

Differential export taxes along the oilseeds value chain: a partial equilibrium analysis

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LAREFI Working Paper N°2013-03

Janvier 2013

<http://lare-efi.u-bordeaux4.fr>

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Sommaire

1. Introduction.....	7
2. Stylized theoretical model on DET and tariff escalation.....	10
3. A partial equilibrium model of the oilseeds sector.....	17
3.1 The oilseed sector and the export tax structure in Argentina, Indonesia and Ukraine...	17
3.2 A Partial Equilibrium Model of the Oilseed Sector.....	19
3.3 Simulation Results.....	24
4. Concluding Remarks.....	34
5. References.....	36

List of table

Table 1.	Export taxes applied at benchmark (percent)	23
Table 2.	Import duties applied at benchmark (percent).....	23
Table 3.	Net exports at benchmark, in thousand metric tons.....	24
Table 4.	Impact of export tax elimination in Argentina, Indonesia and Ukraine on domestic and international prices, percentage change – Scenario S1	25
Table 5.	Impact of export tax elimination in Argentina, Indonesia and Ukraine on production, percentage change – Scenario S1	26
Table 6.	Variation in consumer and producer surpluses, and public revenues from removal of export taxes in Argentina, Indonesia and Ukraine (USD millions) – Scenario S1	28
Table 7.	Variation in domestic and international prices from removal of import duties in the EU and the US (in percent) – Scenario 2.....	31
Table 8.	Variation in production from removal of import duties in the EU and the US (percent) - scenario S2.....	31
Table 9.	Variation in consumer and producer surpluses, and public revenues from removal of import duties in the EU and the US (USD millions) - scenario S2.....	32
Table 10.	Impact on domestic production of elimination of DETs in Argentina, Indonesia and Ukraine, and of import duties in EU and US - percent change.....	34

List of figure

Figure 1 An illustration of the impact of tariff escalation and DET 16

Abstract

This paper studies the implementation of Differential Export Tax (DET) rates along value chains, in particular in the oilseeds chain (seeds/vegetable oils/biodiesel): this trade policy consists in relatively high export taxes on raw commodities and relatively low taxes on processed goods. This policy may generate public revenues and benefit final consumption by lowering domestic prices of vegetable oils and biodiesel, and also promotes production at more processed stages of transformation, particularly in response to tariff escalation by importing partners. We first study the theoretical justification of this trade policy with a simple international trade model. It shows how implementing a tax on exports of raw agricultural commodity in a country exporting seeds and vegetable oils, augments the sum of profits and final consumers' surplus in the processing sector, of farmers' surplus, and of public revenues. Then we develop a world partial equilibrium model of the oilseed value chain that illustrates these theoretical conclusions. We simulate: (i) the elimination of DETs in Argentina, Indonesia and Ukraine; (ii) the elimination of import tariffs applied by the EU and the US on the same goods; (iii) the elimination of DETs in Argentina, Indonesia and Ukraine and of import tariffs applied by the EU and the US. According to our estimates, both consumers and producers throughout the world benefit from the removal of export taxes in these value chains, respectively 931 million USD and 2.2 billion USD. The third scenario leads to a significant expansion of world production of all activities along the value chain, including the production of biodiesel for which world output would expand by one percent.

Keywords: export tax, tariff escalation, oilseeds, partial equilibrium model

JEL classification: F13, F14, F15

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1. Introduction

Export taxes are a trade policy applied by many countries. According to Piermartini (2004), one third of World Trade Organization (WTO) countries imposed some type of export tax in 2003. OECD (2010) concludes that the number of WTO countries which apply export taxes is increasing: on the 2003-2009 period, 65 amongst 128 WTO members have implemented export taxes, in particular on raw commodities. As the main effect of this policy is a decrease in the domestic price of the good in the country applying the export tax (Bouet and Laborde, 2012), this policy is usually applied for food security purposes. Other justifications include terms of trade improvement, income redistribution, increase in public revenue and response to tariff escalation in developed countries (Piermartini, 2004; Kim, 2010). Indeed, tariff escalation, defined as a situation where import duties increase as a product becomes more processed, results in higher “effective protection” (Corden, 1971) given to transforming stages of the value chain and tends to favor processing industries in developed countries when applied in these countries. Tariff escalation in developed countries also tends to increase developing countries’ specialization in unprocessed primary commodities (Piermartini, 2004). As a response to this policy, some developing countries choose to apply decreasing export tax rates along production value chains in order to promote production at more processed stages of the value chain. This tax system is sometimes referred to as Differential Export Taxes (DET).¹

However, even when these countries might be successful in promoting value added at more processed stages of the value chain, these policies might harm producers at less processed stages and also affect, positively or negatively, producers and consumers in the rest of the world, as international prices of goods increase when the country imposing an export tax is a major exporter. Nowadays, we observe this kind of export tax structure applied in several countries along the oilseeds value chain which is characterized by three important stages of transformation: production

¹ The terminology “decreasing export taxes” would be more precise.

of seeds or beans (first stage), production of oils and meals from crushed seeds (second stage), and production of biodiesel (third stage). Examples of countries applying DETs in this sector are Argentina (soybean complex), Indonesia (palm oil) and Ukraine (sunflower seeds).² On the contrary the European Union and the United States apply tariff escalation with zero import tariffs on seeds and positive import duties on vegetable oils.

In spite of their importance, export taxes have not received much attention in the economic literature. By restricting its exports of a particular commodity, a country that supplies a significant share of the world market can raise the world price of that commodity. This implies an improvement in this country's terms of trade. The reasoning behind this argument is very similar to the optimum tariff argument (Bickerdike, 1906; Johnson, 1953). Export taxes on primary commodities (especially unprocessed ones) work as an indirect subsidy to higher-value-added manufacturing or processing industries by lowering the domestic price of inputs compared to their world—non-distorted—price. This justification follows reasoning similar to the theory of effective protection, as noted by Corden (1971). Eaton and Grossman (1986) study the use of export taxes, focusing more on the profit-shifting argument and less on the terms-of-trade argument. Rodrik (1989) derives an optimal tax structure, with taxes differentiated by domestic exporting firms, and shows that the level of these taxes depends on foreign demand elasticity and the size distribution of firms. Bernhofen (1997) investigates strategic export intervention in a final-good industry which uses an intermediate good supplied by a foreign monopolist and concludes that an export tax-cum-subsidy leads to horizontal and vertical rent extraction. Piermartini (2004), but also Mitra and Josling (2009) and Kim (2010) provide good overviews of theoretical developments and empirical assessments of the use of export taxes. Deardorff and Rajaraman (2005) explores the implications for trade policy of buyer concentration in markets for primary commodity exports of developing countries and show that the best available policy for the exporting country may be to tax exports so as to extract some of the

² The list of countries applying export taxes on the oilseeds chain is larger. However, as they only apply on one product, we will not consider them in the analysis. For example, Malaysia has a long tradition of taxing exports of palm oils.

profits of the monopsonist. Bouet and Laborde (2012) assess the rationales for export taxes in the context of a food crisis. They show that when world food prices spike, both the implementation of new export restrictions and the reduction of import tariffs on agricultural commodities exacerbate the increase in world prices and harm small net food-importing countries. Bouet, Estrades and Laborde (2012) evaluate the impact of export taxes on global welfare for all sectors using the MIRAGE model of the world economy and find that disciplines on export taxes should be of interest for policy makers all around the world: their removal increases global welfare by 0.23 percent, a larger figure than expected gains from the Doha Round.

To the best of our knowledge, Differential Export Taxes (DET) have not been systematically studied. The objective of this paper is to provide an understanding of the implications of a DET by developing countries. In particular we consider the case of DET implemented as a response to tariff escalation in developed countries.³ We study both the domestic and international consequences of these policies.

We first develop a stylized theoretical model to understand the detailed impact of these policies and to evaluate their rationales. The model shows that implementing a tax on exports of raw agricultural commodity in a developing country is a rational response to tariff escalation in the developed country when the objective of the government is the sum of profits in the processing sector, farmers' surplus, final consumers' surplus in the processed sector and public revenues.

Second we design a calibrated partial equilibrium model that incorporates ten countries/regions, three production stages (seeds, oils and meals, and biodiesel) and four types of seeds (soybeans, sunflower, palm nuts and rapeseed). We simulate the elimination of DETs along the production chain in three countries: Argentina, Indonesia and Ukraine. We focus on the changes in the production structure that such export tax removal implies and on the changes in consumers' surplus. We also simulate the elimination of import tariffs applied by developed countries (European

³ In fact we study the implementation of DET in countries with comparative advantage in raw agricultural commodities and exporting these products to countries which implement tariff escalation in order to support processing industries. Therefore it is more general that the simple opposition developed/developing countries. However the last denomination is simple to use.

Union, the US) on the same goods. This exercise is important to evaluate the international costs and benefits of export taxation. It is also relevant in order to evaluate to what extent a policy of DET is a valid argument against tariff escalation. Even when there are some previous assessments at a country level (Amiruddin 2003; Costa *et al.*, 2009) this is the first global assessment of the effects of export taxation on the oilseeds complex. To the best of our knowledge, this is also the first time that the validity of DET as a policy against tariff escalation in trading partners is examined.

The remainder of the paper is as follows. In section 2 we introduce a stylized theoretical model that provides general conclusions about DET and tariff escalation. In section 3 we give a short overview of the oilseed sector and of the export tax structure applied in Argentina, Indonesia and Ukraine, then we present the partial equilibrium model calibrated on the oilseeds sector, before commenting results from three policy shocks. Finally section 4 gives concluding remarks.

2. Stylized theoretical model on DET and tariff escalation

In this section we develop a simple theoretical partial model with two sectors (a raw agricultural commodity and a manufactured good using the raw agricultural commodity as an input) and two countries (a developed country implementing tariff escalation on imports and a developing country implementing a DET).

Let us suppose an international (Cournot) duopoly offering a homogenous manufactured good (let us have in mind vegetable oils) with two firms, one firm being in country 1 (developed country) producing and offering this processed good on its domestic market in quantity x , and one firm being in country 2 producing and offering this processed good on its domestic market in quantity z , but also exporting quantity y to country 1's market.⁴ Total supply of vegetable oils on

⁴ This asymmetric configuration is justified if we consider different demand and supply capacities in countries 1 and 2 such that farmers and manufacturers from country 1 cannot export. We have in mind the vegetable oils sector with country 1 being a very rich country like the European Union or the United States and country 2 an emerging country like Argentina, Indonesia or Ukraine. In the rich country, the vegetable oils market is much larger than the emerging one. Of course this configuration explains why an import tax on vegetable oils in the rich market gives more market share and profits to the domestic firm: it is a profit-extracting strategic trade policy. Another theoretical setting is possible with segmented markets and scale economies: protecting the

country 1's market is $X=x+y$ and inverse demand function is $p=p(X)$ with p the demand price and $p'<0$. Supply of vegetable oil on country 2's market is z and inverse demand function is $q=q(z)$ with q the demand price and $q'<0$. Imports y of vegetable oils by country 1 may be taxed with a specific tariff t_1 . There is no transportation cost of this manufactured good.⁵

Production of vegetable oils requires the intermediate consumption of a raw agricultural commodity (let us have in mind soy) that for simplicity we suppose the unique cost of production in the vegetable oils industry. This is a Leontief technology and units of the agricultural commodity are chosen such that one unit of vegetable oils requires one unit of soy. There is no fixed cost. There is no tax on imports of soy in country 1. The vegetable oils industry is the unique demand for soy.⁶ Therefore world demand for soy is $x+z+y$.⁷

Concerning the raw agricultural commodity, supply comes from both countries in quantities s_i for country i , $i=1,2$. Competition is perfect in this sector in both countries. Demands and supply capacities, and also comparative advantage, are such that country 2 exports soy to country 1. Country 2 may tax exports of soy with a specific tax t_2 . There is no tax on exports of vegetable oils in country 2. Let us call w the world price of soy. In the absence of import tax in country 1 and other transaction costs, w is also country 1's domestic price. The implementation of an export tax on soy in country 2 implies that country 2's domestic price of soy is: $w - t_2$. Supplies of soy are expressed as: $s_1 = w$ and $s_2 = \alpha(w - t_2)$. Since $\alpha > 1$, country 2's offer is larger than country 1's offer when no export tax is levied. We justify this assumption by a comparative advantage of country 2 in the supply of this raw agricultural commodity.

home market can improve the competitiveness of the domestic firm and increases its market share, not only in the domestic country, but also in foreign countries. It would follow Krugman (1984)'s theoretical model.

⁵ It is easy to generalize to a case with transportation cost, for example of iceberg type.

⁶ If we consider other potential use, either as final demand or intermediate demand, then it adds another rationale for imposing a tax on the developing country's exports of this raw agricultural commodity since this tax reduces the domestic price of this commodity. We study this rationale in the second part of this paper.

⁷ Considering that the vegetable oil industry is a duopoly while the soy sector is under perfect competition we should envisage the anticipation by each vegetable oil duopolistic firm of the impact of a variation of its input demand on world price of soy. However first it would significantly complicate the resolution of this model in particular since the optimal level of x and y would depend on z ; second we just intend to illustrate our partial equilibrium model calibrated on the oilseeds sector and this assumption does not exist in this calibrated model. Further theoretical research will include this element.

Consequently in this simple theoretical setting, tariff escalation is implemented in country 1 if $t_1 > 0$, while a DET is applied in country 2 if $t_2 > 0$.⁸ In the vegetable oils sector, profits are π_1 for country 1's firm and π_2 for country 2's firm with:

$$\pi_1 = xp(x + y) - wx \quad (1)$$

$$\pi_2 = yp(x + y) + zq(z) - (w - t_2)(z + y) - t_1y \quad (2)$$

Maximization of profits on x for country 1's firm and on y and z for country 2's firm leads to:⁹

$$\pi_{1x} = \frac{\partial \pi_1}{\partial x} = 0 = xp' + p - w \quad (3)$$

$$\pi_{2y} = \frac{\partial \pi_2}{\partial y} = 0 = yp' + p - (w - t_2) - t_1 \quad (4)$$

$$\pi_{2z} = \frac{\partial \pi_2}{\partial z} = 0 = zq' + q - (w - t_2) \quad (5)$$

Let us study the impact of a change in import duty t_1 on supplies x , y and z . Total differentiation of first order conditions brings:

$$\pi_{1xx}dx + \pi_{1xy}dy + \pi_{1xt_1}dt_1 = 0 \quad (6)$$

$$\pi_{2yx}dx + \pi_{2yy}dy + \pi_{2yt_1}dt_1 = 0$$

Let us call $\Delta = \pi_{1xx}\pi_{2yy} - \pi_{1xy}\pi_{2yx} > 0$. Since $\pi_{1xt_1} = 0$ and $\pi_{2yt_1} = -1$, we get:

$$\frac{dx}{dt_1} = \frac{-\pi_{1xy}}{\Delta} > 0 \quad (7)$$

$$\frac{dy}{dt_1} = \frac{\pi_{1xx}}{\Delta} < 0 \quad (8)$$

Thanks to (6) we know that: $x_{t_1} + y_{t_1} < 0$. Therefore: $\frac{dp}{dt_1} = p'(x_{t_1} + y_{t_1}) > 0$.

Therefore an augmentation of the import duty on vegetable oil in country 1 decreases total supply and raises price on this market.

⁸ A more general problem would be to determine the optimal structures of import duties on both goods in country 1 and of export taxes on both goods in country 2. This will be done in future research.

⁹ Second-order conditions are verified: $\pi_{1xx} = 2p' + xp'' < 0$, $\pi_{2yy} = 2p' + yp'' < 0$ and $\pi_{2zz} = 2q' + zq'' < 0$. Marginal profit decreases with the other firm's supply: $\pi_{1xy} = p' + xp'' < 0$ and $\pi_{2yx} = p' + yp'' < 0$. Own effects are greater than cross-effects: $\pi_{1xx} < \pi_{1xy} < 0$ and $\pi_{2yy} < \pi_{2yx} < 0$. This ensures the stability of the Nash equilibrium.

If we turn now on the impact of a change in t_2 on supply z , the same methodology based on first-order condition (5) leads to $\frac{dz}{dt_2} = -\frac{\pi_{2zt_2}}{\pi_{2zz}} = \frac{-1}{(2q' + zq'')} > 0$. An increase in the export tax on soy raises local supply of oil in country 2.

Let us now study the impact of a change in export duty t_2 . Differentiating first order conditions gives:

$$\pi_{1xx}dx + \pi_{1xy}dy + \pi_{1xt_2}dt_2 = 0$$

$$\pi_{2yx}dx + \pi_{2yy}dy + \pi_{2yt_2}dt_2 = 0$$

Since $\pi_{1xt_2} = 0$ and $\pi_{2yt_2} = 1$, we get:

$$\frac{dx}{dt_2} = \frac{\pi_{1xy}}{\Delta} < 0 \quad (9)$$

$$\frac{dy}{dt_2} = \frac{-\pi_{1xx}}{\Delta} > 0 \quad (10)$$

Similarly we get: $x_{t_2} + y_{t_2} > 0$. Therefore: $\frac{dp}{dt_2} = p'(x_{t_2} + y_{t_2}) < 0$. An export tax increases total supply of vegetable oil and decreases its price in country 1.

The equilibrium condition of the soy market brings:

$$s_1 + s_2 = w + \alpha(w - t_2) = x + y + z$$

$$\Leftrightarrow ((1 + \alpha)p'q' - 2q' - p')w - q't_1 - (\alpha p'q' - q' - p')t_2 + 2pq' + qp' = 0 \quad (11)$$

Therefore we get: $dw/dt_1 < 0$ and $dw/dt_2 > 0$. As expected the export tax on soy in country 2 increases the world price of soy w and the import duty on vegetable oil in country 1 decreases the world demand for vegetable oil and therefore also decreases the world demand for soy which implies a reduction in the world price of soy w .

Let us call PR_i public revenues from either taxation of vegetable oil import or taxation of soybeans exports.

$$PR_1 = t_1y \quad (12)$$

$$PR_2 = t_2(s_2 - z - y) = t_2(\alpha(w - t_2) - z - y) \quad (13)$$

In both countries there is a local demand for vegetable oils and local consumers' surplus (CS_i) is affected by these policies: $CS_1 = CS_1(x+y) = (x+y)^2/2$ and $CS_2 = CS_2(z) = z^2/2$ with $CS_1' > 0$ and $CS_2' > 0$. As in the soy sector farmers' supplies are linear, it is easy to evaluate their surplus FS_i :

$$FS_1 = w^2/2 \quad (14)$$

$$FS_2 = \alpha(w - t_2)^2/2 \quad (15)$$

The optimality of a policy depends on how governments' objective functions are designed. Here we simply consider that governments take into account the interest of all their constituents and weigh equally a dollar gained by either the vegetable oils industry, or public revenues, or farmers or vegetable oils consumers. We consider that both countries' governments maximize the sum of firm's profits and final consumers in the processed sector, public revenues and farmers' surplus. Of course this assumption a little bit arbitrary and the literature on political economy has often concluded on other assumptions.¹⁰ However this is a straightforward and simple assumption.

$$Max_{t_1} G_1 = \pi_1 + PR_1 + CS_1 + FS_1 \quad (16)$$

$$Max_{t_2} G_2 = \pi_2 + PR_2 + CS_2 + FS_2 \quad (17)$$

Derivation of G_1 and G_2 leads to:

$$\pi_{1_x} x_{t_1} + \pi_{1_y} y_{t_1} + \pi_{1_z} z_{t_1} + \pi_{1_{t_1}} + y + t_1 y_{t_1} + (x+y)(x_{t_1} + y_{t_1}) + w w_{t_1} = 0$$

$$\pi_{2_x} x_{t_2} + \pi_{2_y} y_{t_2} + \pi_{2_z} z_{t_2} + \pi_{2_{t_2}} + s_2 - z - y + t_2 [\alpha(w_{t_2} - t_1) - z_{t_2} - y_{t_2}] + z z_{t_2} + \alpha(w - t_2)(w_{t_2} - t_1) = 0$$

Since $\pi_{1_x} = 0$, $\pi_{1_y} = x p'$, $\pi_{1_z} = 0$ and $\pi_{1_{t_1}} = 0$, but also $\pi_{2_y} = 0$, $\pi_{2_x} = y p'$, $\pi_{2_z} = 0$ and $\pi_{2_{t_2}} = z + y$, we obtain:

$$t_1 = \frac{x p' y_{t_1} + w w_{t_1} + (x+y)(x_{t_1} + y_{t_1}) + y}{(-y_{t_1})} \quad (18)$$

$$t_2 = \frac{y p' x_{t_2} + \alpha w w_{t_2} + z z_{t_2}}{\alpha + z_{t_2} + y_{t_2}} > 0 \quad (19)$$

¹⁰ See for example Grossman and Helpman, 1994.

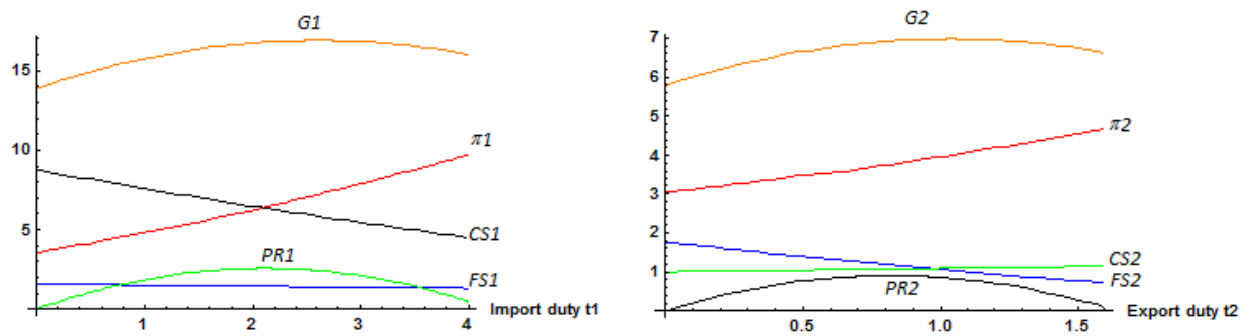
We see that: $\frac{d\pi_1}{dt_1} = xp'y_{t_1} > 0$, $\frac{dFS_1}{dt_1} = ww_{t_1} < 0$, $\frac{dCS_1}{dt_1} = (x + y)(x_{t_1} + y_{t_1}) < 0$. So the import tax on vegetable oil in country 1 raises profit of the vegetable oil firm, decreases farmers' surplus (through a decrease of world price of soy) and decreases local consumers' surplus. Public revenues PR_1 are concave in t_1 since for $t_1=0$, $\frac{dPR_1}{dt_1} > 0$ and PR_1 maximum for $t_1 = -y/y_{t_1} > 0$.

We also get $\frac{d\pi_2}{dt_1} = \pi_{2_x}x_{t_1} + \pi_{2_y}y_{t_1} + \pi_{2_z}z_{t_1} + \pi_{2_{t_1}} = yp'x_{t_1} - y < 0$. Thus the import tax on oil in country 1 decreases profit of country 2's vegetable oil firm.

We also see that: $\frac{d\pi_2}{dt_2} = yp'x_{t_2} > 0$, $\frac{dFS_2}{dt_2} = \alpha(w - t_2)(w_{t_2} - 1) < 0$, $\frac{dCS_2}{dt_2} = zz_{t_2} > 0$. So the export tax on soy in country 2 raises profit of the domestic vegetable oil firm, decreases farmers' surplus and increases local consumers' surplus. Public revenues PR_2 are concave in t_2 since for $t_2=0$, $\frac{dPR_2}{dt_2} = \alpha(w - t_2) - z - y > 0$ and PR_2 maximum for $t_2 = \frac{-[\alpha(w-t_2)-z-y]}{\alpha(w_{t_2}-1)-z_{t_2}-y_{t_2}} > 0$.

Figure 1 illustrates the impact of an import tariff on vegetable oil in country 1 (on the left part) and of an export tax on soy in country 2 (on the right part) with linear demands $p=a-(x+y)$ and $q=b-z$, with $a>0$ and $b>0$. It has been designed for specific parameters a , b and α . It illustrates on the left side that an increase of the import duty on vegetable oil in country 1 benefits the domestic producers of this good but is negative for local consumers. On the right side it shows that an augmentation of the export duty on soy in country 2 benefits domestic consumers and producers of vegetable oil but hurts local farmers.

Figure 1 An illustration of the impact of tariff escalation and DET



Source: authors' calculation. The left-hand side graph represents country 1's vegetable oils firm profits (π_1), vegetable oils consumers' surplus (CS_1), public revenues (PR_1), farmers' surplus (FS_1) and national surplus, G_1 . The right-hand side graph represents country 2's vegetable oils firm profits (π_2), public revenues (PR_2), farmers' surplus (FS_2) and national surplus, G_2 . This representation has been designed for parameters $a=8$, $b=4$ and $\alpha=5$. The implementations of these policies are simultaneous: on the left hand-side, import duty in country 1 varies with export tax in country 2 being equal to 103.94 percent. On the right hand-side, export tax in country 2 varies with import duty in country 1 being equal to 2261.13 percent. Both taxes are optimal levels for $a=8$, $b=4$ and $\alpha=5$.

With this first theoretical model we learnt that economic theory may confirm that for a developing country exporting a raw agricultural commodity and a transformed good made up from this raw commodity to a developed country, the implementation of a tax on exports of raw agricultural commodity is as justified as tariff escalation in the developed country in the sense that it augments the objective of the government when this objective consists in the sum of profits in the processing sector (vegetable oils), farmers' surplus (soy), final consumers' surplus in the processed sector (vegetable oil) and public revenues. While tariff escalation applied by the trading partner decreases profits in the developing country's processing sector (vegetable oils), an export tax increases country 2's public revenues, final consumers' surplus and profits in the same domestic processing sector (vegetable oils). However it decreases farmers' surplus.

Of course it remains to be checked if these conclusions hold under other theoretical frameworks. For example in the manufactured sector it can be supposed a Bertrand competition. A duopolistic competition can also be introduced in the primary sector. This will be the objective of further research.

3. A partial equilibrium model of the oilseeds sector

The theoretical model presented in the previous section helps us understand to what extent a DET is a policy response to tariff escalation applied in developed countries. However this model is highly stylized and does not take into account several of the complexities of the oilseeds value chain: there are more stages than the simple raw/processed sectors and there is substitutability at each stage of the value chain between different types of seeds. Moreover we need to take into account the value of the economic variables (production, trade, ...) relative to this value chain at the world level.

Thus, in this section we develop a partial equilibrium model taking into account some of these complexities and using real data in order to analyze the implications of DETs in developing countries and tariff escalation in developed countries. We first present the main characteristics of the oilseed sector (subsection 3.1) and then we present the model (subsection 3.2).

3.1 The oilseed sector and the export tax structure in Argentina, Indonesia and Ukraine

Let us now describe shortly the world oilseeds sector. We can roughly consider three stages of production in the oilseed value chain: production of seeds (first stage), meals and oils (second stage), and biodiesel (third stage)¹¹. Meals and oils are produced from crushed seeds, while biodiesel is produced from oils. In the model developed here, we consider four types of seeds: soybeans, sunflower seeds, palm nuts, and rapeseeds.¹² Soybean meals and soybean oil are produced from crushed soybeans (there is no substitution among seeds in the second stage). In the third stage, biodiesel is produced from composite oil. Biodiesel industry competes with final consumers in the demand for oils. Final consumers substitute imperfectly the different types of oils.

¹¹ In reality, there are more intermediate steps of production: soybean oil, for example, goes through different stages of refining, from crude oil to refined soybean oil.

¹² Technically, palm nuts are not oilseeds, but we use the terminology oilseed throughout this section to refer to the class of seeds, nuts, and fruits from which oil may be derived. The seeds included in the model are the ones on which export taxes are applied (such as soybeans, palm, or sunflower), or are relevant for the European Union (rapeseed).

According to the FAO database the most important countries, either as producers or consumers of oilseeds and derived products, are: Argentina, Brazil, Canada, China, European Union, India, Indonesia, Malaysia, Ukraine, and United States. All of them may produce seeds, meals, oils, and biodiesel, and may export or import the different goods.

The world oilseeds sector is characterized by the implementation of many export taxes. Nowadays, Argentina imposes a 35 percent export tax on soybeans, a lower rate (32 percent) on soybean byproducts (soy oil and soy meals), and a much lower rate on soy biodiesel (20 percent). Costa *et al.* (2009) show that as a consequence of this policy, the Argentine soybean meal and oil sectors exhibit higher competitiveness and lower production costs (relative to the United States and Brazil, its two major competitors in the global soy market). Since 1979, Indonesia also applies export taxes on crude palm oil and processed palm oil, and the rates have changed according to the level of international prices, in order to ensure domestic availability of the product, as cooking oil is considered by the Indonesian government to be one of the “essential commodities for consumers” (Hasan, Reed and Marchant, 2001). The export tax rates decrease along the palm kernel production structure: they are higher for palm kernels, lower for crude palm oil and refined palm oil, and lowest for palm-based biodiesel (5 percent)¹³. In October 1999, Ukraine imposed a 23 percent export tax on sunflower seeds. Even when the tax was reduced to 17 percent in July 2001, activity was boosted in the sunflower crushing sector in the country, apparently thanks to this policy.

Some importing countries impose import duties on oilseeds products. Even though the range of import duties applied in the sector is wider than export taxes, we can mention two big players that apply tariff escalation in the sector: European Union and United States. Both countries apply import tariffs on vegetable oils and no tariffs on oilseeds.¹⁴

¹³ Indonesia adjusts export tax rates constantly according to international prices.

¹⁴ In fact US does not implement strictly tariff escalation since for example import duties on oils made from soy, sunflower and rape are larger than import duties on biodiesel. However both countries are rich and both apply larger import duties on oils than on seeds (except US in the palm value chain where tariffs are equal to 0).

The next section presents the partial equilibrium model designed to study the economic impact of DETs applied along the oilseeds value chain in Argentina, Indonesia and Ukraine, and of tariff escalation implemented by the EU and the US.

3.2 A Partial Equilibrium Model of the Oilseed Sector

In order to analyze the impact of an elimination of current export taxes on the oilseed production chain, we build a global multimarket partial equilibrium model. Let us present the full equations of the model. Greek letters denote elasticities and K scale parameters. Subscripts in variables and parameters are as follows: s represents seeds, o represents oils, m represents meals, and b represents biodiesel; r is the set of countries, and i stands for the set of seeds (soybeans, sunflower seeds, palm nuts, and rapeseeds), so that, for example, $Y_{S_{i,r}}$ is the production of seed i in country r . In each country or region, there is production of seeds or nuts. There is one production function per each type of seed. The production function is an isoelastic function, which depends positively on the price of the seed and area harvested in the region. Letting $Y_{S_{i,r}}$ represent the output of seed i in region r , $P_{S_{i,r}}$ be the price of seed i in region r , and $A_{i,r}$ be the area of land for harvesting seed i in region r , the production function is given by:

$$Y_{S_{i,r}} = K_{S_{i,r}} A_{i,r} P_{S_{i,r}}^{\varepsilon_{i,r}} \quad (20)$$

where $K_{S_{i,r}}$ is a scale parameter that may vary across seed type and region, and $\varepsilon_{i,r}$ is the supply elasticity. In the next stage of the production chain, seeds are processed into crushed seeds, which are then used in fixed proportions for production of oils and meals.

$$Y_{O_{i,r}} = \alpha_{O_{i,r}} C_{S_{i,r}} \quad (21)$$

$$Y_{M_{i,r}} = \alpha_{M_{i,r}} C_{S_{i,r}} \quad (22)$$

where $C_{S_{i,r}}$ is the demand for crushed seeds i in region r , $Y_{O_{i,r}}$ and $Y_{M_{i,r}}$ are the production of oils and meals in region r , $\alpha_{O_{i,r}}$ and $\alpha_{M_{i,r}}$ are the fixed technical coefficients of crushed seeds in the production of oils and meals. Let us define the crush margin ($MRG_{i,r}$) as the difference between the value of the oil and meal produced from the seeds and the cost of the seeds. Since we

define $MRG_{i,r}$ by reference to a price by unit of crushed seed, we obtain the equation 23 that determines the price and quantity links between the seeds and the byproducts markets.

$$Cs_{i,r}(Ps_{i,r} + MRG_{i,r}) = (Po_{i,r}Yo_{i,r} + Pm_{i,r}Ym_{i,r}) \quad (23)$$

where $Po_{i,r}$ and $Pm_{i,r}$ are the prices of oil and meals respectively. Demand for crush seeds depends on the crush margin: $Cs_{i,r} = Kcs_{i,r}(MRG_{i,r})^{\varepsilon mg_{i,r}}$. We obtain the crush equation expressed as:

$$MRG_{i,r} = (Po_{i,r}\alpha_{o_{i,r}} + Pm_{i,r}\alpha_{m_{i,r}}) - Ps_{i,r} \quad (24)$$

This equation shows that the margin, and thus the production of oils and meals, will depend positively on the price of these goods and negatively on the price of seeds. Thus, if prices of seeds, oils and meals increase, the net effect on the production of derived products is not straightforward. The fixed coefficients $\alpha_{o_{i,r}}$ and $\alpha_{m_{i,r}}$, which determine the production technology of each region, will play a role in the net effect. Production of biodiesel takes composite oil as inputs. One unit of composite oil demanded by the sector is transformed into one unit of biodiesel, as shown in equation 25.

$$Ccomp_{Bio,r} = Yb_r \quad (25)$$

where $Ccomp_{Bio,r}$ is the composite oil demanded by the biodiesel sector, Yb_r is the production of bioenergy in country r . Demand for composite oil by the biodiesel sector will depend on the production margin (equation 26), which is determined by the prices of composite oil and biodiesel.¹⁵

$$Ccomp_{Bio,r} = Kb_r MRGb_r^{\varepsilon mgb_r} \quad (26)$$

$$MRGb_r = Pb_r - Pcomp_{bio,r} \quad (27)$$

where $MRGb_r$ is the production margin in country r , Pb_r is the final price of biodiesel in country r , εmgb_r is the margin elasticity and Kb_r is a scale parameter. Let us focus now on the demand side. In the domestic market, oils are consumed by households (final consumption) and by

¹⁵ So we suppose a constant mark-up in the oil industry. This assumption differs from a monopolistic competition assumption since monopolistic competition is a more complex market structure with monopoly and mark-up in the short run and perfect competition, free entry and elimination of abnormal profits in the long run.

the biodiesel sector (intermediate consumption). Agents have an isoelastic demand for composite oil, which is a CES function of the different types of oils. This means that the different types of oils are imperfect substitutes for consumers and biodiesel producers with a constant degree of substitutability. We use a low value of elasticity: 2.¹⁶ This CES assumption leads to the three following equations:

$$C_{compo_{h,r}} = K_{o_{h,r}} P_{compo_{h,r}}^{\sigma_{l,r}} \quad (28)$$

$$C_{o_{i,f,r}} = a_{C_{i,f,r}} C_{comp_{f,r}} \left(\frac{P_{comp_{f,r}}}{P_{o_{i,r}}} \right)^{\sigma_{o_{i,r}}} \quad (29)$$

$$P_{comp_{f,r}} C_{comp_{f,r}} = \sum_i P_{o_{i,r}} C_{o_{i,f,r}} \quad (30)$$

where $C_{compo_{h,r}}$ is the demand for composite oil by households in region r ; $P_{compo_{h,r}}$ is the price of composite oil faced by households; $K_{o_{h,r}}$ is a scale parameter and $\sigma_{l,r}$ is the elasticity of demand to price. $C_{o_{i,f,r}}$ is the demand of each type of oil i by agent f (households and biodiesel producers) in region r , $\sigma_{o_{i,r}}$ is the elasticity of substitution between different types of oils, $P_{o_{i,r}}$ is the price of oil i in country r , and $a_{C_{i,f,r}}$ is the share parameter. In the domestic market, meals are consumed by the livestock sector (here modeled as final agent). There is perfect substitution between different types of meals.

$$C_{m_{i,r}} = K_{m_{i,r}} P_{m_{i,r}}^{\sigma_{m_{i,r}}} \quad (31)$$

where $C_{m_{i,r}}$ is the final demand for meals in country r , $P_{m_{i,r}}$ is the price of meals, $\sigma_{m_{i,r}}$ is a price demand elasticity and $K_{m_{i,r}}$ is a scale parameter. Final demand for biodiesel by households in each country is isoelastic and depends negatively on the price of biodiesel:

$$C_{b_r} = K_{b_r} P_{b_r}^{\sigma_{b_{i,r}}} \quad (32)$$

where C_{b_r} is the final demand for biodiesel in country r , P_{b_r} is the price of biodiesel, $\sigma_{b_{i,r}}$ is a price demand elasticity and K_{b_r} is a scale parameter. In the international market, we assume that goods are homogenous. This assumption leads to net exporter or net importer countries for each good. The decision of exporters to allocate production domestically or to trade is based on price. Countries can apply export taxes and import duties (ad valorem in both cases) on each of the four

¹⁶ We tested the sensitivity of results to this value. Results are only marginally affected. They are available upon request.

products. The following equations represent the market clearing condition for each type of good (seeds, oils, meals, and biodiesel), in which demand, composed by net exports X (exports minus imports) and domestic demand C , equals supply (production Y).

$$Xs_{i,r} + Cs_{i,r} = Ys_{i,r} \quad (33)$$

$$Xo_{i,r} + \sum_f Co_{i,f,r} = Yo_{i,r} \quad (34)$$

$$Xm_{i,r} + Cm_{i,r} = Ym_{i,r} \quad (35)$$

$$Xb_r + Cb_r = Yb_r \quad (36)$$

The international price parity equations (equations 37 to 40) establish that without distortions, in the form of export taxes ($texp$) or import tariffs ($timp$), international prices (P^*) are equal to domestic prices (P). When a country imposes a positive export tax, the domestic price will be lower than the international price, while the opposite happens if the country imposes a positive import tariff.

$$Ps^* = Ps_{i,r} \frac{(1+texp_{s_{i,r}})}{(1+timp_{s_{i,r}})} \quad (37)$$

$$Po^* = Po_{i,r} \frac{(1+texp_{o_{i,r}})}{(1+timp_{o_{i,r}})} \quad (38)$$

$$Pm^* = Pm_{i,r} \frac{(1+texp_{m_{i,r}})}{(1+timp_{m_{i,r}})} \quad (39)$$

$$Pb^* = Pb_r \frac{(1+texp_{b_r})}{(1+timp_{b_r})} \quad (40)$$

Finally, equations 41 to 44 present the equilibrium in external markets for the four types of goods, where the sum of net trade flows equals zero.

$$\sum_r Xs_{i,r} = 0 \quad (41)$$

$$\sum_r Xo_{i,r} = 0 \quad (42)$$

$$\sum_r Xm_{i,r} = 0 \quad (43)$$

$$\sum_r Xb_r = 0 \quad (44)$$

Table 1. Export taxes applied at benchmark (percent)

		Seeds	Oils	Meals	Biodiesel
Soy	Argentina	35	32	32	20
Palm	Indonesia	40	25	-	3
Palm	Malaysia	-	30	-	-
Sunflower	Argentina	32	30	30	-
Sunflower	Ukraine	12	-	-	-

Source: Authors' computations based on multiple sources.

Table 2. Import duties applied at benchmark (percent)

		Seeds	Oils	Meals
Palm	European Union	0.00	6.68	0.00
Palm	USA	0.00	0.00	0.00
Soy	European Union	0.00	5.17	0.13
Soy	USA	0.00	17.13	1.75
Sunflower	European Union	0.00	6.07	0.00
Sunflower	USA	0.00	5.54	0.00

Source: Authors' computations based on Laborde (2010).

Note: there are also import duties applied at different stages of the oilseeds value chain in Argentina, Brazil, China, India, Malaysia, Ukraine and Canada. These import duties are taken into account in our model but they are not removed in the scenarios presented in the next subsection.

In order to calibrate the model, we take data on production, consumption and trade from FAO-Food balance sheet (year 2007). Values of the elasticities are taken from FAPRI¹⁷. Data on export taxes come from different sources (Trade Policy Reports, WTO; OECD), while import duties are from Laborde (2010). Table 1 and Table 2 present the export taxes and import tariffs applied on oilseeds at the benchmark, while Table 3 shows the net exports of commodities for each region in volume.

¹⁷ See <http://www.fapri.iastate.edu/tools/elasticity.aspx>.

Table 3. Net exports at benchmark, in thousand metric tons

Type of seed	Commodity	Argentina	Brazil	US	China	India	Indonesia	EU	Malaysia	Ukraine	Canada	Rest of the world
Palm	Seeds	-	-	-	-	1	18		-73	-	-	54
Palm	Meals	-	-	-	-	-	2,528	-2,268	1,960	-	-	-2,220
Palm	Oils	-6	-87	-270	-380	-147	1,332	-857	500	-48	-28	-9
Rapeseed	Seeds	11	-18	-323	-835	25	-	-450	-	786	5,334	-4,530
Rapeseed	Meals		-3	-1,468	-304	1,164	-117	532	-27	17	1,587	-1,381
Rapeseed	Oils	-1	-11	-497	-773	2	-	36	-7	19	1,154	78
Soybeans	Seeds	7,649	18,843	23,555	-32,665	41	-2,238	-14,900	-479	596	1,651	-2,053
Soybeans	Meals	25,989	12,373	6,303	705	4,906	-1,928	-22,472	-833	-50	-1,371	-23,622
Soybeans	Oils	6,055	2,316	915	-2,844	-1,122	-18	-484	284	10	-59	-5,053
Sunflower	Seeds	25	-1	574	419	-2	-9	236	-	324	128	-1,694
Sunflower	Meals	838	-2	-3	-3	43	4	-1,817	-	1,305	-	-365
Sunflower	Oils	852	-15	68	-79	-79	-	-1,109	-	1,242	-50	-830
	Biodiesel	412	4	783	42	-	42	-1,297	33	-	41	-60

Source: Authors' computations based on FAO

Note: some adjustments were made: first we cancel production of meals and oils in countries that do not have any corresponding production or imports of seeds; second in order to balance the data (sum of net exports on all regions has to be zero) we adjust net exports from the rest of the world.

3.3 Simulation Results

We use now the model presented in the previous section to evaluate three scenarios: first we remove export taxes in countries implementing a DET (Argentina, Indonesia and Ukraine – see Table 1 – scenario S1); second we remove import duties in countries implementing tariff escalation (EU and the US; scenario S2); third we study the removal of DETs in Argentina, Indonesia and Ukraine and of import duties in EU and US (scenario S3).

Elimination of export taxes in Argentina, Indonesia and Ukraine – scenario S1

We first simulate the simultaneous elimination of export taxes in Argentina, Indonesia and Ukraine. As price parity equations (37 to 40) show, the removal of export taxes raises domestic prices in the country implementing the tax and reduces the international price of the good. This is what happens when we remove all export taxes applied on the oilseed complex by Argentina, Indonesia and Ukraine, as shown in Table 4 (changes in international prices are indicated in last

column).¹⁸ In most cases, international seed prices fall the most because they face initially higher export taxes. In the palm sector, prices fall more sharply than for other types of seeds. This happens because Indonesia, which controls 25 percent of world exports (see Table 3), imposes high export taxes on the palm oil sector (40 percent - see Table 1).

Table 4. Impact of export tax elimination in Argentina, Indonesia and Ukraine on domestic and international prices, percentage change – Scenario S1

		Argentina	USA	Indonesia	EU	Ukraine	International
Seeds	Soy	30.4	-3.4	-3.4	-3.4	-3.4	-3.4
Seeds	Sunflower	28.8	-2.4	-2.4	-2.4	9.3	-2.4
Seeds	Rape	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
Seeds	Palm	-7.7	-7.7	29.3	-7.7	-7.7	-7.7
Meals	Soy	27.9	-3.1	-3.1	-3.1	-3.1	-3.1
Meals	Sunflower	26.6	-2.6	-2.6	-2.6	-2.6	-2.6
Meals	Rape	0.6	0.6	0.6	0.6	0.6	0.6
Meals	Palm	-4.1	-4.1	-4.1	-4.1	-4.1	-4.1
Oils	Soy	29.4	-2	-2	-2	-2	-2.0
Oils	Sunflower	27.5	-1.9	-1.9	-1.9	-1.9	-1.9
Oils	Rape	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4
Oils	Palm	-3.1	-3.1	21.2	-3.1	-3.1	-3.1
Biodiesel	Biodiesel	19.1	-0.7	2.2	-0.7	-0.7	-0.7

Source: Authors' calculation

There are no export taxes on rapeseed at the benchmark. International prices of rapeseed products vary as consumption for rapeseed products is substituted worldwide for consumption of other types of products. For example, rapeseeds are less demanded in countries where domestic prices of soybeans, sunflower seeds and palm nuts decrease (European Union for example) but more demanded in countries where these prices increase (Argentina, Indonesia, and Ukraine). The former effect is larger and international prices of rapeseeds decrease. This, in turn, also affects the rapeseed crushing industry. Meals and vegetable oils may be made from different seeds and as the international price of other seeds decrease, the crushing activity produces more vegetable oils from soy, sunflower and palm and less from rape. As we assume perfect substitution of meals from different seeds, international price of meals made from rapeseeds increases. In the oil sector

¹⁸ For clarity of presentation we only present results in the three countries implementing a DET and the two countries implementing tariff escalation. Consequently comments may concern figures which are not presented in Tables. All results are available upon request.

substitutability is lower and international price decreases, but the fall is less pronounced than for other oils.

As Table 4 shows, as expected there is an increase in domestic prices of soybeans and sunflower seeds and their downstream products (biodiesel included) in Argentina.

In Indonesia the prices of palm nuts and palm oils rise and in Ukraine the domestic price of sunflower seeds increases. In all cases, the magnitude of variation in domestic prices is directly related to the value of the export tax that was initially in place.

Table 5. Impact of export tax elimination in Argentina, Indonesia and Ukraine on production, percentage change – Scenario S1

		Argentina	US	Indonesia	EU	Ukraine
Seeds	Soy	8.9	-1	-1	-0.7	-1
Seeds	Sunflower	3.9	-0.7		-0.5	2.7
Seeds	Rape	-0.1	-0.2		-0.2	-0.2
Seeds	Palm			8		
Meals	Soy	4.1	0.0	1.2	0.0	1.8
Meals	Sunflower	5.1	0.0	0.1	-0.2	-0.8
Meals	Rape	-0.1	-0.1		-0.1	-0.1
Meals	Palm			-0.1		
Oils	Soy	4.1	0	1.2	0	1.8
Oils	Sunflower	5.1	0	0.1	-0.2	-0.8
Oils	Rape	-0.1	-0.1		-0.1	-0.1
Oils	Palm			-0.1		
	Biodiesel	-0.4	0.9	-1.1	0.0	

Source: Authors' calculation.

In the case of soybeans and their products in Argentina, export taxes are applied all along the production chain. Elimination of export taxes on oils and meals increases domestic prices, raising the crush margin, which promotes higher production of these goods (direct DET effect). On the other hand, elimination of export taxes on soybeans promotes production and exports in this sector, and reduces production of downstream products (oils and meals) as production costs rise and the crush margin falls (indirect DET effect). If we only simulate the elimination of export taxes on meals and oils, their production and exports would increase. The opposite would happen if we only eliminate export taxes on soybeans: production and exports of downstream products would fall. The net effect is an increase in the crush margin and a consequent rise in production (and exports) of soybean oil

and meals in Argentina, as Table 5 shows. A similar picture is found for the sunflower sector in Argentina and the palm value chain in Indonesia.

When a DET is removed in one country, there are two antagonist effects on cultivation of other seeds: (i) a supply-side effect: other things being equal, farmers allocate significantly more resources for cultivating this seed and cultivation of other seeds decreases, which implies an increase in domestic price. (ii) a demand-side effect: since export taxes on downstream products are also removed (oils made of soy in Argentina for example), the demand for downstream products in the same value chain (soy oils in Argentina) augments leading to less demand for substitutes (oils made of palm nuts or rapeseeds or sunflower seeds in Argentina) which leads to less demand for upstream products (palm nuts, rapeseeds and sunflower in Argentina). This implies a decrease in domestic prices of upstream products of which exports are not initially taxed. The demand effect is often larger, due in particular to large export taxes on downstream products. This explains why when Argentina removes a DET on the soy value chain or the sunflower value chain, the impact is negative on domestic prices of rapeseeds: it is also the case of Indonesia with soybeans and sunflower seeds. Finally the reduction in international prices leads to reduced domestic prices in countries which do not change their policy (US and EU).

From Table 5 we can conclude that the DET in Argentina and Ukraine has a positive impact on the local production of biodiesel. Therefore the indirect DET effect (the removal of export taxes at earlier stages of production increases the cost of production at this stage) is larger. Removing the DET decreases production of biodiesel by only 0.4 percent in Argentina and 1.1 percent in Indonesia (it is zero in Ukraine). This reflects a larger export tax on biodiesel in Argentina, while being much smaller in Indonesia. If we simulate the removal of the export tax on biodiesel in Argentina only, we find a 9.6 percent increase in local production of biodiesel.¹⁹ Thus while the claim that DET in agricultural commodity-exporting developing countries is a policy response to tariff escalation in developed countries in order to support processing industries is a valid statement, a high export tax

¹⁹ If we simulate the only removal of the export tax on biodiesel in Indonesia, the augmentation of local production of biodiesel is 0.3 percent. This is related to the low level of the export tax on biodiesel.

on the last stage of processing is not a valid policy to promote industrialization and only increases fiscal revenue.

Table 6 presents the value of the consumer and producers surplus variations, and also public revenues due to a simultaneous elimination of DETs in Argentina, Indonesia and Ukraine.²⁰ Consumers' surplus is affected through changes in final consumption and consumption prices of biodiesel and oils. As expected, consumers in Argentina and Indonesia lose as a consequence of the elimination of export taxes: domestic prices increase and they consume less. However, consumers in the rest of the world are benefited, and their gains are higher than the losses of consumers in the former countries for a total gain of 931 million USD in consumers' surplus throughout the world. In Ukraine the DET consists in a single export tax of sunflower seeds while exports of oils, meals and biodiesel are not taxed. Removing the export tax on sunflower seeds has an expansionary effect on exports at the detrimental of sales on the domestic market. Domestic price of sunflower seeds augments by 9.3 percent. It increases the cost of crushing and leads to a reduction in this activity. But thanks to the reduction of international prices, imports of oils from soy and palm augment significantly. The domestic price of all vegetable oils decreases and consumers' surplus is positively affected.

Table 6. **Variation in consumer and producer surpluses, and public revenues from removal of export taxes in Argentina, Indonesia and Ukraine (USD millions) – Scenario S1**

	Argentina	US	Indonesia	EU	Ukraine	Rest of the World
Producers' surplus	3,766.8	-612.7	116.9	32.7	-62.5	-1,040.4
Consumers' surplus	-158.0	171.8	-42.2	199.4	18.3	742.4
Public Revenues	-4,519.1	-0.5	-237.0	0.9	-11.8	30.6
Total	-910.3	-441.4	-162.3	233.0	-56.0	-267.4

Source: Authors' calculation.

²⁰ In case of seeds, surpluses are estimated using linear approximations. Concerning meals and oils, producers' surpluses are evaluated through the crushing margin. Finally concerning biodiesel, producers' surplus is estimated by the production margin. Moreover we do not measure the surplus derived from the consumption of livestock products, surplus which could be affected through the variation of meals price. Therefore if the removal of trade policies leads to a decrease of meals price, we underestimate the positive impact on buyers of meals (or of final consumers).

Concerning producers let us keep in mind that producers' surplus consists in surplus of farmers (seeds), the crushing margin and the production margin of biodiesel. Farmers in Argentina (soybeans and sunflower seeds), Indonesia (palm nuts) and Ukraine (sunflower seeds) are benefitted as domestic prices increase, and producers in the rest of the world are harmed because international prices fall. Producers of biodiesel in Argentina benefit from the removal of export tax on biodiesel but are hurt by the removal of export taxes on vegetable oils which increases their production cost. The second effect is larger and Argentinean producers of biodiesel lose surplus. These are farmers that benefit the most (and by far) from the removal of export taxes (82 percent of the total gain) while the loss of biodiesel producers is negative but close to zero.

Gains of producers in Argentina, Indonesia and Ukraine are larger than losses of producers in the rest of the world and consequently removing DETs in these three countries imply a global augmentation of producers' surplus by 2,200 million USD.

Removing export taxes means less public revenues for countries implementing this kind of policy with in particular a large loss for Argentina: it was expected since export taxes are high in this country and export flows are substantial, in particular of soy meals (see Table 3). But removing all export taxes also mean more public revenue for countries that do not impose such taxes but benefit from higher import duty revenues as imports rise due to the removal of export taxes. Public revenues increase in Brazil, India, EU, Canada and the rest of the world. The case of US is specific since US imports are concentrated on meals made from rapeseeds (see Table 3), and this is the only commodity for which international prices is increased in this scenario: consequently imports are decreased and so do public revenues.

Elimination of import tariffs

Just as Argentina and Indonesia apply higher export taxes to less processed products along the oilseed chain, some countries apply lower—or null—import duties to less processed products and higher tariffs on processed products of the same production chain. In this section we briefly

describe the effects of the elimination of import duties of two regions—European Union and United States— all along the oilseeds value chain.²¹

The imposition of import tariffs has the opposite effect on prices than the imposition of export taxes: it increases domestic prices and reduces international prices if the country imposing the tax is a big economy. Thus, the elimination of tariffs increases international prices of goods for which the EU and US impose tariffs: vegetable oils. As shown in Table 7, international prices of all types of seeds also increase. Only soy meals are taxed at the benchmark (see Table 2), and thus for the rest of meals prices fall. Changes in the international price of oils come directly from the elimination of import duties in both countries, while in the case of seeds it is explained by a demand effect: as domestic prices of oil in both countries fall, demand for oils increases leading to a world increase in demand for seeds and consequent price increases, as shown in Table 7. The rise in international prices is higher for oils as a consequence of the direct effect. International price of biodiesel also increases: +1.64 percent.

Table 7 also points out the variation of domestic prices in this scenario. In the EU and the US in sectors where import duties are reduced (initial tariffs strictly positive), domestic prices fall. In other sectors in these two countries and in other countries, domestic prices follow the evolution of international prices. The only exception is soy meals in the EU which benefits from a removal of tariffs but simultaneously its world price augments.

²¹ Other countries also apply import duties on these products. However, in order to simplify the analysis, we only simulate the elimination of tariffs in the two regions that apply an increasing rate along the production chain.

Table 7. **Variation in domestic and international prices from removal of import duties in the EU and the US (in percent) – Scenario 2**

		Argentina	USA	Indonesia	EU	Ukraine	International
Seeds	Soy	0.2	0.2	0.2	0.2	0.2	0.2
Seeds	Sunflower	0.5	0.5	0.5	0.5	0.5	0.5
Seeds	Rape	0.6	-1.1	0.6	0.6	0.6	0.6
Seeds	Palm	0.9	0.9	0.9	0.9	0.9	0.9
Meals	Soy	0.4	-1.3	0.4	0.3	0.4	0.4
Meals	Sunflower	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Meals	Rape	-0.4	-0.7	-0.4	-0.4	-0.4	-0.4
Meals	Palm	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
Oils	Soy	3.8	-11.4	3.8	-1.3	3.8	3.8
Oils	Sunflower	2.5	-2.9	2.5	-3.3	2.5	2.5
Oils	Rape	2.0	-3.8	2.0	-3.5	2.0	2
Oils	Palm	1.8	1.8	1.8	-4.6	1.8	1.8
Biodiesel	Biodiesel	1.6	-1.4	1.6	-4.3	1.6	1.6

Source: Authors' calculation.

As we might expect, the EU and the US increase their imports of oils and meals, while the rest of the regions increase their exports to these markets. This is particularly true in the case of sunflower and palm oil in the case of EU, with an increase of respectively 12.9 percent and 4 percent of European imports. US imports of meals made from sunflower increase by 79.7 percent and those made from rapeseeds by 0.5 percent.

Table 8. **Variation in production from removal of import duties in the EU and the US (percent) - scenario S2**

		Argentina	US	Indonesia	EU	Ukraine
Seeds	Soy	0.1	0.1	0.1	0	0.1
Seeds	Sunflower	0.1	0.1		0.1	0.1
Seeds	Rape	0.1	-0.3		0.1	0.2
Seeds	Palm			0.3		
Meals	Soy	1.4	-5.1	2.5	-0.1	3.5
Meals	Sunflower	1.9	-0.6	0.8	-3.5	0.2
Meals	Rape	0.9	-0.4		-0.7	0.1
Meals	Palm			0.1		
Oils	Soy	1.4	-5.1	2.5	0	3.5
Oils	Sunflower	1.9	-0.6	0.8	-3.5	0.2
Oils	Rape	0.9	-0.4		-0.7	0.1
Oils	Palm			0.1		
Biodiesel	Biodiesel	-0.6	6.3	0.1	-0.1	

Source: Authors' calculation.

In the EU and the US the elimination of tariff implies positive or negative variations of production depending on the value chain and the stage of processing. Different forces are in play. A

direct effect is related to the removal of the import duty: when more exposed to international production, local production is reduced. Another effect is a demand effect: when a tariff is cut on a downstream stage of processing (oil for example), it increases demand of inputs at this stage and supports production at upstream stages of production (seeds). Finally a production cost effect is also in play with downstream stages of production (an example is biodiesel in the US): with trade liberalization occurring at earlier stages of production, prices of intermediate goods are cut and production is stimulated at downstream stages since it is more efficient. This effect predominates for biodiesel in the US, while the direct effect predominates for biodiesel in the EU.

Table 9 presents the value of the consumer and producers surplus variations, and also public revenues due to a simultaneous elimination of import duties in the EU and the US.²² As expected, consumers in the EU and the US gain surpluses as a consequence of the elimination of these import duties: in general domestic prices decrease and households consume more. However, households in the rest of the world are in general hurt due to the augmentation of international prices. On the other hand, producers in the EU and in the US are hurt as domestic prices decrease and domestic producers are more exposed to international competition. In both countries this reflects opposed interests: for example in the US, seeds cultivation (positive demand effect) and production of biodiesel (positive production cost effect) is benefitting from the removal of import duties all along the value chain while the crushing activity (meals and oils) is negatively affected (-1,308 million USD): the direct effect, related to the loss of protection from abroad is predominant.

Table 9. Variation in consumer and producer surpluses, and public revenues from removal of import duties in the EU and the US (USD millions) - scenario S2

	Argentina	US	Indonesia	EU	Ukraine	Rest of the World
Producers' surplus	224.8	-666.0	36.9	-866.7	67.2	1,084.1
Consumers' surplus	-18.1	920.1	-16.9	363.0	-23.6	-1,166.1
Public revenues	87.4	-26.9	5.5	-206.7	-19.4	-6.2
Total	294.1	227.2	25.5	-710.4	43.6	-88.2

Source: Authors' calculation.

²² The same restrictions as for surpluses calculated in scenario S1 apply here.

Removing import duties means less public revenues for the EU and the US. But it also mean more public revenue for countries that do not impose such duties but benefit from constant export taxes and larger exports due to the removal of import duties abroad: see the case of Argentina and Indonesia on Table 9.

Elimination of DETs in Argentina, Indonesia and Ukraine and of import duties in EU and US

Let us turn now to the last scenario which consists in removing both export taxes in Argentina, Indonesia and Ukraine and import tariffs in the EU and the US. The total effect is close to the sum of both scenarios but it does not match perfectly.

A removal of export taxes in Argentina, Indonesia and Ukraine combined with a removal of import duties in the EU and the US would lead to an expansion of production of all activities along the value chain, including the production of biodiesel for which world output would expand by one percent. Of course this variation in percentage would not be the same in all countries, with the production of biodiesel expanding in the US (7 percent – see Table 10), but decreasing in Argentina (-1.1 percent) and Indonesia (-1.0 percent). Concerning the production of oil, this scenario would expand the production of soy oil in Argentina (5.7 percent), in Indonesia (3.3 percent), and in Ukraine (4.5 percent) and also sunflower oil in Argentina (7.2 percent) while production of soy oil would contract by 5 percent in the US and of sunflower oil by 3.7 percent in the EU. The international production of meals would change similarly.

Table 10. **Impact on domestic production of elimination of DETs in Argentina, Indonesia and Ukraine, and of import duties in EU and US - percent change**

		Argentina	US	Indonesi a	EU	Ukraine
Seeds	Soy	8.9	-1	-1	-0.6	-1
Seeds	Sunflower	3.9	-0.6		-0.4	2.9
Seeds	Rape	0	-0.6		0	0
Seeds	Palm			8.3		
Meals	Soy	5.7	-5	3.3	0	4.5
Meals	Sunflower	7.2	-0.6	0.9	-3.7	-0.6
Meals	Rape	0.7	-0.4		-0.8	0.1
Meals	Palm			0		
Oils	Soy	5.7	-5	3.3	0	4.5
Oils	Sunflower	7.2	-0.6	0.9	-3.7	-0.6
Oils	Rape	0.7	-0.4		-0.8	0.1
Oils	Palm			0		
Biodiesel	Biodiesel	-1.1	7.0	-1.0	-0.1	

Source: Authors' calculation.

This clearly points out that the combination of these policies is negative for output in these emerging countries and that international cooperation should handle the issue of tariff escalation in developed countries and DETs in developing countries.

4. Concluding Remarks

This paper studies the potential impact and policy justification of Differential Export Tax (DET) rates along production value chains in order to promote production at more processed stages. These policies are often implemented in response to tariff escalation by importing partners.

First we studied the theoretical justification of this trade policy with a simple model based on a downstream-upstream linkage of a farming sector under perfect competition and a manufacturing one under Cournot oligopolistic competition. We learnt that in this framework, for a developing country exporting a raw agricultural commodity and a transformed good made up from this raw commodity to a developed country, implementing a tax on exports of the raw agricultural commodity augments the sum of profits and final consumers' surplus in the processing sector, of

farming surplus and of public revenues. In particular while tariff escalation applied by the trading partner decreases profits in the domestic processing sector, an export tax increases these profits.

Our results from the partial equilibrium model calibrated on the international oilseeds sector show that the removal of exports taxes leads to the convergence of prices worldwide, resulting in a better transmission of price signals to all economic actors. For those countries that apply a decreasing export tax rate along the production chain (soybean and sunflower complex in Argentina; palm in Indonesia; sunflower in Ukraine), the elimination of export taxes is expected to augment production in the first stage of the value chain (i.e. raw materials) and exports (soybean and sunflower seeds in Argentina and palm nuts in Indonesia). In Argentina the production of oils and meals is also significantly increased while the one of biodiesel is decreased.

Given that developed countries apply tariff escalation in oilseeds value chain, policy which has a negative impact on production at processed stages in countries like Argentina, Ukraine or Indonesia, DETs allow to retaliate against tariff escalation and to augment production in these countries. In that sense DETs are a coherent response, but they generate distortions and may harm consumers in other parts of the world as well. Therefore our paper shows that if export taxes are a significant trade distortion that merits specific attention from international organization like WTO, tariff escalation is also a distortive trade policy that impacts significantly production structure in emerging and developing countries.

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