

Since the physical input-coefficients and the price differentials are not allowed to vary with the output level, formula (1) yields the same results as formula (5).

$$(5)\quad 1 + ERP_j = \frac{V_j}{V_j^*} = \frac{x_j p_j - x_j \sum_i \alpha_{ij}\, p_i}{x_j p_j^* - x_j \sum \alpha_{ij}\, p_i^*}$$

were V_j and V_j^* are the amounts of total value added measured in protection and free trade prices respectively and x_j is the level of output. The terms $x_j p_j$ $(x_j p_j^*)$ and $x_j \sum_i \alpha_{ij}\, p_i$ $(x_j \sum_i \alpha_{ij}\, p_i^*)$ denote total sales and total costs in the protection (free trade) situation. This type of formula is used for example by Grubel and Johson [14], Lewis and Guisinger [23] and Gamir [12]. Though both formulas yield the same results I prefer to use the type of formula (4) because of its simplicity.

Sometimes, especially in theoretical papers, there is shown a third type of formula in which free trade value input-coefficients a_{ij}^*, are used [*see* 2, 8 and 13]. This formula can be derived by dividing numerator and denominator of (1) by p_j and with some rearrangements :

$$(1')\quad ERP_j = \frac{1 + t_j - \sum_i a_{ij}^* (1+t_i)}{1 - \sum_i a_{ij}^*} - 1 = \frac{t_j - \sum_i a_{ij}^*\, t_i}{1 - \sum_i a_{ij}^*}$$

[5] If the required data stem from an input-output-table, the product j has to be interpreted as an aggregate product. The corresponding activity producing this aggregate product is called industry j.

Since available statistics normally show input costs and output values at actual and not at free trade prices, it is easier to calculate a_{ij} than a_{ij}^*. Accordingly, further modifications of the ERP formula are made on the basis of formula (4) which uses protection value input-coefficients.

Protection of Industries Producing for the Domestic and the Foreign Market

In reality industries are not clean in the sense that all tradable products of an industry are either imported but not exported or vice versa. Normally, there will be some exports and imports besides the production for the domestic market. Therefore it is hard to understand why in most empirical studies the authors treat the whole production of an industry as domestic sales and neglect the important fact that exports are not protected by import duties. *See* Balassa [2], Basevi [6], Grubel and Johnson [14], Lewis and Guisinger [23], Barker and Han [5], and Gamir [12].

How can this problem be solved ? Balassa [3,pp. 21,61 & 316-317] divides all industries of a country into three groups : export industries, import-competing industries and non-import-competing industries. The first group includes industries with an export share higher than 10 percent. The second group includes industries with an import share higher than 10 percent. The third group includes all industries with trade shares lower than 10 percent. Though not mentioned by Balassa, there must exist a fourth category where import and export shares are higher than 10 percent.

For the first group (export industries) he uses a formula where domestic sales are not protected by import duties [3, pp.316-317, formulas 3 & 4]. This procedure implies that at an export share of over 10 percent domestic firms will behave competitively and sell their products domestically at world market prices. Instead of import duties on final products he takes into account a nominal rate of subsidy to exports. This rate seems to reflect the fact that some countries subsidize export industries in proportion to their exports. If this is so, the treatment of the domestic sales is inappropriate, because in the computation formula all sales of an export industry are treated equally though domestic sales are not subsidized by export subsidies. For the second group he uses a formula that resembles formula (4) or, using free trade value input-coefficients, formula (1′) [3, pp.316-317]. In this case export sales are treated inappropriately because they are not protected by import duties and, if they are subsidized proportionately, because their subsidies are neglected. Any formulas for industries within the third and the fourth group seem not to have been mentioned. The difficulties which arise in computing ERPs for industries of the fourth category (trade shares higher than 10 percent) are in my opinion insurmountable because these industries are classified both as export and import-competing industries at the same time. This means that all sales are subsidized by export subsidies while they are not protected by import duties *and* vice versa.

Because of these difficulties which arise when an industry is treated either as an export industry or as an import-competing industry (or as non-import-competing) a more flexible solution seems to be appropriate. Domestic sales and foreign sales of an industry should be treated separately because different protection measures apply to them.

One suggestion in this direction was made by Wonnacott [29, cited in 20, p.596] and was followed by Hiemenz and v Rabenau in a computation of ERPs for West-German industries[16]. Wonnacott proposed the calculation of a combined rate in which domestic sales are deflated by the average tariff rate while exports are not, if they are not taxed or subsidized.[6]

Referring to equation (5) we can express this rate as

$$(6)\quad 1 + ERP_j^{DF} = \frac{x_j^d\, p_j^d + x_j^f\, p_j^* - x_j \sum_i \alpha_{ij} p_i}{\frac{x_j^d\, p_j^d}{1+t_j} + x_j^f\, p_j^* - x_j \sum_i \frac{\alpha_{ij} p_i}{1+t_i}}$$

where $x_j^d\, p_j^d$ and $x_j^f\, p_j^*$ are domestic sales and foreign sales respectively and ERP^{DF} is the combined rate of effective protection.

In the denominator of formula (6) only the domestic sales are deflated by the industry tariff because import duties apply to imports only, allowing a price rise of domestically sold products.[7] Dividing throughout by total sales $(x_j^d\, p_j^d + x_j^f\, p_j^*)$ we get

$$(7)\quad 1 + ERP_j^{DF} = \frac{1 - \sum_i a_{ij}}{\frac{d_j}{1+t_j} + (1-d_j) - \sum_i \frac{a_{ij}}{1+t_i}}$$

where d_j is the share of domestic sales in total sales and $(1-d_j)$ is the share of exports in total sales. Note that input-coefficients a_{ij} relate the input costs per unit of output to an average output price consisting of the domestic and the foreign price. See equation (8).

$$(8)\quad \frac{x_j \sum_i \alpha_{ij}\, p_i}{x_j^d\, p_j^d + x_j^f\, p_j^*} = \frac{\sum_i \alpha_{ij}\, p_i}{\frac{x_j^d}{x_j}\, p_j^d + \frac{x_j^f}{x_j}\, p_j^*} = \frac{\sum_i \alpha_{ij}\, p_i}{p_j^{df}} = \sum_i a_{ij}$$

$$\text{where } p_j^{df} \equiv \frac{x_j^d}{x_j}\, p_j^d + \frac{x_j^f}{x_j}\, p_j^* \text{ and } p_j^* \leq p_j^{df} \leq p_j^d$$

This is important for the understanding of two different sets of input-coefficients, a_{ij}^d and a_{ij}^f which are introduced later in formulas (10) and (12).

The combined rate, however, is not so much of interest as two different rates which focus on the protection of domestic sales and foreign sales separately. It

[6] Throughout this article t_i and t_j will denote the actual price differentials of domestically-sold goods due to nominal import duties or quantitative import restrictions. This definition shall apply to products which are mainly produced for export, too, though often their tariffs will be zero because the protective measures – if there exist any – do not lead to higher domestic prices. In this and the following section the tariffs, t_i and t_j, reflect the whole actual price differentials between domestic and world market prices. Later indirect taxes will be introduced which affect domestic prices. Then this identity will no longer hold.

[7] Note that this formula does not imply any assumption on the price behaviour of firms which sell their products on the domestic and the foreign markets nor any assumption on the redundancy of nominal tariff rates. The latter problem—admittedly a very difficult one—should be solved separately and not be mixed up with the problem of how to treat domestic and foreign sales of an industry.

is not useful to have the domestic and the foreign sales of the industries lumped together in one rate when the main interest is to see if and to what extent export industries are discriminated against relative to import substituting industries. Otherwise the ERP would depend, among other things, on the industries' export shares. The same is true if a test is to be made to determine whether there exists any correlation between a high export share and a low protection for domestic sales. Therefore, it is useful to calculate two ERPs, one for the protection of domestic sales and the other for the protection of exports (domestic sales rate and export rate).

Assuming, as usual, the same intermediate input-coefficients for exports and domestically sold goods, the ERP for domestic sales can be written as

$$(9) \quad 1 + ERP_j^D = \frac{x_j^d\, p_j^d - x_j^d \sum_i \alpha_{ij}\, p_i}{\frac{x_j^d\, p_j^d}{1+t_j} - x_j^d \sum_i \frac{\alpha_{ij}\, p_i}{1+t_i}}$$

Dividing throughout by $x_j^d\, p_j^d$, we get

$$(10) \quad 1 + ERP_j^D = \frac{1 - \frac{\sum_i \alpha_{ij}\, p_i}{p_j^d}}{\frac{1}{1+t_j} - \frac{\sum_i \alpha_{ij}\, p_i/1+t_i}{p_j^d}} = \frac{1 - \sum_i a_{ij}^d}{\frac{1}{1+t_j} - \sum_i \frac{a_{ij}^d}{1+t_i}}$$

where a_{ij}^d, the value input-coefficient of domestic sales, relates the input costs per unit of output j to the domestic output price.

The formula for foreign sales can be derived in the same way

$$(11) \quad 1 + ERP_j^F = \frac{x_j^f\, p_j^* - x_j^f \sum_i \alpha_{ij}\, p_i}{x_j^f\, p_j^* - x_j^f \sum_i \frac{\alpha_{ij}\, p_i}{1+t_i}}$$

Dividing throughout by $x_j^f\, p_j^*$ we get.

$$(12) \quad 1 + ERP_j^F = \frac{1 - \frac{\sum_i \alpha_{ij}\, p_i}{p_j^*}}{1 - \frac{\sum_i \alpha_{ij}\, p_i/1+t_i}{p_j^*}} = \frac{1 - \sum_i a_{ij}^f}{1 - \sum_i \frac{a_{ij}^f}{1+t_i}}$$

where a_{ij}^f, the value input-coefficient of exports, relates the input costs per unit of output j to the export price.

It is important to emphasize, that *two different sets of input-coefficients* a_{ij}^d and a_{ij}^f, are essential for the calculation of two separate rates of protection for every industry[8,9].

Since the calculation of two sets of input-coefficients will be too time-consuming, a second possibility of calculating domestic sales and export rates with the use of only one set of input-coefficients, a_{ij}, as defined in (8) will be shown. Dividing numerator and denominator of (9)

by $x_j^d \left(\frac{x_j^d}{x_j} p_j^d + \frac{x_j^f}{x_j} p_j^* \right)$ we get.

$$(13) \quad 1 + ERP_j^D = \frac{1 + t_j - d_j t_j - \sum_i a_{ij}}{\frac{1 + t_j - d_j t_j}{1 + t_j} - \sum_i \frac{a_{ij}}{1+t_i}}$$

Dividing numerator and denominator of (11) by

$x_j^f \left(\frac{x_j^d}{x_j} p_j^d + \frac{x_j^f}{x_j} p_j^* \right)$ we get

$$(14) \quad 1 + ERP_j^F = \frac{1 - \frac{d_j t_j}{1+t_j} - \sum_i a_{ij}}{1 - \frac{d_j t_j}{1+t_j} - \sum_i \frac{a_{ij}}{1+t_i}}$$

Formulas (10) and (13) as well as formulas (12) and (14) yield the same results for $1 + ERP_j^D$ and $1 + ERP_j^F$ respectively since they are derived from the same basic equations, (9) and (11). But compared to (10) and (12), formulas (13) and (14) have an advantage in that only the familiar set of input-coefficients, a_{ij}, are used, although the formulas look complicated because the unit output price in (13) becomes $1 + t_j - d_j t_j$ and the unit output price in (14) becomes $1 - \frac{d_j t_j}{1+t_j}$. They can

[8]Note that $a_{ij}^d < a_{ij} \leq a_{ij}^f$ because of $p_j^d < p_j^{df} \leq p_j^*$. See equation (8).

[9]It is possible to calculate with $1 + ERP_j^D$ and $1 + ERP_j^F$ a combined rate $1 + ERP_j^{DF}$. The weights, however, must not be d_j and $(1 - d_j)$ but the shares of domestic and foreign sales in total sales at free trade prices. Multiplying $(1 + ERP_j^D)$ with d_j^* and $(1 + ERP_j^F)$ with $(1 - d_j^*)$ yields $1 + ERP_j^{DF}$ as defined in formula (7), where $d_j^* = x_j^d p_j^d / (x_j^d p_j^* + x_j^f p_j^*)$.

be regarded as "modified unit" prices and will be denoted by o_j^d and o_j^f.[10] The question arises as to which pair of formulas is better suited for practical purposes. It is pair (13) and (14) because the calculation of only one matrix (the a_{ij}) and two vectors (o_j^d and o_j^f) are needed instead of two matrices (the a_{ij}^d and the a_{ij}^f). Accordingly, further extensions are shown in formulas (13) and (14).

If, for example, 1 ERP_j^D is to be calculated by the familiar formula (4) instead of by (10) or (13), the results will be biased upwards. If e.g. $\sum_i a_{ij} = 0.5$, $t_j = 0.3$, $t_i = 0.1$ for all i, and $d_j = 0.5$, formula (4) gives an ERP of 59% and formulas (10) or (13) give 51%. The deviation amounts to 8 percentage points or 15%.

Formulas (13) and (14) do not suffer from the disadvantages of Balassa's proposal. In calculating separate rates for the domestic and foreign sales of every industry, account can be taken of export promoting or discriminating measures without resorting to use of any arbitrary criteria on the definition of an export industry. The same is true for import-competing industries. Import duties do not protect sales abroad and should therefore be applied for the domestic sales only whatever the import share may be.

Compared to formula (7), which shows the combined effective protection of total sales of an industry, formulas (13) and (14) provide detailed information on the protection of domestic sales and of exports. This detailed information is often needed, for example, to answer questions on import substitution or on export performance of domestic industries. moreover, it is possible to calculate with ERP^D, and ERP^F the combined rate of protection, ERP^{DF}.

Tariff Aggregation

Since results of ERP studies depend heavily on the aggregation procedure of tariffs[11] and since nearly everybody doing an empirical study on effective protection employs a different method,[12] this point seems to be of crucial importance.

As already pointed out by Anderson [1, p.59] the ideal weighting scheme in calculating the input tariff t_i is that of proportions of use of the components of commodity i by the user industries. Hence the average t_i would differ for every industry because every industry uses a differently structured input product bundle of those products which constitute the "commodity i" in the sense of the input-output-table. Normally such information will not be available, because if it would be, the input-output-table itself could be more disaggregated. In most cases there

[10]If the whole domestic production of commodity bundle j is sold domestically, o_j^d equals 1 and a_{ij}^d equal a_{ij}. If, on the other hand, the whole production is exported, o_j^f equals 1 and a_{ij}^f equal a_{ij}. Of course it is useless to calculate in these extreme cases two rates of effective protection. If $O < d_j < 1$, o_j^d cannot be smaller and o_j^f cannot be greater than 1. The modified "unit" price o_j^d will be greater than 1 if $O < d_j < 1$ and if t_j is positive because in this case $a_{ij} > a_{ij}^d$. In other words the a_{ij} overstate the input costs a_{ij}^d if they are subtracted from a price of 1. To eliminate this bias, the price of 1 has to be increased. It then becomes o_j^d. The opposite is true for o_j^f which is smaller than 1 because of $a_{ij} < a_{ij}^f$

[11]*See* for example the sensivity tests done by Till and Tumlir [28, pp. 155-156].

[12]Balassa [2,p. 579] weighed tariffs (implicitly) by combined imports of five industrial areas. Basevi [6,p. 151] took production weights in calculating the t_j. Grubel, Johnson [14, p. 764] and Gamir [12, p. 202] weighed tariffs (implicitly) by imports, $t_j = t_i$. Lewis and Guisinger [23, p. 1171] weighed input tariffs by the country's own input-output-structure (?) and took an arithmetic mean of output tariffs. Anderson [1, pp. 59-60] took up to the four digit level of the U.S. tariff schedule (implicitly) import weights and from there on presumably output weights. Hiemenz and Rabenau [16, p. 139] took simple means for calculating t_i and production weights for calculating the t_j from the t_i.

will be only two possibilities of choice : calculating a simple mean or calculating a weighted mean with imports being the weights, since data on trade flows exist on a very disaggregated level, and tariff and trade classifications are normally very similar. It is, however, very difficult to decide which of the two weights resemble more the "ideal" weights. For two reasons I would suggest we take the simple mean. First, there might exist some errors in the trade statistics which can be circumvented by taking the simple mean Second, because the same input tariffs (t_i) can be used to calculate the output tariff (t_j) if an output j contains several commodities i.

The output tariff (t_j) should reflect the average domestic price increase of all products produced and sold locally by industry j due to the imposition of protective measures. Therefore, it is suggested for example by Anderson [1, p. 59] and Melvin [25, p. 291] to take production weights of the individual products of an industry. But in my opinion, however, one should not take total production but only production for the domestic market as weights. The simple reason is that prices of exports, under the given assumptions, are not affected by the imposition of import duty rates and import quotas. Therefore, the weights for the domestic price increases of the individual products should only be the domestic sales of those products. Price indices are usually calculated with Laspeyres weights. Therefore the domestic sales weights should be those of the free trade situation. But, since information on free trade domestic sales is not available, protection values should be taken as a proxy.

If several commodities i are produced in an industry j then there exists the prior problem of how to calculate the tariffs on the commodity level. If the domestic sales weights are not available at a subcommodity basis the choice of the weighting scheme is limited again to the two second-best weighting schemes as above. Equal weights should be used for averaging. They are a better proxy for domestic sales than imports because domestic sales of locally produced goods are exclusive of imports. The calculated tariffs are then identical with the input tariffs t_i. Using domestic sales weights for the t_j, the average t_j is then calculated.

With regard to the price differentials of exported goods the same rules should be applied.[13] The u_i should be calculated by taking equal weights for the differentials of subcommodities, and the u_j, should be calculated by taking exports as weights for the u_i.

Excise Taxes

First, I will focus on the problem of how excise taxes can be incorporated into the calculation of ERPs of domestic sales.[14] Excise taxes are levied either on domestic *and* imported goods or solely on domestic goods.[15] In the latter case import duties are higher than in the former because they include excise taxes. Assume the latter tax system where no excise taxes are levied on imported goods[16]

[13] In one of the next sections, for example, export duties are introduced which depress domestic producers' prices of exported goods and thus create price differentials between domestic and world market prices. These price differentials are denoted by u_i and u_j.

[14] See also J.C. Leith [21].

[15] For example, the first system applies to West Germany while the second applies to Malaysia.

[16] If excise taxes are levied on domestically produced goods *and* on imports with the same amounts payable, they can be disregarded on the output side. Of course there may occur some demand shifts if one good is taxed highly compared to the other goods even if imports are treated equally. The first reaction will be that imports are driven out of the domestic market. This reaction is not harmful to the concept of effective protection, because the domestic producers are not affected by it. If the domestic demand, however, decreases more than by the amount of the former imports the change of relative domestic prices would be harmful to domestic producers because it is unlikely that the lacking domestic demand can be replaced by exports at the same producers' price. Therefore it is assumed in the theory of effective protection that the imposition of a protective system (or the abolition of a protective system) will not bring about changes in the trade direction. On the input side, however, they increase the input costs and decrease value added. This case equals the case of a turnover tax. *See* the discussion under the following subheading.

and that the official nominal tariffs are not lower than the corresponding excise taxes. The formula of effective protection (13) then becomes

$$(15)\quad 1 + ERP_j^D = \frac{o_j^d - \sum_i a_{ij}}{\frac{o_j^d}{1+t_j-s_j} - \sum_i \frac{a_{ij}}{(1+t_i)}}$$

where s_j is the average excise duty on products in the commodity bundle j, and t_j and t_i have to be interpreted as the price differential due to nominal tariffs. Note that o_j^d is the producers' price. It has to exclude indirect taxes. It has to include, however, the impact of nominal tariffs because the domestic output price is higher owing to their existence. It is true that indirect taxes have to be paid on the output side as well but they are not part of the price which the producer gets for wages, profits depreciation and costs of intermediate products. The producers' price minus the input costs is, however, the relevant basis to show the effects of a protective system on factor allocation and domestic resource costs.

The change in the producers' price is now calculated by deflating the protected producers' price with $1 + t_j - s_j$. Why? The underlying rationale is that the domestic users' price is determined under the assumption of an infinite foreign supply elasticity by the c.i.f.-import price *plus* the tariff ($p_j^{d*}(1+t_j)$). Since the users' price is the same for imported and domestic goods the domestic producers' price can be derived by substracting the excise taxes (which are related for convenience to the c.i.f.-import price) from the given users' price ($p_j^d = p_j^{d*}(1+t_j) - s_j\ p_j^{d*}$). Therefore $p_j^{d*} = p_j^d/(1+t_j-s_j)$.

Since Grubel and Johnson corrected their ERP formula (14, pp. 674 and 675) it is known that input-coefficients have to be calculated at different price levels. The input prices have to include indirect taxes, because indirect taxes—if they are not reimbursed by the government—are part of the input costs. The output prices have to exclude indirect taxes as shown above.

In order to get the input costs valued at free trade prices one has to deflate them simply by the tariff (and not by $1+t_i-s_i$) because domestic free trade input prices are equal to the c.i.f.-import prices.[17]

The producers price, o_j^d, changes with the introduction of excise taxes, too. It becomes $1 + t_j - s_j - d_j\ (t_j - s_j)$ instead of $1 + t_j - d_j t_j$. Its derivation is basically the same as in equation (13) above. The former price differential on outputs, t_j, has now to be replaced by $t_j - s_j$.

Under the assumption that exporters are exempted from paying excise taxes on the output side, formula (14) changes only slightly :

$$(16)\quad 1 + ERP^F = \frac{o_j^f - \sum_i a_{ij}}{o_j^f - \sum_i \frac{a_{ij}}{1+t_i}}$$

[17]A reference system which is characterized by the replacement of all excise taxes by a non distorting tax might not be very reasonable. *See* Hiemenz and Rabenau [16, p. 184]. In order to reach comparability of future ERP results, however, one should stick to this assumption.

The change is in the expression o_j^f which is now equal to

$$1 - \frac{d_j(t_j - s_j)}{1 + t_j - s_j}$$

This change is due to the replacement of the former price differential, t_j, by t_j s_j as stated above.

Value Added Tax, Single Stage Sales Tax, Turnover Tax

The value added tax can be disregarded in the calculation of ERPs, if the same tax rates apply to domestic and imported goods. The reason is that the domestic producers price does not change and taxes on inputs are reimbursed.

A single stage sales tax is levied equally on imported and domestically produced goods. It is levied exclusively on final demand and hence does not alter input prices nor output prices at producers' value. It need not be taken into account in the computation of ERPs.

A turnover tax at every stage of production diminishes the effective protection to an industry if it is levied at the same rate on domestic and imported products and not at a cumulative rate on imports. Why ? The domestic output price at producers' value is not affected by the existence of the turnover tax because it is levied on domestic and imported goods equally. Of course, users' prices will rise by the tax rate. Therefore input costs rise and value added (net of indirect taxes on the output side) diminishes. If the taxes have to be paid on a price basis including tariffs, formulas (15) and (16) become respectively

$$(17)\quad 1 + ERP^D = \frac{o_j^d - \sum_i a_{ij}}{\frac{o_j^d}{1+t_j-s_j} - \sum_i \frac{a_{ij}}{(1+t_i)\ (1+w_i)}}$$

and

$$(18)\quad 1 + ERP^F = \frac{o_j^f - \sum_i a_{ij}}{o_j^f - \sum_i \frac{a_{ij}}{(1+t_i)\ (1+w_j)}}$$

where w_i is the constant or variable turnover tax rate and o_j^d and o_j^f are the same as in formulas (15) and (16).

Export Duties

The f.o.b.-price minus domestic transport costs is the relevant free trade price of exports in the framework of effective protection. Since the producers have to bear the export duty, the producers' price of product j is p_j^* minus duty in the case of export ($p_j^f = p_j^*(1-u_j)$). If there is competition among export firms on the domestic market, the producers' price for exports will equal the domestic users' price. Introducing export duties into the computations, formulas (15) and (16) become:

$$(19)\quad 1 + ERP_j^D = \frac{o_j^d - \sum_i a_{ij}}{\dfrac{o_j^d}{1+t_j-s_j} - \sum_i \dfrac{a_{ij}}{1+t_i-u_i}}$$

$$(20)\quad 1 + ERP_j^F = \frac{o_j^f - \sum_i a_{ij}}{\dfrac{o_j^f}{1-u_j} - \sum_i \dfrac{a_{ij}}{1+t_i-u_i}}$$

where o_j^d is $d_j + (1-d_j)\dfrac{1+t_j-s_j}{1+u_j}$ and o_j^f is $1 + \dfrac{d_j\,(1-u_j)}{1+t_j-s_j} - d_j$.[18]

Depreciation

The question is whether to treat depreciation as an intermediate input, i.e. to include or to exclude it from value added. There exists no unambigous answer to this question. Generally it is better to treat depreciation as an input cost because value added comes closer to net profits and to the residual from which factors of a supply elasticity less than infinite are paid off. Moreover, capital goods are often taxed by import duties. Treating the wear on capital goods as intermediate inputs allows us to take account of the discrimination against the user industries. If, however, the depreciation on capital goods does not reflect the wear on them this procedure becomes inappropriate. This is the case if the government's economic policy grants e.g. accelerated depreciation allowances or depreciation possibilities of more than 100%. Then the discounted net profit increases but the current net value added decreases. In this case it is better to base the calculations of ERPs on gross value added because such a decrease in net value added causes an undesirable change of ERPs. In order to calculate ERPs in such a way that they can be compared internationally at least one set of ERPs should be based on gross value added regardless of the fact that generally net value added is a better basis.

Subsidies

Balassa [3, p.33*a*] proposed to add the amount of subsidies to the value added in the protection situation.[19] In my opinion this procedure is unacceptable since subsidies are already included in total value added at the protection situation. To add subsidies to V_j means double-counting. *Subsidies have to be subtracted from the free trade value added* because this situation is characterized by a non-existence of protective measures.

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[18] The modified "unit" price, o_j^d, is derived by replacing in formula (9) the term $1+t_j$ by $1+t_j-s_j$ and t_i by $t_i - u_i$. The equation (9) has to be divided through out by

$$p_j^{df} = x_j^d \left[\frac{x_j^d}{x_j}\, p_j^d + \frac{x_j^f}{x_j}\, p_j^f\right], \text{ where } p_j^f = p_j^*\,(1-u_j).$$

The modified "unit price" of the foreign sector, o_j^f, is derived in similar fasion.

[19] Only lump-sum subsidies are investigated here. Subsidies in proportion to sales have to be treated in the same manner as tariffs.

With subsidies, excise taxes and export duties, formula (6) has to be modified as follows

$$(21)\quad 1 + ERP_j^{DF} = \frac{x_j^d p_j^d + x_j^f p_j^f + Z_j - x_j \sum_i \alpha_{ij} p_i}{\frac{x_j^d p_j^d}{1+t_j-s_j} + \frac{x_j^f p_j^f}{1-u_j} - x_j \sum_i \frac{\alpha_{ij} p_i}{1+t_i-u_i}}$$

where Z_j is the total amount of subsidies to the industry j. Dividing numerator and denominator by total sales $(x_j^d p_j^d + x_j^f p_j^f)$ yields

$$(22)\quad 1 + ERP_j^{DF} = \frac{1 + z_j - \sum_i a_{ij}}{\frac{d_j}{(1+t_j-s_j)} + \frac{(1-d_j)}{(1-u_j)} - \sum_i \frac{a_{ij}}{1+t_i-u_i}}$$

where z_j is the ratio of subsidies to total sales. Note that input costs have now to be related to gross production value [20] at producers' prices excluding subsidies in order to calculate the a_{ij}.

Since subsidies are granted to an industry irrespective of its export share it does not seem useful to integrate subsidies into the formulas of effective protection for domestic sales and sales abroad. If subsidies play a major role as protective instruments one should calculate three rates of effective protection, ERP^D ERP^F and ERP^{DF}.

Two Concepts of Effective Protection and the Concept of Domestic Resource Costs

So far it has been assumed that there are no non-traded inputs in traded goods. If there are, a certain aggregate product j will be produced by primary factors, traded and non-traded inputs. If the interest is in the protection of primary factors *directly* involved in industry j then a formula of the following type has to be employed[21]

$$(23)\quad 1 + ERP_j^D = \frac{o_j^d - \sum_i a_{ij} - \sum_n a_{nj}}{\frac{o_j^d}{1+t_j-s_j} - \sum_i \frac{a_{ij}}{1+t_i-u_i} - \sum_n \frac{a_{nj}}{1+t_n}}$$

where the a_{ij} are now the value input-coefficients of traded and the a_{nj} the value input-coefficients of non-traded goods. t_n denotes the price differentials of non-traded goods between the protection and the free trade situation.

[20]Throughout this article changes in inventories are dis-regarded for simplicity. Therefore, (gross) production values and total sales are used interchangeably.

[21]To avoid unnecessary repetitions the differences between the three concepts are demonstrated with the domestic sales' case.

On the other hand, where the focus is on the protection of the primary factors *directly and indirectly* involved in the production of j then from the output price only a part of the cost of non-traded inputs has to be substracted. This part consists of the traded inputs in the non-traded inputs.

$$(24)\quad 1 + CERP_j = \frac{o_j^d - \sum_i a_{ij} - \sum_i \sum_n a_{in}\, a_{nj}}{\dfrac{o_j^d}{1+t_j-s_j} - \sum_i \dfrac{a_{ij}}{1+t_i-u_i} - \sum_i \sum_n \dfrac{a_{in}\, a_{nj}}{1+t_i-u_i}}$$

where the a_{in} are the value coefficients of traded inputs in non-traded inputs of j.[22]

The former rate is called "Balassa rate" (ERP_j) and the latter the "Corden rate" ($CERP_j$).[23] The "Corden rate" shows the costs of primary factors which are directly and indirectly involved in the production of the aggregate product j relative to the opportunity costs. The opportunity costs are the corresponding free trade value added per unit of output.

Both measures are similar in as far as they measure the costs of primary factor use compared to opportunity costs, though on a different value added basis. Both measures have to be interpreted carefully because a high rate means either waste of domestic resources *and/or* super-normal profits and wages in one industry (ERP) or, alternatively, in several industries (CERP). An advantage of the ERP compared to the CERP can be seen in the fact that the ERP focusses on the primary factors of a certain well defined industry while the CERP does not. Hence it is not clear, for example, where inefficiencies or super-normal factor prices are located in the case of a high $CERP_j$. They may be with industry j or be with the main non-traded input industries. Another difference between these measures is that the CERP can hardly be interpreted as an incentive measure – as can be the ERP[24] – because it is not clear which industries enjoy the given benefits if the $CERP_j$ is high.[25] Therefore generally, the ERP is preferable to the Corden measure. If one is interested, however, in the costs of particular industries with all their implications, *i.e.* the direct and indirect costs which occur with the production of a certain commodity bundle, CERPs should be calculated, too.

The ex-post concept of domestic resource costs (DRC) comes in practice very close to the Corden measure of effective protection because it measures the costs of direct and indirect primary factor use compared to the free trade costs of importing the final product and thereby not using (direct and indirect) traded inputs. A formal difference is that the free trade costs are expressed in foreign currency units. Defining the exchange rate in the protection situation, r, as the

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[22]The value of non-traded good can be separated into the cost shares of traded inputs $\sum_i a_{in}$, non-traded inputs $\sum_m a_{mn}$ and value added a_{vn} where $\sum_i a_{in} + \sum_m a_{mn} + a_{vn} = 1$ for every n. In order to determine indirect traded inputs one has to divide also the a_{mn} into its three components and then the non-traded inputs in the a_{mn} and so on. To keep things simple, I assume that a_{mn} is small and the errors of not going back to previous stages of production negligible. Therefore the $\sum_m a_{mn}$ will be treated like a_{vn}. This assumption implies that $\sum_i \sum_n a_{in}\, a_{nj}$ is the total costs of indirect traded inputs.

[23]See for example Balassa and Associates [3, p. 17].

[24]*See* e.g. Ethier [10, pp. 17—43].

[25]As W. Ethier has shown on the basis of a neoclassical model, there exists no theoretical foundation for the CERP to be an indicator of changes in gross output. *See* Ethier [10, pp. 17—43].

domestic price of one unit of foreign currency, the DRC measure can easily be derived by multiplying the Corden measure with the exchange rate :

$$(25)\quad (1+CERP_j^D)\, r = \frac{o_j^d - \sum_i a_{ij} - \sum_i \sum_n a_{in}\, a_{nj}}{\left(\frac{o_j^d}{1+t_j-s_j} - \sum_i \frac{a_{ij}}{1+t_i-u_i} - \sum_i \sum_n \frac{a_{in}\, a_{nj}}{1+t_i-u_i}\right)\frac{1}{r}} = DRC_j^D$$

The denominator of the fraction in (25) expresses the free trade production costs in foreign currency. The numerator shows as before actual production costs in terms of domestic currency. If the $CERP_j$ is positive, the DRC_j is greater than the exchange rate and *vice versa*.

The appealing characteristic of the DRC rates is that they can be compared with the exchange rate. They indicate more clearly than the CERPs whether domestic resource costs are higher than the opportunity costs (DRC $>$ r) or not (DRC $<$ r). The exchange rate—if it is an equilibrium rate—represents the costs of a "dollar's" worth of imports and hence the opportunity costs of not producing locally[26]. The domestic rate, DRC_j^D, can be interpreted as domestic costs of a "dollar" saved and the export rate, DRC_j^F, as domestic costs of a "dollar" earned.

Aside from the fact that the DRC has some ex-ante significance in project evaluation the focus here will be exclusively on the theoretical differences between the ex-post DRC and the CERP—the latter being a pure ex-post measure. These differences are :[27]

> First, in the numerator of the DRC fraction the costs of direct and indirect primary factor use are priced at shadow prices (social opportunity costs) while in the CERP they are priced at their actual prices.
>
> Second, only domestic direct and indirect factor costs are regarded in the DRC while in the CERP no distinction is made between domestic and foreign primary factors.

To price primary factors at their social opportunity costs would be very useful in eliminating the ambiguity of the DRCs and ERPs. As stated above, high private rates do not allow an inference on any inefficiency because profits or wages may be higher than normal. Pricing at shadow prices would allow exact efficiency conclusions from the calculated rates. On the other hand, it is extremely difficult to estimate shadow prices. In addition, this pricing concept implies information on various quantities of physical primary inputs which have to be multiplied with the estimated shadow prices. Therefore, in the few empirical studies which have been published in the past actual prices rather than shadow prices have predominantly been used.[28]

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[26] Ideally the DRCs should not be compared with the actual exchange rate, be it an equilibrium rate or not, but with the free trade exchange rate because this is the rate which would prevail if all trade restrictions are abolished and factors could be allocated without distortions. Since the estimation of the free trade exchange rate is subject to a substantial amount of guesses and hence is very un-reliable, the average DRC of all traded goods can be taken instead. This average bears a close relationship to the percentage exchange rate change between the free trade and the protection situation under the condition that the protection exchange rate can be regarded as an equilibrium rate. *See* Hiemenz and Rabenau [16, pp. 66—71] and footnote 1.

[27] *See* Bruno [7, pp. 16 *sqq.*] and Krueger [18, pp. 48 *sqq.*].

[28] In her study on the economic costs of exchange control in Turkey, A. Krueger made no corrections for labour income. She used, however, capital stock data and rates of interest of 20% and 30% in place of private capital income. See Krueger [18, pp. 473—75]. A very similar correction of domestic production costs has been made by Taylor and Bacha in an article on trade distortions in Chile. *See* Taylor and Bacha [27, pp. 130—31]. Owing to the lack of data, no adjustment has been made in the domestic resource cost study on Spanish industries by Donges and Banerji [9, p. 38].

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The second point is on the ownership of primary factors. From a national point of view it seems legitimate to be concerned only with the efficient allocation of domestic primary factors. It can be argued, however, that foreign owned capital and foreign labour are, in an ex-post sense, part of the domestic resource base and should also be allocated efficiently to achieve low domestic prices and good growth prospects and should therefore not be excluded from the DRC calculations. Furthermore foreign labour will often be replaced when indigenous workers become skilled. Anyhow, if foreign factors, especially capital, are priced at competitive prices, as discussed above, the problem becomes minimal.

An interesting question to ask is what would be the outcome of the proposed deduction of the earnings of foreign factors from the domestic production costs (numerator) and the free trade value added (denominator) ?[29]

The outcome in a highly protected infant industry—and this is typical for developing countries—would be that the productivity of the domestic factors compared to the free trade value added would be lower (if not negative) than the average productivity of domestic and foreign factors. Despite the above objections this will provide interesting additional information for the measure of direct as well as direct plus indirect factor costs.

It should be emphasized, however, that present statistical data do not contain the relevant information to allow such detailed calculations. And this explains why up to now this difference has generally not been included in empirical calculations.[30]

To summarize, the Corden measure (CERP) is, in contrast to the Balassa measure (ERP), a measure of direct and indirect primary factor inputs. It has some disadvantages compared with the ERP as discussed above. The DRC measure which has been developed independently from the ERP concept and was applied in earlier times predominantly to (ex-ante) project evaluation resembles very much the Corden measure of effective protection. It is also concerned with direct and indirect primary factor inputs. One formal difference between these two measures is that the denominator of DRC is expressed in foreign currency units while in the CERP all values are expressed in domestic currency. If this would be the only difference, both measures are proportionate to each other. In practice, that often is the only difference. In theory, however, domestic resource costs should be priced at shadow prices and should not include the earnings of foreign capital or labour.

Both claims are justified. Pricing the primary factor inputs at competitive prices would turn the DRC as well as the ERP into a strong efficiency measure. Because of inadequate statistical data on physical primary factor inputs and the formidable difficulties in estimating shadow prices this claim has only been partly fulfilled in empirical investigations. Limiting the primary factor use to exclusively domestically owned factors would yield useful supplementary information for ERP as well as DRC computations. Here again the lack of information on foreign owned capital, profits, and salaries of foreign experts etc. have up to now undermined the importance of this approach.

Non-traded Inputs

In this section we will be concerned with the determination of the deflator of non-traded goods, t_n. If traded parts of non-traded inputs are treated like direct

[29]*See* Krueger [19, pp. 55-56].

[30]The only empirical study I know of wherein an attempt has been made is that by Taylor and Bacha. In their study foreign *produced* capital goods—yielding a normal rate of interest—are treated like intermediate imports. *See* Taylor and Bacha [27, pp. 130-31].

traded inputs and if no price changes of direct and indirect primary inputs in non-traded inputs are assumed, equation (23) becomes

$$(26)\quad 1+ERP_j^D = \frac{o_j^d - \sum_i a_{ij} - \sum_n a_{nj}}{\frac{o_j^d}{1+t_j-s_j} - \sum_i \frac{a_{ij}}{1+t_i-u_i} - \sum_{in}\sum \frac{a_{in}a_{nj}}{1+t_i-u_i} - \sum_n (1-\sum_i a_{in}) a_{nj}}$$

This formula is very unsatisfactory from a theoretical point of view because of the assumption of constant primary factor prices within the non-traded goods industries—which is equivalent to an infinite elastic supply of primary factors—in contrast to a finite eleastic supply of primary factors within the traded goods industries. It is more realistic to assume that the prices of primary factors within the non-traded goods industries rise on average by the same percentage as in the traded goods industries because of substitutability between factors and factor price equalizing competition in the factor markets. This assumption is reflected by a formula which deflates the costs of primary factors producing non-traded inputs by the average price increase of primary factors within the traded goods industries, $1+\bar{E}$.[31]

$$(27)\quad 1+ERP_j^D = \frac{o_j^d - \sum_i a_{ij} - \sum_n a_{nj}}{\frac{o_j^d}{1+t_j-s_j} - \sum \frac{a_{ij}}{1+t_i-u_i} - \sum_{in}\sum \frac{a_{in}a_{nj}}{1+t_i-u_i} - \sum_n (1-\sum_i a_{in}) \frac{a_{nj}}{1+\bar{E}}}$$

where $1+\bar{E}$ is a weighed average of $1+ERP_j^D$ and $1+ERP_j^F$ for all industries producing traded goods. The weights are total free trade value added of the respective parts of the industries.[32] Though the ERP formulas proposed here differ, this method of treating non-traded goods is identical with the proposal of Little, Scitovsky and Scott [24, p. 432] which to date has remained rather unnoticed in the ERP literature.

The corresponding ERP for exports is

$$(28)\quad 1+ERP^F = \frac{o_j^f - \sum_i a_{ij} - \sum_n a_{nj}}{\frac{o_j^f}{1-u_j} - \sum_i \frac{a_{ij}}{1+t_i-u_i} - \sum_{in}\sum \frac{a_{in}\, a_{nj}}{1+t_i-u_i} - \sum_n (1-\sum_i a_{in}) \frac{a_{nj}}{1+\bar{E}}}$$

Concluding Remarks on the Final Computation Formulas (27) and (28)

Formulas (27) and (28) show how effective rates of protection should be calculated if the usual protective and discriminating measures are in existence. The protection for domestic sales and exports is treated separately because separate protective measures apply to them and because a formula that combines the protection for domestic sales and exports gives no information on questions concern-

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31The calculation of ERPs will be an iterative process because every set of results will change $\bar{E}$ hence invalidating this set of results. Since the changes of $\bar{E}$ and the ERPs become small very quickly it is sufficient to finish the process of computations after the first round.

32Note that $V_j^* = V_j/(1 + ERP_j)$. $V_j^{DF} = V_j^D + V_j^F =$

$$= x_j^d p_j^d - d_j^* x_j (\sum_i a_{ij} + \sum_n a_{n_j}) + x_j^f p_j^f - (1-d_j^*) x_j (\sum_i a_{ij} + \sum_n a_{n_j}).$$

Therefore $V_j^{D*} = V_j^D/(1 + ERP_j^D)$ and $V_j^{F*} = V_j^F/(1 + ERP_j^F)$.

ing import substitution and export performance of an industry. It is possible, however, to combine the two rates into an industry average. Both rates are calculated with the same set of input-coefficients. Therefore the usual domestic unit prices are replaced by modified "unit" prices, o_j^d and o_j^f without this modification the results would be biased. For sake of international comparability of results one set of ERPs should be based on gross value added. In this case the input-coefficients do not reflect the depreciation of capital goods. Value added per unit of output is shown in (27) and (28) net of indirect taxes. The costs of non-traded inputs in commodity bundle j are divided into the costs of their traded inputs and the costs of their non-traded inputs plus their value added. The free trade costs of the first are derived by dividing by $1+t_i-u_i$. This procedure does not differ from the treatment of direct traded inputs. The free trade costs of the second are derived by deflating with $1+\bar{E}$, where $\bar{E}$ is the average ERP of all industries producing traded goods.

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