

A NEW INDEX TO EVALUATE THE EFFECTIVE PROTECTION: AN APPLICATION IN A CGE CONTEXT

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7th Annual Conference on Global Economic Analysis

Trade, Poverty, and the Environment

June 17 - 19, 2004

Washington, D.C., United States

Keywords: Protection, Commercial policy, GTAP model, Agriculture in International trade,

JEL classification: F13, Q17, F17

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May 2004

Draft

1. Introduction

As it know, in spite of the Agreement on agriculture during the Uruguay Round, the level of protection in agricultural and food products trade among countries, in terms of tariffs, is still quite high (De Filippis, Salvatici, 2003). Market access, therefore, continues to be one of the major bone of contention within the World Trade Organization (WTO) negotiations on agriculture; countries with a comparative advantage in agriculture, as Cairns group, underline the fact that while trade of manufacturing goods has been liberalized, many OECD countries maintain restrictions on import of agricultural and food products. Furthermore, tariffs are generally higher on processed agricultural products than on primary commodities. Tariff escalation - which refers to the wedge between the tariff on a processed commodity and the one on the corresponding primary commodity – has been discussed in the round within the WTO as one of the major obstacles, for developing countries, to the establishment of processing industries and to the diversification of agricultural exports .

Negotiations on agriculture require measuring the degree of openness of agriculture markets. One measure gauging the effects of border policies is the effective protection rate (ERP). The ERP seeks to capture in a single figure support to productive factors resulting from a complex tariff structure. By including the price-distorting effects on intermediate inputs as well as on output, ERP provides a measure of the "net" effect of border policies.

Even if effective protection rate suffers from well known drawbacks, according to Anderson (1998) "Effective protection concept is the ranch house of trade policy construction – ugly but apparently too useful to disappear". In order to avoid the critiques that were brought to the index originally conceived by Corden (1971), Anderson defined a Distributional Effective Rate of Protection (DERP) for each sector j : the idea is to find the uniform tariff on all distorted goods affecting profits in j , which is equivalent to that of the initial tariff structure.

This work aims at computing the effective protection by this new method . In section 2 and 3 we present the analytical foundation of the DERP and describe the method followed (based on the Global Trade Analysis Project, GTAP, model). In section 4 we show the main results of the analysis, while the last section reports concluding remarks and next developments.

2. Market access and the effective protection¹

Tariffs are perhaps one of the market access issues which we have the most information on. Nevertheless, there are still considerable conceptual and practical problems for constructing synthetic and meaningful indicators of tariff barriers (Bureau, Salvatici, 2003).

Reducing tariff dispersion across commodities is an objective of several countries' market access reform proposal. Tariff dispersion presents two problems. First, non-uniform tariff introduce relative price distortions that can worsen the resource misallocation induced by tariffs. Second, there is concern, especially among developing countries, that tariff dispersion often takes the form of tariff escalation. The fact that the developed countries' tariff structures protect the market for processed products more than they protect the market for primary products is often seen as an obstacle for the industrial and economic development of developing countries (OECD, 1997)².

Given the large dispersion of tariffs across commodities, one question facing policy makers and negotiators is whether a single, aggregate indicator can be derived that compares the levels of agricultural tariff protection across countries.

The tariff wedge approach is the simplest measure of tariff escalation, and it is easy to operate since it relies on generally available data. However, this method has several limitations: nominal tariffs wedges do not fully represent the protection level caused by the tariff structure, and do not provide information about the impact of tariffs on the value added of processed products; secondly, since tariff wedges do not take into account the value added, they cannot be compared across commodities. Finally, the concept of tariff wedges can hardly be applied to production functions with multiple input and/or multiple output (J. Lindland, 1997).

These limitations can be overcome through the effective rate of protection, which focuses the attention on gross outputs of sectors, taking account of the role of intermediate inputs. If we are interested in a sector's total use of primary resources, gross output appears to be the appropriate concept to work with. Similarly to the measurement of net output protection, gross output protection can be defined as the proportional increase in the price of a sector's gross output relative to free trade. Since the economy's total value of gross output priced at value added per unit equals the total value of net output (valued at equilibrium prices), an appropriate price for gross output seems to be the *value-added per unit*. Accordingly, the effective rate of protection of industry i (ERP_i) measures the increase in industry's value added per unit of output under protection (V_j') as a percentage of the free trade value added per unit (V_j):

¹ This section, and the next one, are based on Antimiani, Conforti and Salvatici (2003).

$$(1) \quad {}^3 ERP_j = \frac{V'_j - V_j}{V_j}.$$

In terms of the possibility for the ERP to be a good predictors of gross outputs change, effective protection is a partial equilibrium index, that measures the impact of protection on the ability of sectors to compete with other industries in factors markets. Given the assumption of non-substitutability between imported inputs and domestic factors, one can conceive of the domestic factors as producing a value-added good in each activity, which is combined in fixed proportions with imported inputs in the manufacture of the final good. The relative prices of value-added goods will then depend on the structure of effective protective rates. The effective protective rates for an activity determines the price of its value-added good in precisely the same manner that the nominal rate determines the price of a final good when intermediate goods are not traded. It follows from the celebrated Stolper-Samuelson theorem that, if there are two activities, the levy of a tariff will pull resources toward the activity enjoying the higher effective protective rate. If there are more than two activities but the number of final goods and the number of domestic factors are equal, and constant returns to scale prevail in each activity, we can conclude that a tariff will pull resource toward the activities enjoying relatively high effective protective rates (Ramaswami, Srinivasan, 1971).

Although we have identified value-added per unit as a price of gross output, and have defined the ERP as the proportional divergence of this price from its free trade level, Ethier (1977) showed that the link between nominal rates and net outputs is not always equal to the link between effective rates and gross output. Moreover, a key assumption of the basic effective protection model is fixed coefficient or separability in the production function. If there is any substitutability between primary factors and intermediates, the computation of effective rates is biased (Anderson and Naya, 1969). If the value of intermediate inputs is close to the value of output when these values in domestic prices are converted into free trade prices, the effective rates approaches positive infinity, and then switch to negative infinity. Negative value added can be explained by inefficient inputs use in highly protected industries, but it is also likely to be the consequence of the fixed coefficient assumption. If the assumption of fixed physical input coefficients does not hold, free trade input-

² It must be underlined that for the high “value-added” products the competition, though market access, is often based on the marketing tools rather than on the prices. Furthermore, taking account of multinational enterprise and of foreign direct investments, for developing countries the competition on these products is something more than tariffs.

³ Another way to write the standard measure of ERP, is $ERP_j = \frac{T_j - \sum a_{ij}T_i}{1 - \sum a_{ij}}$, where T_j is the tariff on the final product and T_i

on the input; a_{ij} is the input cost-share coefficients. Effective rate can also be negative. For example, for a given rate of duty on outputs (T_j), which is lower than a given rate of duty on the inputs (T_i) then as the free trade input cost-share coefficients (a_{ij}) rises, the ERP declines and become negative, i.e., when, $T_j < (a_{ij} * T_i)$.

output coefficients must be inferred from the observed distorted coefficients. This is the approach followed by Bureau and Kalaitzandonakes (1995).

In general equilibrium, though, the prices of primary (non-produced) factors are endogenous, and the prices of (internationally) non-traded goods may change as well. The fundamental theoretical critique moved to the effective protection concept stems largely from concerns about drawing general equilibrium inferences from a partial equilibrium measure (Ethier, 1971, 1977; Davis, 1998). Even if the fixed coefficient assumption is met, as a matter of fact, ranking effective rates may not allow ranking percentage output changes: a non-prohibitive import tariff or export tax in partial equilibrium, for example, might become prohibitive in general equilibrium (Anderson, 1970; Bhagwati and Srinivasan, 1973). In other words, if we instead focus in the general equilibrium aspects of ERP analysis the main concern with the index problem is not that the calculated ERPs are biased, but that the bias varies across sectors, resulting in distortions in the ranking of ERPs. In this case, the ERP index does not necessarily work in predicting output shifts and the latter are of a greater interest in trade negotiations where an "effective protection index" may be thought of as replacing nominal tariffs in the future (Davis, 1998; Bhagwati, Srinivasan, 1973).

The development of the concept of effective protection may be seen as an attempt to define a 'price' system as a pure production concept - expressed in terms of nominal prices and input coefficient - making enough assumptions so that demand might be ignored, and imposing technological restrictions in order to obtain a simple measure. Due to the large number of heterogeneous tariff lines, the measurement of protection faces an index number problem. It is necessary to compute weighted averages of different components. Any trade policy has impacts in different dimensions (producer or consumer welfare, volume of trade, efficiency loss, rents, etc.); in order to be consistent with economic theory, the economic effects should provide the "weights" in the process of aggregation (Bureau, Salvatici, 2003).

Nowadays, the development of Computable General Equilibrium models implies that the rate of effective protection can be computed as a general equilibrium index summarizing all the model information (Stevens, 1996). Moreover, gross output is also relevant for income distribution, since the income of an industry-specific factor will be related to the overall level of activity of that industry, rather than the to production for final use. In this perspective, Anderson suggested an interesting new definition of the index: the *distributional effective rate of protection* (DERP), based on "the uniform tariff (on distorted goods) which is equivalent to the actual differentiated tariff structure in its effects on the rents to residual claimants in sector j".

Following Anderson, let v denote the fixed supply of primary factors which are mobile between sectors at price w , while let k denote the vector of sector specific factors, and let p is the domestic price vector. It is important to notice that the vector k is a convention, not necessarily associated with any measurable factor, which accounts for diminishing returns, and thus positive profits ($\Pi = \sum_j \pi_j$) which go to residual claimants.

The sum of payments to all factors is equal to gross domestic product function g , defined as

$$(2) \quad g(p, v, k) = \min_w \{w'v + \Pi(p, w, k)\}.$$

Drawing on the properties of the gross domestic product function we know that:

g_p = the vector of general equilibrium net (final) supply function;

g_v = the vector of competitive factor prices for intersectorally mobile factors;

g_k = the vector of the sector specific competitive factors returns (ad a proxy of the sectoral profit function).

The effective rate of protection $DERP^j$ of sector j in general equilibrium is defined as the uniform tariff which exert on the return to specific factor j an effect which is equivalent to the initial tariff structure. That is

$$(3) \quad DERP_j = 1/D_j - 1, \text{ where}$$

$$(4) \quad D_j(p^1; p^0, v, k) \rightarrow D_j \Big|_{g_k^j(p^1/D_j, v, k) = g_k^j(p^0, v, k)},$$

The function, D is the distance function applied in tariff distorted price space. Accordingly, D^j is the uniform output price deflator which maintains profits in j constant. Since D is equal to the inverse of a uniform tariff factor, $DERP^j$ is equal to the uniform tariff on distorted goods, which has the same effect on the profits of sector j as the initial tariff vector. This index rely on the idea that the entire tariff vector can be "summarized" by a single tariff that, if applied to the whole set of imports, would holds constant the income of a sector's fixed factor (thought, the profit of a sector) than the vector of heterogeneous tariffs.

In a special case, that of partial equilibrium with fixed coefficients of production, the formula implied by the new definition is identical to the usual effective rate of protection formula; with variable coefficients but still in partial equilibrium, the formula is a simple variant of the usual formula (Anderson, 1998).

Sector specific factor income changes are a product of two elements: the level of protection given to the sector (and this is what the old effective protection concept tried to measure) and the rate at which the level of protection is translated into sector-specific factor's income. Differences in income changes across sectors arise from the differences in both elements of the product, and the new concept gives a precise measure of the "level" of protection in this context. In other words, the

main difference refers to the concepts of effective protection and tariff escalation: these two concepts, even if correlated, are different because the former refers “only” to the tariffs, while the latter takes into account the structure of production. The traditional ERP captures only the tariff escalation, while the new index tries to compute all the effects on the production function arising from the tariff structure (Anderson, 1998).

The higher a sector's DERP, the higher the economy-wide costs associated with the protection afforded to the sector's fixed factor by the whole tariff schedule; a negative DERP provides the tariff equivalent of a negative effective protection (IATRC, 2001).

For a different political economy point of view, it could be interesting to link the effective protection and the sectoral output. The method showed by Anderson for the DERP can be used to construct a different index, *Output Effective Rate of Protection* (OERP), based on the uniform tariff on all distorted sectors which produces the same level of output, sector by sector, as does the initial differentiated tariff structure.

Using the previous metrics, where w price of mobile factor (w is function of the price vector p and of the fixed supply of primary factor v) and π profit function and according to Anderson we can write define DERP by the profit function π while its proxy g_k ,

$$(5) \quad D_j(p^1; p^0, w, v) \rightarrow D \left| \pi_j \left[p^1 / D_j, w(p^1 / D_j, v) \right] \right| = \pi_j^0(p^0, w^0),$$

By Hotelling's lemma we know that if profit function is differentiable at p and w , then,

$$(6) \quad \frac{\partial \pi(p, w)}{\partial p} = y(p, w).$$

So we can find the supply function just differentiate the profit function, that is, we can use the same method of DERP to construct OERP, changing the equivalence criteria and making use of the level of output.

Then,

$$(7) \quad OERP_j = 1 / D_j - 1$$

$$(8) \quad D_j(p^1; p^0, w) \rightarrow D \left| Y_j \left[p^1 / D_j, w(p^1 / D_j) \right] \right| = Y_j(p^0, w^0).$$

The OERP could be useful in analysis where we want look at how much the outputs of different sectors are affected by trade policy. It follows that, having the rank of OERP, a policy maker could be better plan an industrial developing strategy taking account of the tariffs schedule too (Antimiani, 2004). While DERP concerns with distribution changes OERP is rather focused on the output changes.

3. GTAP model and the new method

In this work we use the GTAP applied general equilibrium model (Hertel, 1997), which is a multi-region model built on a complete set of economic accounts and detailed inter-industry linkages for each of the economies represented. The model represents the global economy, including bilateral trade flows based on Armington hypothesis, and a global bank linking total savings to total investment. In each region, there is a representative agent who maximizes its own utility. Private demand is based on a Constant Difference of Elasticity functional form, while supply is based on a “production tree”: at the bottom of the inverted tree are the individual inputs demanded by the firm which purchase on one side, primary factors (with a Constant Elasticity of Substitution) and, on the other side, intermediate inputs (both domestic and foreign produced, with a Constant Elasticity of Substitution). Firms choose their optimal mix of primary factors (intermediate inputs) independently of the price of intermediate inputs (primary factors). Since the level of output is also irrelevant, due to the constant returns to scale assumption, the only argument in the firms’ conditional demand equation for components of value-added (of the costs due to intermediate input) is the relative prices of the primary factors (the intermediate inputs). By assuming this type of separability, the elasticity of substitution between any individual primary factor, on the one hand, and intermediate inputs, on the other, is equal. The GTAP production system, moreover, distinguishes sectors by their intensities in five primary production factors: land (agricultural sectors only) and natural resources (extractive sectors only), which are sluggish, and unskilled labor, skilled labor and capital, which are mobile across productive sectors.

The baseline of latest available version of the GTAP database (version 5) is 1997. Version 5 includes up to a maximum of 66 regions and 57 sectors (Dimaranan and McDougall, 2002). The tariffs come from the AMAD base data and are those bounded after the Uruguay Round.

As seen in the previous section, the definition of the DERP requires the "small country" assumption. As it was mentioned, in the GTAP model foreign trade is described according to an Armington specification, which implies endogenous world prices. If the vector p is a function of the tariff vector τ , equation (4) becomes:

$$(9) \quad D_j(p^1, p^0, v, k) \rightarrow D_j \left[g_k^j \left[p^1(\tau^1 / D_j), v, k \right] = g_k^j \left[p^0(\tau^0), v, k \right] \right]$$

This extension is already suggested in the original work by Anderson (1998), though it was not implemented in his analysis of US agriculture effective protection.

Like the DERP, we had to introduce the endogenous world prices for the OERP too; again, if the vector p is a function of the tariff vector τ , equation (6) becomes:

$$(10) \quad D_j(p^1; p^0, w) \rightarrow D_j \left[Y_j \left\{ p^1(\tau^1 / D_j), w \left[p^1(\tau^1 / D_j) \right] \right\} = Y_j \left\{ p^0(\tau^0), w^0 \left[p^0(\tau^0) \right] \right\} \right].$$

The model we use departs from the standard GTAP in two main respects. Firstly, in order to compute the DERP and OERP, we introduce a new variable $tr(j)$ defined as the power of a uniform (that is, product-generic as well as source-generic) *ad valorem* import tariff. Secondly, capital is moved from the set of mobile factors to the sluggish one. This allows us to set exogenously factor used by the sector for which we are computing the index, while for the rest of the economy capital is still mobile, since we set its elasticity of transformation parameter at a high level. In other words, this allows us to leave the capital factor mobile across sectors, like it is in the real economy, however it enables us to fix it in a specific sector in order to compute the index.

In order to compute the uniform tariff equivalent of the actual protection levels, the policy experiment requires the elimination of all existing tariffs and export subsidies. In this free-trade scenario, the new variable, $tr(j)$ is swapped with the capital endowment available to firms in the sector under consideration. In other words, to compute the DERP, we ask the model to compute the uniform tariff that would eliminate any incentives to reallocate the "fixed factor" to or from the sector for which we are computing the index. Similarly, for the OERP, we ask the model to compute the uniform tariff that would eliminate any incentives to change, up or down, the level of output of the sector for which we are computing the index.

In order to evaluate the ERP we use the model to simulate the free-trade for a single region, then we compute the value added for each sector in the to different scenarios, that is, with and without tariffs and subsidies⁴.

⁴ Stevens (Hertel, 1997) has developed a formula for calculating ERPs in the GTAP data base, based on a composite measure of import and export protection. In this work, anyway, we don't use this method, simulating the free-trade market for a single region. However, simulating a free-trade scenario, as we have done, due to the Armington hypothesis assumed in the model, could be lead to mislead the values of the ERPs (Devaranjan, Sussangkarn, 1992), so the results by ERP must be read carefully.

4. Experiment and results

In this section we show the results of three different analysis⁵. In the first, we compare the two different methods to compute effective protection, i.e. ERP with DERP/OERP. In the second experiment, we use the OERP to compare the level of effective protection of USA, EU, Mercosur and North Africa⁶. Finally, we use the OERP to show the effects of application of different proposals in actual WTO negotiations for USA and EU.

In all experiments we use the same sectoral and factorial aggregation, showed in table 1.

Tab. 1 - Sectoral and factorial aggregation used in GTAP

<i>Sectors</i>	<i>Endowments</i>
Paddy rice	Land (<i>sluggish; only for agricultural sectors</i>)
Rice	Natural Resource (<i>sluggish, only for extractive sectors and forestry</i>)
Cereals sector	Capital (<i>weakly mobile</i>)
Oil seeds	Skilled labor (<i>mobile</i>)
Vegetables oil and fats	Unskilled labor (<i>mobile</i>)
Sugar filière	
Livestock (<i>bovine, sheep, goats, horse, asses, mules and hinnies</i>)	
Meat (<i>bovine, sheep, goats, horse, asses, mules and hinnies</i>)	
Dairy filière	
Other primary	
Other sectors	

We choose these sectors because of their relevance for the trade of developing countries and consequently we are interested to evaluate the market access for these sectors of USA and EU. Beside, we left desegregated the sectors of rice, vegetables oil and fats and meat to better understand the effective protection in these filière.

(A) In tables 2 and 3, we show the results for USA and EU in terms of nominal rates, ERP and both DERP and OERP.

⁵ Signed, in the text, as A, B and C.

⁶ Here, in the Mercosur, as well as Argentina, Brazil, Paraguay and Uruguay, there are also Guyana and Suriname, due to the GTAP regional aggregation. Morocco, Algeria, Agypt, Libyan and Tunisia represent the North Africa area. We use OERP instead of DERP, because of its criteria of equivalence, focused on the levels of sectoral outputs rather than the distribution of the rents. Consequently it looks more appropriate when the objective of the analysis regard different regions.

Tab. 2 - Level of protection by different index in United States of America

	Nominal rate	ERP	DERP	OERP
Paddy rice	4,87	0,08	2,50	2,85
Rice	5,34	0,70	0,20	0,19
Cereals sector	1,40	0,67	0,39	0,64
Oil seeds	17,69	0,32	1,18	1,35
Vegetables oil and fats	4,27	0,32	3,35	3,36
Sugar filière	53,13	28,12	90,79	85,43
Livestock*	1,07	0,76	(-)	-0,27
Meat*	5,29	0,76	-3,59	-3,69
Dairy filière	41,38	3,92	151,66	105,71

Source: Base data of GTAP, version 5.0, 1997

*Bovine, sheep, goats, horse, asses, mules and hinnies

(-) Lack of solution

For USA, both looking to ERP and DERP the effective protection for food and agricultural sectors is, on average, lower than the nominal protection. At same time, nevertheless, the ranking, as well as the level of effective protection, it's different if we look at the ERP or DERP. While paddy rice, using the ERP, it's the lowest effective protected sector, turning to DERP it receives a protection about 2,5%, quite higher than rice sector even if the nominal tariff is similar, respectively, 4,9% and 5,3%. One more example could be the oil seeds and vegetables and oil sectors. In this case, the ERP index gives exactly the same level of protection for both of them, while nominal rates are appreciably different with oil seeds sector that receives a higher nominal protection. Looking at the DERP index, not only the levels of effective protection are different but DERP is higher for vegetables oil and fats than for oil seeds.

Furthermore, looking at sugar and dairy filière we can see that nominal protection is higher than the effective one if we use ERP while it's lower looking at DERP. Finally, for the meat sector, DERP shows a “negative effective protection”, i.e., the sector is taxed by the actual tariff structure.

All these “conflicting” results should be explained referring to the theoretical difference between the two methods. According to Anderson (1998), “how much protection is given” and “how much does income change as result” are distinct and ERP measures only the first, i.e., *tariff escalation*. By ERP we capture “only” the effect of tariffs along the filière and not all the linkages among sectors which represents the idea behind the concept of effective protection: highly protected sectors (in terms of effective rates) are able to bid up

wages, land and other inputs thus affecting the cost of other sectors⁷. The new concept, DERP and OERP, gives an exact measure of the level of protection in this context and so, by these new indexes, analysts can take the rates of effective protection as the main point of reference about resource allocation.

In table 3 we see the levels of protection, by nominal rates, ERP and DERP/OERP for EU.

Tab. 3 - Level of protection by different index in European Union

	Nominal rate	ERP	DERP	OERP
Paddy rice	64,93	111,36	144,83	146,25
Rice	87,38	70,27	198,00	197,54
Cereals sector	49,67	18,93	(-)	(-)
Oil seeds	0,00	1,99	-1,79	-3,43
Vegetables oil and fats	11,41	4,24	38,45	38,23
Sugar filière	77,48	43,69	(-)	(-)
Livestock*	36,62	23,76	173,13	191,22
Meat*	88,94	25,31	215,40	212,56
Dairy filière	84,19	16,66	(-)	(-)

Source: Base data of GTAP, version 5.0, 1997

*Bovine, sheep, goats, horse, asses, mules and hinnies

(-) Lack of solution

For USA, DERP gives both different ranking and level of protection with respect to nominal rates and ERP. The European oil seeds sector, which hasn't nominal protection structure, turn out to be taxed looking at DERP while is slightly protected by ERP. In the EU, by DERP, most protected sectors are meat, rice and livestock while ERP gives different ranking where on the top there are paddy rice, rice and sugar.

In both the tables we also computed the OERP. In the EU experiment we don't find any appreciable difference between OERP and DERP whether looking at the ranking or at the absolute levels. For USA, by OERP, sugar and dairy sectors appear to be more protected in terms of rent of specific factor than of level of output.

- (B) In table 4 we show the levels of effective protection, computed by OERP, of four different areas, USA, EU, Mercosur and North Africa.

⁷ For example, we have a filière, X, with different stages of production and tariffs which are increasing from raw materials to final product. At same time, tariff system also affects the cost structure of a sector who supplies a semi-finished products, Y, to X. No tariffs are applied on Y. In this case it's quite clear that *tariff escalation* and effective protection are distinct and therefore, ERP and DERP or OERP are distinct measurements of the protection too, i.e., DERP and OERP include ERP.

Tab. 4 - Levels of effective protection, by OERP, in different regions

	USA	EU	Mercosur ⁽¹⁾	North Africa ⁽²⁾
Paddy rice	2,85	146,25	10,60	90,00
Rice	0,19	197,54	(-)	75,30
Cereals sector	0,64	(-)	4,46	19,05
Oil seeds	1,35	-3,43	29,62	33,34
Vegetables oil and fats	3,36	38,23	17,33	85,25
Sugar filière	85,43	(-)	38,19	56,82
Livestock*	-0,27	191,22	14,31	(-)
Meat*	-3,69	212,56	12,83	79,42
Dairy filière	105,71	(-)	(-)	47,98

Source: Base data of GTAP, version 5.0, 1997

⁽¹⁾ Due to the base data, in the Mercosur area, there are also Guyana and Suriname

⁽²⁾ Morocco, Algeria, Agypt, Libyan and Tunisia

*Bovine, sheep, goats, horse, asses, mules and hinnies

(-) Lack of solution

In terms of OERP, almost all sectors appear to be higher protected in the EU than in other areas. The effective protection of meat, rice and livestock is nearly to 200%. Sugar and dairy products are highly protected in the USA, which is the region with the lowest rates for all other sectors, with livestock and meat taxed by the actual tariff structure.

For all sectors, it has to be noted that the effective protection of North Africa is higher than the one of Mercosur; especially for paddy rice, sugar and meat the level of protection in North Africa is quite high: nearly to 80% for meat and up to this level for sugar and paddy rice. Furthermore, even if we are computing the index about bounded tariffs rather than applied it's worth noting that sometimes effective protection, which includes *tariff escalation*, it's higher in a developing area than in a developed region. In the Mercosur, oil seeds, which represents a relevant production for this area, shows a value of OERP higher than the one of USA and of EU (where this sector it's taxed).

- (C) In the last experiment we look at the effects, in USA and EU, of the impact of different proposal within WTO negotiations. For USA, we simulate a reduction of tariffs applying the “Swiss formula”⁸ (25% as coefficient) together with, and without, a cut of 50% in domestic support⁹. For EU, we apply the Uruguay approach with a uniform cut of 36% together with a 100% or 50% of reduction of export subsidies¹⁰.

⁸ $T_f = \frac{aT_i}{a + T_i}$, where T_f is the tariff after the application of the formula, a is the “negotiated” coefficient of reduction and T_i is the

initial tariff. We apply the formula with $a=25\%$, as proposed by the USA in the present negotiations (Bureau, Salvatici, 2003).

⁹ In the experiment we have reduced the tax/subsidies to inputs and outputs. It's interesting to look at when the effective protection due to tariffs is quite low as it's the case of USA.

¹⁰ In this case we apply this approach, uphold by EU, with a different scenario with respect of the subsidies because of their levels in the Common Agricultural Policy (CAP).

Tab. 5 - Levels of effective protection, by OERP, in United States of America*, (1997)

	OERP	OERP _{swiss formula}	OERP _{swiss formula + cut of domestic support}
Paddy rice	2,85	2,35	5,54
Rice	0,19	0,98	-1,99
Cereals sector	0,64	2,38	-26,23
Oil seeds	1,35	1,58	9,43
Vegetables oil and fats	3,36	1,54	12,25
Sugar filière	85,43	24,99	19,05
Livestock**	-0,27	-0,29	22,32
Meat**	-3,69	-2,48	-19,53
Dairy filière	105,71	23,15	33,34

Source: our experiment on the base data of GTAP, version 5.0, 1997

*In the swiss formula the coefficient is equal to 25%.

**Bovine, sheep, goats, horse, asses, mules and hinnies

(-) Lack of solution

In the USA (table 5), the application of the “swiss formula”, with a coefficient of 25%, lead to different results among sectors. In terms of effective protection, the application of the formula means a reduction for paddy rice, vegetables oil and fats, sugar and dairy products. Viceversa, for rice, cereals and oil seeds we have a rise in effective protection.

In the second experiment, application of swiss formula on tariffs and 50% reduction in domestic support, we have different results. For sugar and dairy products there is a reduction of the effective protection while it increases for oil seeds, vegetables oil and fats, paddy rice and livestock. Cereals, rice and meat become taxed sectors. For cereals it could be explained by a high level of domestic support while for rice and meat it could be consistent with the increase of OERP in sectors supplying them, i.e., paddy rice and livestock¹¹.

In table 6 we show the results, for the EU, of the application of a 36% not weighted average reduction¹² together with zero export subsidies and with a reduction by 50% of the actual levels.

¹¹ Higher OERP, smaller the “hypothetical free trade” sectoral output and so higher price of inputs (when output is the input for other sectors).

¹² In this experiment we simplify the approach, cutting by 36% the level of tariffs of aggregated sectors.

Tab. 6 - Levels of effective protection, by OERP, in EU*, (1997)

	OERP	OERP ^{Uruguay approach +}	
		100% cut of subsidies	50% cut of subsidies
Paddy rice		146,25	97,82
Rice		197,54	135,05
Cereals sector	(-)	(-)	(-)
Oil seeds	-3,43	-3,24	-3,99
Vegetables oil and fats	38,23	20,61	20,32
Sugar filière	(-)	(-)	(-)
Livestock**	191,22	122,52	129,84
Meat**	212,56	136,29	145,49
Dairy filière	(-)	(-)	(-)

Source: our experiment on the base data of GTAP, version 5.0, 1997

*In the Uruguay approach a linear reduction of 36% is applied

**Bovine, sheep, goats, horse, asses, mules and hinnies

(-) Lack of solution

For paddy rice, rice, livestock and meat, the reduction in terms of nominal tariffs leads to a significant decrease of effective protection. In the second experiment, the smaller reduction of export subsidies do not imply any important difference on the level of the OERP with respect to the hypothesis of 100% reduction in export subsidies. It should mean that the sectoral effective protection in the EU depend, as partially expected, on the tariffs rather than export subsidies¹³.

¹³ This result is quite interesting given that in WTO negotiations EU export subsidies represent a bone of contention (using nominal rates!).

5. Concluding remarks

This paper attempted to measure the effective protection by a new methodology with respect to the one introduced by Corden (1971). The DERP, proposed by Anderson (1998), is defined as the uniform tariff which has the same impact on the profit of the sector as the actual tariff structure. Moreover, following the indication by Anderson we use the same approach to construct the OERP, based on the uniform tariff on all distorted sectors which produces the same level of sectoral output as does the initial differentiated tariff structure. We computed both the indexes with a global CGE model, the GTAP, by removing the “small country” assumption underlying the original application by Anderson to the US agriculture.

Despite our results are still preliminary and should be used with caution, they show that the old and new concepts of effective protection give rather different pictures of the pattern of protection afforded to sectors of actual tariff structure. ERP and DERP or OERP are not correlated like it is in the work by Anderson; further, the absolute values, and in some case also the signs, differ significantly. Consequently the DERP and OERP leads to a reconsideration of the ranking of effective protection across different sectors.

It will be interesting in the future to use the new method to rank the effective protection given to a sector, among several countries taking part in a specific custom union to show the different national levels of protection, for each sector, granted from the same trade policy. Besides, it should also be interesting for a bilateral trade policy analysis to update the tariffs from “bounded” to “applied” in order to compute a “bilateral” effective protection rates.

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