



INTERNATIONAL FOOD POLICY
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IFPRI Discussion Paper 01236

December 2012

**Differential Export Taxes along the Oilseeds
Value Chain**

A Partial Equilibrium Analysis

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PARTNERS AND CONTRIBUTORS

IFPRI gratefully acknowledges the generous unrestricted funding from Australia, Canada, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, the Netherlands, Norway, the Philippines, South Africa, Sweden, Switzerland, the United Kingdom, the United States, and the World Bank.

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ABSTRACT

This research has been undertaken to understand the rationale for the implementation of decreasing export taxes along the value chain in middle-income countries, in particular in the oilseeds value chain. 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 of 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. The authors 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 the authors develop a world partial equilibrium model of the oilseed value chain that illustrates these theoretical conclusions. They simulate (1) the elimination of DETs in Argentina, Indonesia, and Ukraine; (2) the elimination of import tariffs applied by the European Union (EU) and the United States on the same goods; and (3) the elimination of DETs in Argentina, Indonesia, and Ukraine and of import tariffs applied by the EU and the United States. According to the authors' estimates, both consumers and producers throughout the world benefit from the removal of export taxes in these value chains: US\$931 million and US\$2.2 billion, respectively. 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 1 percent.

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

JEL codes: F13, F14, F15

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. The Organization for Economic Cooperation and Development (2010) concludes that the number of WTO countries that apply export taxes is increasing: during the 2003–09 period, 65 among 128 WTO members 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 wherein 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 to promote production at more processed stages of the value chain. This tax system is sometimes referred to as Differential Export Taxes (DETs).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 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 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—nondistorted—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 that 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)—provides good overviews of theoretical developments and empirical assessments of the use of export taxes. Deardorff and Rajaraman (2005) explore 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 profits of the monopsonist. Bouet and Laborde (2012) assess the rationales for export taxes in the context of a food

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

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

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 policymakers 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, DETs 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 DET's implementation 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 10 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 3 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 Union and the United States) on the same goods. This exercise is important to evaluate the international costs and benefits of export taxation. It is also relevant 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 on results from three policy shocks. Finally, Section 4 gives concluding remarks.

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

2. A STYLIZED THEORETICAL MODEL ABOUT 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 homogeneous 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 The total supply of vegetable oils on country 1's market is $X = x + y$, and the inverse demand function is $p = p(X)$, with p being the demand price and $p' < 0$. The supply of vegetable oil on country 2's market is z , and the inverse demand function is $q = q(z)$, with q being the demand price and $q' < 0$. Imports y of vegetable oils by country 1 may be taxed with a specific tariff t_1 .

The international transportation of vegetable oils implies costs that are of iceberg type: Offering 1 unit on country 1's domestic market requires the production of $1/g$ units of vegetable oil in country 2 with $0 < g < 1$.

Production of vegetable oils requires the intermediate consumption of a raw agricultural commodity (let us have in mind soy) that for simplicity we suppose is 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.⁵ Therefore, world demand for soy is $x + z + y/g$.⁶

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 an 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.

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 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's (1984) theoretical model.

⁵ If we consider another 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.

⁶ 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 intend to illustrate just 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 $t_1 > 0$, whereas a DET is applied in country 2 if $t_2 > 0$.⁷ In the vegetable oils sector, profits are π_1 for country 1's firm and π_2 for country 2's firm, with

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

and

$$\pi_2 = yp(x + y) + zq(z) - (w - t_2)(z + \frac{y}{g}) - t_1y. \quad (2)$$

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

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

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

and

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

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:

$$\pi_{1xx} < \pi_{1xy} < 0 \quad \text{and} \quad \pi_{2yy} < \pi_{2yx} < 0. \quad (6)$$

This ensures the stability of the Nash equilibrium. 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

$$\pi_{1xx}dx + \pi_{1xy}dy + \pi_{1xt_1}dt_1 = 0$$

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

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

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

and

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

Thanks to equation (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.

⁷ 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.

If we turn now to 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 the 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 $\pi_{2yt_2} = 1/g$, we get

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

and

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

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 the total supply of vegetable oil and decreases its price in country 1. The equilibrium condition of the soy market brings

$$\begin{aligned} s_1 + s_2 &= w + \alpha(w - t_2) = x + \frac{y}{g} + z \\ \Leftrightarrow ((1 + \alpha)p'q'g^2 - q'g^2 - q' - g^2p')w - gq't_1 - (\alpha p'g^2q' - q' - g^2p')t_2 \\ &+ pqq'(1 + g) \\ &+ qg^2p' = 0 \end{aligned} \quad (11)$$

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.

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

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

In both countries there is a local demand for vegetable oils, and local consumers' surplus (CS_i) is affected by these policies. We suppose $CS_1 = CS_1(x + y) = (x + y)^2/2$ and $CS_2 = CS_2(z) = z^2/2$ with $CS_1' > 0$ and $CS_2' > 0$. As 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 the vegetable oils industry, public revenues, farmers, or vegetable oils consumers. We consider that both countries' governments maximize the sum of firms' profits and final consumers in the processed sector, public revenues, and farmers' surplus. Of course this assumption is a little bit arbitrary, and the literature on political economy has often concluded on other assumptions.⁸ 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

$$\begin{aligned} \pi_1 x_{t_1} + \pi_1 y_{t_1} + \pi_1 z_{t_1} + \pi_1 t_1 + y + t_1 y_{t_1} + (x + y)(x_{t_1} + y_{t_1}) + ww_{t_1} &= 0 \\ \pi_2 x_{t_2} + \pi_2 y_{t_2} + \pi_2 z_{t_2} + \pi_2 t_2 + s_2 - z - \frac{y}{g} + t_2 \left[\alpha(w_{t_2} - t_1) - z_{t_2} - \frac{y_{t_2}}{g} \right] + zz_{t_2} + \\ \alpha(w - t_2)(w_{t_2} - t_1) &= 0. \end{aligned}$$

Since $\pi_1 x = 0$, $\pi_1 y = xp'$, $\pi_1 z = 0$, and $\pi_1 t_1 = 0$, but also $\pi_2 y = 0$, $\pi_2 x = yp'$, $\pi_2 z = 0$, and $\pi_2 t_2 = z + y/g$, we obtain

$$t_1 = \frac{xp'y_{t_1} + ww_{t_1} + (x+y)(x_{t_1} + y_{t_1}) + y}{(-y_{t_1})} \quad (18)$$

and

$$t_2 = \frac{yp'x_{t_2} + \alpha ww_{t_2} + zz_{t_2}}{\alpha + z_{t_2} + \frac{y_{t_2}}{g}} > 0. \quad (19)$$

We see that $\frac{d\pi_1}{dt_1} = xp'y_{t_1} > 0$, $\frac{dFS_1}{dt_1} = ww_{t_1} < 0$, and $\frac{dCS_1}{dt_1} = (x + y)(x_{t_1} + y_{t_1}) < 0$. So the import tax on vegetable oil in country 1 raises the profit of the vegetable oil firm, decreases farmers' surplus (through a decrease in the 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 $t_1 = -y/y_{t_1} > 0$.

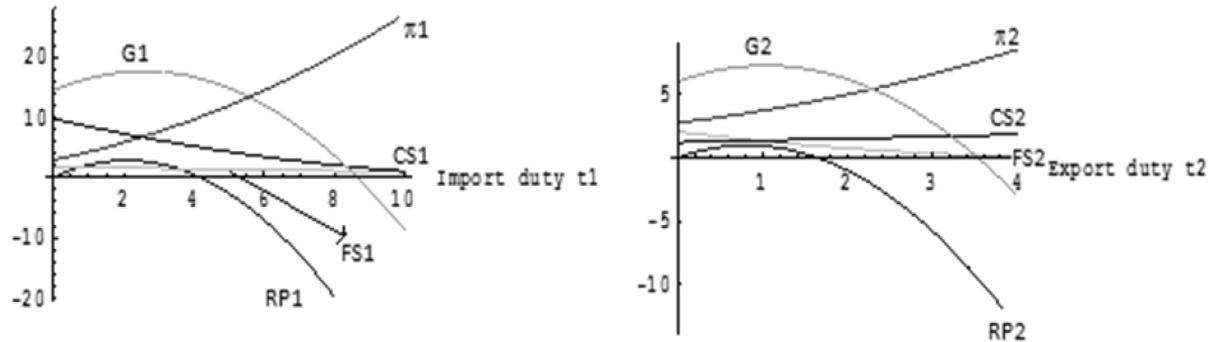
We also get $\frac{d\pi_2}{dt_1} = \pi_2 x_{t_1} + \pi_2 y_{t_1} + \pi_2 z_{t_1} + \pi_2 t_1 = yp'x_{t_1} - y < 0$. Thus, the import tax on oil in country 1 decreases the profit of country 2's vegetable oil firm.

We also see that $\frac{d\pi_2}{dt_2} = yp'x_{t_2} > 0$, $\frac{dFS_2}{dt_2} = \alpha(w - t_2)(w_{t_2} - 1) < 0$, and $\frac{dCS_2}{dt_2} = zz_{t_2} > 0$. So the export tax on soy in country 2 raises the 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 $t_2 = 0$, $\frac{dPR_2}{dt_2} = \alpha(w - t_2) - z - y/g > 0$ and PR_2 maximum for $t_2 = \frac{-[\alpha(w - t_2) - z - y/g]}{\alpha(w_{t_2} - 1) - z_{t_2} - \frac{y_{t_2}}{g}} > 0$.

⁸ See, for example, Grossman and Helpman (1994).

Figure 2.1 illustrates the impact of an import tariff on vegetable oil in country 1 (in the left part) and of an export tax on soy in country 2 (in 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 , g , 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 2.1—An illustration of the impact of tariff escalation and differential export tax



Source: Authors' calculation.

Notes: The left-hand side of the graph represents country 1's vegetable oils firm profits (π_1), vegetable oils consumers' surplus (CS1), public revenues (PR1), farmers' surplus (FS1), and national surplus (G1). The right-hand side of the graph represents country 2's vegetable oils firm profits (π_2), public revenues (RP2), farmers' surplus (FS2), and national surplus (G2). This representation has been designed for parameters $a = 8$, $b = 4$, $g = 0.95$, 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 103.55 percent. On the right-hand side, export tax in country 2 varies, with import duty in country 1 being equal to 258.618 percent. Both taxes are optimal levels for $a = 8$, $b = 4$, $g = 0.95$, and $\alpha = 5$.

With this first theoretical model we learned 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 a policy response to tariff escalation in the developed country in the sense that it augments the objective of the government when this objective consists of 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. Although 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.

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, and so forth) 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 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, and then we present the model.

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).⁹ Meals and oils are produced from crushed seeds, whereas biodiesel is produced from oils. In the model developed here, we consider four types of seeds: soybeans, sunflower seeds, palm nuts, and rapeseeds.¹⁰ 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. The biodiesel industry competes with final consumers in the demand for oils. Final consumers substitute imperfectly the different types of oils.

According to the Food and Agriculture Organization of the United Nations' 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 has applied export taxes on crude palm oil and processed palm oil, and the rates have changed according to the level of international prices to ensure domestic availability of the product, as cooking oil is considered by the Indonesian government 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).¹¹ 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.

⁹ 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.

¹⁰ 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).

¹¹ Indonesia adjusts export tax rates constantly according to international prices.

Some importing countries impose import duties on oilseeds products. Even though the range of import duties applied in the sector is wider than the range of export taxes, we can mention two big players that apply tariff escalation in the sector: European Union and United States. Both apply import tariffs on vegetable oils and no tariffs on oilseeds.¹²

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 United States.

A Partial Equilibrium Model of the Oilseed Sector

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, 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 , $Ps_{i,r}$ 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

$$Y_{s_{i,r}} = Ks_{i,r}A_{i,r}Ps_{i,r}^{\varepsilon_{i,r}} \quad , \quad (20)$$

where $Ks_{i,r}$ 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.

$$Yo_{i,r} = \alpha_{o_{i,r}}Cs_{i,r} \quad (21)$$

and

$$Ym_{i,r} = \alpha_{m_{i,r}}Cs_{i,r} \quad (22)$$

where $Cs_{i,r}$ is the demand for crushed seeds i in region r , $Yo_{i,r}$ and $Ym_{i,r}$ are the production of oils and meals in region r , and $\alpha_{o_{i,r}}$ 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 equation (23), which determines the price and quantity links between the seeds and the by-products 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

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

¹² In fact, the United States does not strictly implement 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 the United States in the palm value chain, where tariffs are equal to 0).

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 $am_{i,r}$, 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 and Yb_r is the production of bioenergy in country r . Demand for composite oil by the biodiesel sector will depend on the production margin (see equation [26]), which is determined by the prices of composite oil and biodiesel.¹³

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

and

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

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 the biodiesel sector (intermediate consumption). Agents have an isoelastic demand for composite oil, which is a Constant Elasticity of Substitution (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: 2.¹⁴ This CES assumption leads to the three following equations:

$$Ccomp_{o_{h,r}} = Ko_{h,r} Pcomp_{o_{h,r}}^{\sigma_{l,r}}, \quad (28)$$

$$Co_{i,f,r} = aC_{i,f,r} Ccomp_{f,r} \left(\frac{Pcomp_{f,r}}{Po_{i,r}} \right)^{\sigma_{o_{i,r}}} \quad (29)$$

and

$$Pcomp_{f,r} Ccomp_{f,r} = \sum_i Po_{i,r} Co_{i,f,r} \quad (30)$$

where $Ccomp_{o_{h,r}}$ is the demand for composite oil by households in region r , $Pcomp_{o_{h,r}}$ is the price of composite oil faced by households, $Ko_{h,r}$ is a scale parameter, and $\sigma_{l,r}$ is the elasticity of demand to price. $Co_{i,f,r}$ 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, $Po_{i,r}$ is the price of oil i in country r , and $aC_{i,f,r}$ 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.

$$Cm_{i,r} = Km_{i,r} Pm_{i,r}^{\sigma_{m_{i,r}}} \quad (31)$$

¹³ So we suppose a constant markup in the oil industry. This assumption differs from a monopolistic competition assumption since monopolistic competition is a more complex market structure with monopoly and markup in the short run and perfect competition, free entry, and elimination of abnormal profits in the long run.

¹⁴ We tested the sensitivity of results to this value. Results are only marginally affected. They are available on request.

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

$$Cb_r = Kb_r Pb_r^{\sigma_{b_{i,r}}} \quad (32)$$

where Cb_r is the final demand for biodiesel in country r , Pb_r is the price of biodiesel, $\sigma_{b_{i,r}}$ is a price demand elasticity, and Kb_r is a scale parameter. In the international market, we assume that goods are homogeneous. 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 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).

$$XS_{i,r} + CS_{i,r} = YS_{i,r} \quad (33)$$

$$XO_{i,r} + \sum_f CO_{i,f,r} = YO_{i,r} \quad (34)$$

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

and

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

The international price parity equations (equations [37] to [40]) establish that without distortions, in the form of export taxes (*exp*) or import tariffs (*imp*), 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, whereas the opposite happens if the country imposes a positive import tariff.

$$PS^* = PS_{i,r} \frac{(1+exp_{s_{i,r}})}{(1+imp_{s_{i,r}})} \quad (37)$$

$$PO^* = PO_{i,r} \frac{(1+exp_{o_{i,r}})}{(1+imp_{o_{i,r}})} \quad (38)$$

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

and

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

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.

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

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

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

and

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

To calibrate the model, we take data on production, consumption, and trade from the Food and Agriculture Organization of the United Nations' food balance sheet (year 2007). Values of the elasticities are taken from the Food and Agriculture Policy Research Institute.¹⁵ Data on export taxes come from different sources (trade policy reports, WTO, Organization for Economic Cooperation and Development), whereas import duties are from Laborde (2010). Table 3.1 and Table 3.2 present the export taxes and import tariffs applied on oilseeds at the benchmark, whereas Table 3.3 shows the net exports of commodities for each region in volume.

Table 3.1—Export taxes applied at benchmark (in percentages)

		Seeds	Oils	Meals	Biodiesel
Soy	Argentina	35	32	32	20
Palm	Indonesia	40	25	0	3
Palm	Malaysia	0	30	0	0
Sunflower	Argentina	32	30	30	-
Sunflower	Ukraine	12	0	0	0

Source: Authors' computations based on multiple sources.

Table 3.2—Import duties applied at benchmark (in percentages)

		Seeds	Oils	Meals
Palm	European Union	0.00	6.68	0.00
Palm	United States	0.00	0.00	0.00
Soy	European Union	0.00	5.17	0.13
Soy	United States	0.00	17.13	1.75
Sunflower	European Union	0.00	6.07	0.00
Sunflower	United States	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.

¹⁵ See <http://www.fapri.iastate.edu/tools/elasticity.aspx>.

Table 3.3—Net exports at benchmark (in thousand metric tons)

Type of Seed	Commodity	Argentina	Brazil	United States	China	India	Indonesia	EU	Malaysia	Ukraine	Canada	Rest of the World
Palm	Seeds	0	0	0	0	1	18		-73	0	0	54
Palm	Meals	0	0	0	0	0	2,528	-2,268	1,960	0	0	-2,220
Palm	Oils	-6	-87	-270	-380	-147	1,332	-857	500	-48	-28	-9
Rapeseed	Seeds	11	-18	-323	-835	25	0	-450	0	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	0	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	0	324	128	-1,694
Sunflower	Meals	838	-2	-3	-3	43	4	-1,817	0	1,305	0	-365
Sunflower	Oils	852	-15	68	-79	-79	0	-1,109	0	1,242	-50	-830
	Biodiesel	412	4	783	42	0	42	-1,297	33	0	41	-60

Source: Authors' computations based on Food and Agriculture Organization of the United Nations data.

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, 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.

Simulation Results

We now use 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 3.1]; scenario S1); second, we remove import duties in countries implementing tariff escalation (EU and United States; scenario S2); third, we study the removal of DETs in Argentina, Indonesia, and Ukraine and of import duties in the EU and the United States (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 3.4 (changes in international prices are indicated in the last column).¹⁶ 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 prices for other types of seeds. This happens because Indonesia, which controls 25 percent of world exports (see Table 3.3), imposes high export taxes on the palm oil sector (40 percent; see Table 3.1).

Table 3.4—Impact of export tax elimination in Argentina, Indonesia, and Ukraine on domestic and international prices (in percentage change): Scenario S1

		Argentina	United States	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

¹⁶ For clarity of presentation, we present results from only the three countries implementing a Differential Export Tax and the two countries implementing tariff escalation. Consequently, comments may concern figures that are not presented in the tables. All results are available on request.

and vegetable oils may be made from different seeds, and as the international price of other seeds decreases, 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, the international price of meals made from rapeseeds increases. In the oil sector, substitutability is lower, and international price decreases, but the fall is less pronounced than for other oils.

As Table 3.4 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. The magnitude of variation in domestic prices is directly related to the value of the export tax that was initially in place.

For 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 simulate only the elimination of export taxes on meals and oils, their production and exports would increase. The opposite would happen if we only eliminated 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 3.5 shows. A similar picture is found for the sunflower sector in Argentina and the palm value chain in Indonesia.

Table 3.5—Impact of export tax elimination in Argentina, Indonesia, and Ukraine on production (in percentage change): Scenario S1

		Argentina	United States	Indonesia	EU	Ukraine
Seeds	Soy	8.9	-1.0	-1.0	-0.7	-1.0
Seeds	Sunflower	3.9	-0.7		-0.5	2.7
Seeds	Rape	-0.1	-0.2		-0.2	-0.2
Seeds	Palm			8.0		
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	0.0	1.2	0.0	1.8
Oils	Sunflower	5.1	0.0	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.

When a DET is removed in one country, there are two antagonist effects on cultivation of other seeds: (1) 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. (2) 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, 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 true of Indonesia with soybeans and sunflower seeds. Finally, the reduction in international prices leads to a reduction in domestic prices in countries that do not change their policies (United States and EU).

From Table 3.5 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 and a much smaller one 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.¹⁷ Thus, although the claim that DET in agricultural commodity-exporting developing countries is a policy response to tariff escalation in developed countries to support processing industries is a valid statement, a high export tax on the last stage of processing is not a valid policy to promote industrialization and only increases fiscal revenue.

Table 3.6 presents the value of consumers' and producers' surplus variations and also public revenues due to a simultaneous elimination of DETs in Argentina, Indonesia, and Ukraine.¹⁸ 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 US\$931 million¹⁹ in consumers' surplus throughout the world. In Ukraine the DET consists of a single export tax on sunflower seeds, whereas exports of oils, meals, and biodiesel are not taxed. Removing the export tax on sunflower seeds has an expansionary effect on exports to the detriment of sales on the domestic market. The 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 3.6—Variation in consumers' and producers' surpluses and public revenues from removal of export taxes in Argentina, Indonesia, and Ukraine (in millions of US dollars): 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.

¹⁷ 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.

¹⁸ With 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 that could be affected through the variation of meals price. Therefore, if the removal of trade policies leads to a decrease in meals price, we underestimate the positive impact on buyers of meals (or on final consumers).

¹⁹ All dollars are US dollars.

Concerning producers, let us keep in mind that producers' surplus consists of 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 benefited 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 taxes on biodiesel but are hurt by the removal of export taxes on vegetable oils, which increases their production costs. The second effect is larger, and Argentine producers of biodiesel lose surplus. These are farmers who benefit the most (and by far) from the removal of export taxes (82 percent of the total gain), whereas 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 implies a global augmentation of producers' surplus by \$2,200 million.

Removing export taxes means less public revenue 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 3.3). But removing all export taxes also means 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 United States is specific since US imports are concentrated on meals made from rapeseeds (see Table 3.3), and this is the only commodity for which international prices increased in this scenario: Consequently imports decreased, and so did 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.²⁰

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 United States impose tariffs: vegetable oils. As shown in Table 3.7, international prices of all types of seeds also increase. Only soy meals are taxed at the benchmark (see Table 3.2), 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, whereas with 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 3.7. The rise in international prices is higher for oils as a consequence of the direct effect. The international price of biodiesel also increases by 1.64 percent.

²⁰ Other countries also apply import duties on these products. However, to simplify the analysis, we simulate only the elimination of tariffs in the two regions that apply an increasing rate along the production chain.

Table 3.7—Variation in domestic and international prices from removal of import duties in the EU and the United States (in percentages): Scenario 2

		Argentina	United States	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	2.0
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.

Table 3.7 also points out the variation of domestic prices in this scenario. In the European Union and the United States, 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 European Union, which benefits from a removal of tariffs but simultaneously augments its world price.

As we might expect, the EU and the United States increase their imports of oils and meals, whereas the rest of the regions increase their exports to these markets. This is particularly true with sunflower and palm oil in the EU, with an increase of 12.9 percent and 4.0 percent of European imports, respectively. US imports of meals made from sunflower increase by 79.7 percent and those made from rapeseeds by 0.5 percent.

In the EU and the United States the elimination of tariff implies positive or negative variations of production depending on the value chain and the stage of processing (Table 3.8). 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 United States): 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 United States, whereas the direct effect predominates for biodiesel in the EU.

Table 3.8—Variation in production from removal of import duties in the EU and the United States (in percentages): Scenario S2

		Argentina	United States	Indonesia	EU	Ukraine
Seeds	Soy	0.1	0.1	0.1	0.0	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.

Table 3.9 presents the value of the consumers' and producers' surplus variations and also public revenues due to a simultaneous elimination of import duties in the EU and the United States.²¹ As expected, consumers in the EU and the United States 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 United States 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 United States, seeds cultivation (positive demand effect) and production of biodiesel (positive production cost effect) benefit from the removal of import duties all along the value chain, whereas the crushing activity (meals and oils) is negatively affected (-\$1,308 million): The direct effect, related to the loss of protection from abroad, is predominant.

Table 3.9—Variation in consumer and producer surpluses and public revenues from removal of import duties in the EU and the United States (in millions of US dollars)—scenario S2

	Argentina	United States	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.

²¹ The same restrictions as for surpluses calculated in scenario S1 apply here.

Removing import duties means less public revenues for the EU and the United States. But it also means 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 Argentina and Indonesia in Table 3.9.

Elimination of DETs in Argentina, Indonesia, and Ukraine and of Import Duties in the EU and United States

Let us turn now to the last scenario, which consists of removing both export taxes in Argentina, Indonesia, and Ukraine and import tariffs in the EU and United States. 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 United States 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 1 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 3.10) 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), whereas production of soy oil would contract by 5 percent in the United States and of sunflower oil by 3.7 percent in the EU. The international production of meals would change similarly.

Table 3.10—Impact on domestic production of elimination of Differential Export Taxes in Argentina, Indonesia, and Ukraine and of import duties in the EU and US (in percentage change)

		Argentina	United States	Indonesia	EU	Ukraine
Seeds	Soy	8.9	–1.0	–1.0	–0.6	–1.0
Seeds	Sunflower	3.9	–0.6		–0.4	2.9
Seeds	Rape	0.0	–0.6		0.0	0.0
Seeds	Palm			8.3		
Meals	Soy	5.7	–5.0	3.3	0.0	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			0.0		
Oils	Soy	5.7	–5	3.3	0.0	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			0.0		
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 DET rates along production value chains 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 learned 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 whereas 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 (that is, 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 whereas biodiesel is decreased.

Given that developed countries apply tariff escalation in the oilseeds value chain, a policy that has a negative impact on production at processed stages in countries such as Argentina, Ukraine, and Indonesia, DETs allow retaliation against tariff escalation and augmentation of 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 organizations such as WTO, tariff escalation is also a distortive trade policy that significantly affects the production structure in emerging and developing countries.

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