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Non-Tariff Measures when Alternative Regulatory Tools can be Chosen

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Abstract

This paper analyzes whether or not different non-tariff measures (NTM) like a standard or a mandatory label can be considered as protectionist in presence of market imperfections. From a welfare-based approach, protectionism occurs when the instrument maximizing domestic welfare is different from the alternative instrument maximizing international welfare inclusive of foreign profits. A framework taking into account different tools shows the complexity for characterizing protectionism related to different NTM. When the standard impacts variable costs, the mandatory label can be protectionist. When the standard impacts sunk costs, the standard can be protectionist. The framework is also useful for empirically characterizing the impact of NTM related to a specific product. An application to shrimp trade illustrates the feasibility of the welfare measure, for an *ex ante* evaluation of possible environmental regulations that could be implemented in the future. This application confirms that the tool maximizing domestic welfare does not systematically correspond to the tool maximizing international welfare.

Keywords: Non-tariff measures, market failure, trade, welfare

JEL Classification: F13**,** D61, Q17

1. Introduction

Regulations are enforced by governments in order to address market failures or societal problems, in a context where unregulated markets are not leading to the best allocation. However, some of these regulatory measures can be motivated by protectionism, since trade flows are often affected by non-tariff measures (NTMs). Different countries may have antagonistic social preferences resulting in possible contentious regulations, and there are some debates regarding the impact of regulation on trade and economic efficiency (see, Josling et al., 2004 and Cadot et al., 2013).

Several disputes related to environmental or human health regulations were arbitrated by the World Trade Organization (WTO), including the shrimp-turtle case between the US and India, Malaysia, Pakistan and Thailand in 1998 and 2001 (see a review by the WTO, 2014a). Recently, a WTO's Appellate Body ruling, released on May 22 2014, upheld the European Union's ban on the import of seal products, by arguing that concerns about animal welfare can dominate trade interests (see Sykes, 2014, and WTO, 2014b). These WTO decisions based on the article XX of the General Agreement on Tariffs and Trade (GATT) show the possibility to implement stringent environmental or human health regulations, if these choices are not discriminatory between domestic and foreign producers.

New contentious issues have also recently gained momentum, which suggests that new NTM questions could hit the headlines in the future. In particular, one of stumbling blocks of the ongoing EU-US talk for a free trade agreement, entitled Trans-Atlantic Trade and Investment Partnership, concerns food safety. Thus, chicken washed in chlorine, meat treated with artificial beef hormones and/or some genetically modified crops, allowed in the US and actually banned in Europe could enter Europe under this possible new free trade agreement (Pica and Stoczkiewicz, 2013). Moreover, for another sector, the EU's fuel quality directive that disadvantages sands oil could be renegotiated because of this EU-US free trade agreement. Beyond this forthcoming free trade agreement, carbon footprint taxations for the reduction of CO2 emissions also raised many challenges regarding their impact on both domestic and import products and the compliance with the WTO rules (McAusland and Najjar, 2014). Alternatively, the building collapse that killed over 1,000 workers in Dhaka, Bangladesh, on April 2013 raised some important questions about the links between safety norms for workers and clothes trade. Eventually, controversies around the negative impact of palm oil or soybean on the environment suggest that new regulations, such as stringent standards for protecting rainforest and/or a mandatory label signaling the sustainability of imports could be enforced by retailers or nations, which could be ultimately characterized as a protectionist NTM (van Berkum and Bindraban, 2008, Greenpeace, 2007, Grothe et al., 2000).

All these previous examples suggest that future conflicts between domestic and foreign partners are possible with new regulations related to health, ethics and/or environment. However, as dispute settlements are lengthy, litigious and complex, there are important economic benefits to avoid conflicts for guaranteeing free trade with efficient regulations. One way to promote transparent and efficient regulation consists in studying the impact of all possible regulatory options on both domestic and international welfares. The methodology presented in this paper can be used for helping solve trade disputes related to the article XX of the GATT, clarify benefits and costs of future trade agreements, and/or understand the impact of future regulations decided at the international level. The Codex Alimentarius for food, the International Atomic Energy Agency for nuclear safety and the Basel Committee on Banking Supervision for bank solvency (...) epitomize policymakers with international welfare objectives.

In this paper, we analyze the impact of different regulatory tools that can be chosen by a welfare-maximizing policymaker, with domestic objective or international objective. In a partial equilibrium setup, foreign producers sell a product in the domestic market, in presence of consumption externalities. The policymaker may choose either a standard for eliminating externalities or a mandatory label informing consumers about externalities and damage. Both instruments are costly and have to be met by foreign producers when they are selected.

Protectionism occurs when the tool maximizing the domestic welfare is different from the international tool maximizing welfare inclusive of foreign profits. We kept the term "protectionism" as a direct reference to the definition given by Fisher and Serra (2000), even if some readers would alternatively prefer the terms "non-legitimate regulation" or "contentious regulation" in case of discrepancies between domestic and international regulations. We show that the instrument, characterized as protectionist, depends on the foreign producers' cost structure. When the standard impacts variable costs, the mandatory label can be protectionist. When the standard impacts sunk costs, the standard can be protectionist.

The empirical part focuses on shrimps and environmental regulations. An application to shrimp trade illustrates the feasibility of the welfare measure, for an *ex ante* evaluation of possible environmental regulations that could be implemented in the future. The framework integrates experimental results regarding the consumers' WTP for the characteristic(s) influenced by the regulation, namely the environmental impact of shrimps. This application confirms that the tool maximizing domestic welfare does not systematically correspond to the tool maximizing international welfare. The methodology could be implemented *ex ante,* when controversial policies are planned to be enforced by one country.

This paper differs from previous NTM papers studying foregone trade and/or trade costs (Disdier and van Tongeren, 2010). Gravity analyses allow to measure trade impeding effects and sometimes trade expanding effects of NTMs (see Disdier et al., 2008 and Czubala et al., 2009). Effects of NTMs have also been studied with partial and general equilibrium simulation models, usually by parameterizing NTM as tariff-equivalent in the import demand or export supply functions, as detailed by Ferrantino (2006), Kee et al. (2009), Korinek et al. (2008) and Yue et al. (2006). Our paper differs from these previous contributions by precisely focusing on consumers' preferences and surpluses, and by comparing welfare impact of different regulatory tools.

This paper also contributes to the theoretical literature on protectionism and regulation developed by Fisher and Serra (2000). These authors only study one instrument, namely a minimum-quality standard, and the protectionism coming from this standard is defined by a higher level under a domestic regulation than the selected level under the international regulation. Bureau et al. (1998) and Tian (2003) study some alternative scenarios with a label signaling a high-quality characteristic. Our paper differs by directly and endogenously comparing several regulatory instruments. Our paper raises the complexity of characterizing a regulatory tool as protectionist, since different tools should be compared before claiming protectionism.

Eventually, this paper is related to some previous empirical estimations of the impact of NTM on the welfare, as studied by van Tongeren et al. (2009 and 2010), Disdier and Marette (2010), Beghin et al. (2012) and Beghin (2013). However, our paper differs from these approaches by insisting on the comparison between some alternative regulatory tools. The novelty of our approach also consists in simulating the impact of different regulatory instruments *ex ante*, namely before any real political decision.

The paper is structured as follows. Section 2 presents the model. Section 3 presents theoretical developments focusing on standards and labels with domestic objective or international objective. Section 4 details the empirical application. Section 5 concludes.

2. A simple model

This section presents a simplified framework that tailors both theoretical and empirical sections. The analytical simplifications allow a sharper focus on the implications of regulatory choices. The welfare-based approach is used to define optimal non-tariff trade policies, both from a domestic and global point of view as advised by Baldwin (1970). When market imperfections/failures are present, the interface between NTMs, trade and welfare is more complex than the simple mercantilist message.

For simplicity, foreign consumers and governments are not included here, and the administrative cost of regulation including the public label is zero. We assume that, without regulation, all producers offer a good with a specific characteristic (related to an environmental problem) that domestic consumers do not want. In the absence of regulation, consumers are initially unaware of the negative characteristic before the purchase, which gives no incentive for firms to get rid of this characteristic.

A competitive industry with price taking firms is assumed. There are M_O domestic firms and M_F foreign firms. Firms' cost functions are assumed quadratic in output for tractability purposes. For a given price *p*, a firm *j* chooses output to maximize profits:

$$\pi_{uj} = pq_{uj} - Max\left[1, Max(\delta_{uj}, S) \times \lambda_u\right] \times \left(f_u q_{uj} - \tfrac{1}{2}\bar{c}_u q_{uj}^2 \right) - Max(\delta_{uj}, S)\bar{K}\ , \qquad (1)$$

for $j=\{1,\ldots,M_u\}$ and $u=\{O, F\}$ denoting domestic and foreign. In equation (1), $\bar{c}_u$, f_u are the variable cost parameters. The parameter λ_u with $\lambda_u > 1$ is a measure of the increase in variable cost coming from this effort for improving quality and eliminating the negative characteristic. $\bar{K}$ is a sunk cost linked to the effort for eliminating the negative characteristic related to the low-quality. This sunk cost $\bar{K}$ is incurred before producing and cannot be recovered. For simplicity, we assume that this sunk cost does not impact the entry/exit of firms, since its level is relatively low compared to the gross profit (see the end of this section for the alternative).

In equation (1), $Max(\delta_{uj}, S)$ is related to the decision of improving quality of the product and getting rid of the negative characteristic. The private decision to make an effort leads to $\delta_{uj} = 1$, while the absence of effort corresponds $\delta_{uj} = 0$. The effort also depends on the regulatory choice detailed below. In equation (1), the implementation of the mandatory standard for all producers leads to *S*=1, while its absence leads to *S*=0. When $\delta_{uj} = S = 0$, the variable cost is $\left(f_u q_{uj} - \tfrac{1}{2} \overline{c}_u q_{uj}^2 \right)$, while when $\delta_{uj} = 1$ or $S = 1$, the variable cost is $\lambda_u \times \left(f_u q_{uj} - \tfrac{1}{2} \overline{c}_u q_{uj}^2 \right)$ with $\lambda_u > 1$. Note that the quality choice is discrete (1 or 0), simplifying the analysis compared to an alternative configuration in which a continuous possibility of efforts gradually reduces the per-unit damage related to the consumption (see Polinsky and Rogerson, 1983).

Profit maximization yields individual firm supply functions that are added up to yield industry supply by country and quality segments. After inverting these supplies, it is possible to have inverse supplies equations. Without any standard (*S*=0), the inverse supplies for the low (*L*) and high (*H*) quality products by domestic (O) and foreign (F) firms are expressed as

$$\begin{cases} p_{OL}^S(Q_{OL}) = c_O Q_{OL} / (1-\beta_O) + f_O \\ p_{OH}^S(Q_{OH}) = \lambda_O \left(c_O Q_{OH} / \beta_O + f_O \right) \\ p_{FL}^S(Q_{FL}) = c_F Q_{FL} / (1-\beta_F) + f_F \\ p_{FH}^S(Q_{FH}) = \lambda_F \left(c_F Q_{FH} / \beta_F + f_F \right) \end{cases} \quad (2)$$

with $c_O = \overline{c}_O / M_O$ and $c_F = \overline{c}_F / M_F$. β_O and β_F are the respective proportion of domestic and foreign suppliers choosing the effort, for getting rid of the negative characteristic, with $\delta_{Oj} = 1$ and $\delta_{Fj} = 1$ in equation (1). If no quality effort is made, then $\beta_O = 0$ and $\beta_F = 0$, and the supplies for high-quality are $Q_{OH} = Q_{FH} =$ 0 because $p_{OH}^S(Q_{OH}) \to +\infty$ and

$p^S_{FH}(Q_{FH}) \to +\infty$. If the standard is imposed, then $\beta_O = 1$ and $\beta_F = 1$, and the supplies for low-quality are $Q_{OL} = Q_{FL} = 0$ because $p^S_{OL}(Q_{OL}) \to +\infty$ and $p^S_{FL}(Q_{FL}) \to +\infty$.

The characterization of consumers preferences largely follows Polinsky and Rogerson (1983). Demand of each consumer i={1,…,N} is derived from a quasi-linear utility function that consists of the quadratic preference for the market good of interest and is additive in the numeraire:

$$U_i(q_{H\_i}, q_{L\_i}, w_i) = a(q_{H\_i} + q_{L\_i}) - \overline{b}(q^2_{H\_i} + q^2_{L\_i} + 2\theta q_{H\_i} q_{L\_i})/2 - Ir_i q_{L\_i} + Js_i q_{H\_i} + w_i, \quad (3)$$

where q_{H_i} and q_{L_i} are the respective consumptions of high and low quality products. The parameters $a, \overline{b} > 0$ allow to capture the immediate satisfaction from consuming products and w_i is the numeraire good. The parameter θ measures the degree of substitutability between low-quality and high-quality products, with $\theta = 0$ for independent products and $\theta = 1$ for perfect substitutes.

The negative effect of the characteristic coming from the low-quality product is captured by the term $-Ir_i\, q_{L\_i}$ with the per-unit damage r_i and the positive effect linked to the high-quality product is captured by $Js_i q_{H\_i}$ with the per-unit benefit s_i. The parameter I (respectively J) represents the consumers' knowledge regarding the negative characteristic of the low-quality product (respectively the high-quality product). If consumers are not aware of the characteristic related to each product, then I=0 (or J=0). However, the characteristic is accounted for in the welfare via the non-internalized damage (Foster and Just, 1989). Conversely, I=1 (or J=1) means that consumers are aware of the characteristic r_i (or s_i) and internalize it in the consumption.

Consumers see low and high-quality products as different when both products are offered and clearly signaled by a label, which impacts their utility. The maximization of utility defined by (3) with respect to q_{L_i} and q_{H_i}, subject to the budget constraint with prices p_L for the low-quality product and p_H for the high-quality product gives inverse demands $p_L = Max\left[0, a - Ir_i - \bar{b}(q_{L\_i} + \theta q_{H\_i})\right]$ and $p_H = Max\left[0, a + Js_i - \bar{b}(q_{H\_i} + \theta q_{L\_i})\right]$. With the respective-corresponding demands for every consumer, aggregate demand can be determined.

The aggregate demand are then inversed for having the overall inverse demand. With $b = \bar{b}/N$, $s_i = s$ and $r_i = r$ for i={1,…,N}, the overall inverse demands are:

$$\begin{cases} p_L^D(Q_L, Q_H, I, r) = Max\left[0, a - Ir - b(Q_L + \theta Q_H)\right] \\ p_H^D(Q_L, Q_H, J, s) = Max\left[0, a + Js - b(Q_H + \theta Q_L)\right] \end{cases} \quad (4)$$

When the high-quality is not offered on the market, because of absence of a credible label signaling it or because of the unawareness of consumers, $Q_H = 0$ and $p_H^D(Q_L, 0, J, s) = 0$. This implies a demand for low quality given by $p_L^D(Q_L, 0, I, r) = a - Ir - bQ_L$.

In the absence of regulation or private label, consumers are initially unaware of product differences regarding quality. For this configuration, they are also unaware of the negative characteristic before the purchase (with *I=0*), which gives no incentive for firms to deal with this characteristic. The regulation therefore may be enforced to protect domestic consumers regarding the negative characteristic conveyed by products.

Possible choices of regulatory tools

The regulator may choose between a label (or a campaign) and a standard.[1] We will assume

[1] A public campaign informing about a characteristic/problem provides information about dangerous products and maintains product diversity. However, a detailed message is very difficult to provide to consumers in real situations because of labels proliferation and consumers' imperfect recall, which is a shortcoming. An

that a mandatory label perfectly informs domestic consumers about the negative characteristic (*I=1*) linked to the consumption. Alternatively, the standard fully eliminates the negative characteristic r_i, but is costly for producers as detailed in equation (1). This standard eliminates the negative characteristic but consumers do not know it. In the following sections, different cases will be considered regarding the ability of individual producers to signal the high quality and the absence of the negative characteristic linked to an individual effort, when the standard is not selected. We now turn to some new theoretical results.

3. Theoretical results: market mechanisms and regulation

This section isolates stylized results that were overlooked by previous contributions. Some additional simplifying assumptions are made.

First, we consider a case without domestic producers for simplicity. As the domestic firms are absent, the additional compliance costs linked to the standard fall on foreign firms. Second, for each firm, the public label signaling the negative characteristic is impossible to thwart by a private campaign of information, signaling an effort to get rid of the damage. This corresponds to a case where the private signal is too costly or the private reputation for high quality is too long to build-up/recover for an individual producer. In this context, there is no product differentiation between good and bad products. In this section, the label only signals low-quality and the standard eliminates the negative characteristic without signaling it to consumers.

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alternative instrument that avoids revelation of information to consumers consists in selecting a minimum-quality standard getting rid of (or reducing) the damage. Even if no information is revealed with the mandatory standard, it reduces the negative effect of ignorance accounted in the complete participants' surplus. The shortcomings of this last instrument are a reduction of products diversity for consumers and additional costs for all products coming from both necessary inspections and expensive process of production.

Market mechanisms under the absence of regulation

In our context of absence of high-quality products signalled by a private label, the maximization of the utility function (3) under a budget constraint leads to the overall demand function $p_L^D(Q_L, 0, I, r) = a - Ir - bQ_L$. We slightly modify the notation for integrating the fact that the standard *S* eliminates the negative characteristic without informing consumers. The demand $p_L^D(Q_L, 0, I, r)$ becomes $p^D(Q, I, r) = a - (1-S)Ir - bQ$. In particular, the negative characteristic becomes $-(1-S)Ir$, where *S* is the standard. Under the absence of a label, a standard selected by the regulator (with *S=1*) eliminates the damage. When the standard is not implemented (with *S=1*), the label may provide information. Consumers are initially unaware of the damage with *I*=0. Without a label (*I*=0) the non-internalized damage should be accounted for in the welfare calculations, but does not feedback in the demand. Creating the awareness (*I*=1) depends on the mandatory public label implemented by the domestic regulator.

Regarding the firms' supply functions given by (2), the notations are slightly modified for integrating the fact that the standard *S* is the only way to improve the quality of the product, because of the absence of positive label. The overall inverse supply functions $p_{FL}^S(Q_{FL}) = c_F Q_{FL} / (1-\beta_F) + f_F$ and $p_{FH}^S(Q_{FH}) = \lambda\left(c_F Q_{FH} / \beta_F + f_F\right)$ are combined for becoming $p^S(Q\ , S) = Max[1, S\lambda]cQ$ with $f_F = 0$, $c_F = c$ and $\lambda > 1$. If the standard with *S*=1 is imposed, the variable costs increase with λ for all producers and the supply shifts upward. When *S*=0, no quality improvement is made and the variable cost does not increase for every producer.

At the equilibrium, the demand is equal to the supply, which leads to a price $p^* = Max[1, S\lambda]c\left(a - (1-S)Ir\right) / \left(b + Max[1, S\lambda]c\right)$ and an equilibrium quantity $Q(p^*)$. From (3) with no high-quality products and with an individual consumption equal to $Q(p^*)/N$, the overall surplus for the N consumers is defined by $NU_i\left(0, Q(p^*)/N, R - p^*Q(p^*)/N\right) - (1-S)(1-I)Q(p^*)r$, where R is the individual income (not detailed in the following expression). The non-internalized damage $(1-S)(1-I)Q(p^*)r$ is a cost of ignorance that only matters for ignorant consumers with I=0 and under the absence of standard with S=0. At the equilibrium, the consumers' surplus is

$$CS(I,S) = \frac{b\left(a-(1-S)Ir\right)^2}{2\left(b+Max[1,S\lambda]c\right)^2} - (1-S)(1-I)\frac{a-(1-S)Ir}{b+Max[1,S\lambda]c}r\,. \tag{5}$$

This value (5) is also the domestic welfare, since there are no domestic producers. For all foreign producers, the equilibrium profits are

$$\Pi(I,S) = \frac{Max[1,S\lambda]c\left(a-(1-S)Ir\right)^2}{2\left(b+Max[1,S\lambda]c\right)^2} - MS\overline{K}\,. \tag{6}$$

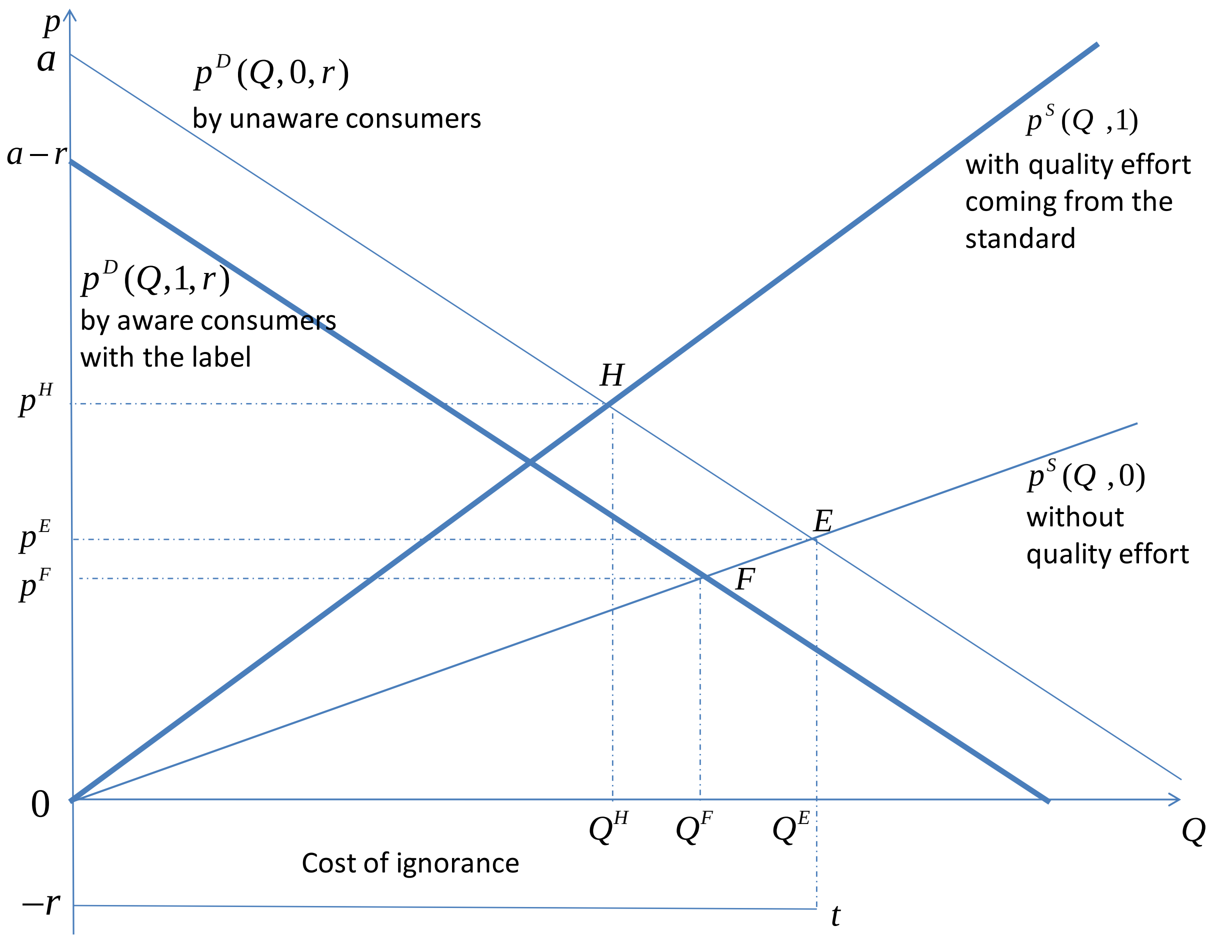
The international welfare is defined as the sum of foreign producers' profit and domestic consumers' surplus (or welfare), namely, $W(I,S) = CS(I,S) + \Pi(I,S)$, which leads to

$$W(I,S) = \frac{\left(a-(1-S)Ir\right)^2}{2\left(b+Max[1,S\lambda]c\right)} - (1-S)(1-I)\frac{a-(1-S)Ir}{b+Max[1,S\lambda]c}r - MS\overline{K}\,. \tag{7}$$

Equilibrium is first presented for the initial situation where consumers are unaware of the damage (*I=0*) when no regulation is implemented (with *S=0*). As consumers are not aware of the damage, firms have no incentive to reduce the damage.

Figure 1 shows domestic demand $p^D(Q,0,r)$ and foreign supply $p^S(Q\ ,0)$. The price, *p*, is located on the vertical axis and the quantity, *Q*, is shown along the horizontal axis. Free trade without regulation leads to an equilibrium *E*, where no effort is made for reducing the damage. The equilibrium price p^E clears the market by equalizing demand and supply with an overall equilibrium quantity Q^E. As there is no sunk cost with *S*=0, the profits correspond to area OEp^E for foreign producers. The usual surplus of domestic consumers corresponds to area $p^E aE$. The foreign products with the characteristic leading to the damage do not influence the demand since I=0. The corresponding cost of ignorance for domestic consumers is accounted for in the welfare calculations and is equal to rQ^E represented by the area $0(-r)tQ^E$. Domestic welfare $p^E aE$ - $0(-r)tQ^E$ is the sum of consumer surplus minus the cost of ignorance incurred by these ignorant consumers. International welfare is the sum of domestic welfare and foreign producers' profits.

Figure 1. Impact of a label or a standard



Regulation

When the mandatory label is enforced, the damage r is internalized with $I=1$ and the demand decreases with the bold curve $p^d(Q,1,r)$ leading to the new equilibrium point F with a lower price p^F compared to p^E. There is no cost of ignorance with $I=1$ and the domestic consumers' surplus corresponds to area $p^F(a-r)F$. As there is no sunk cost with S=0, the profits correspond to area OFp^F for foreign producers. Regarding both domestic and international welfares, the label is better than the absence of regulation since the damage is internalized in the demand and the label is not costly for simplicity. The domestic welfare $p^F(a-r)F$ with a label is higher than the domestic welfare p^EaE- $0(-r)tQ^E$ under the initial situation E without regulation (this result is the same when the international welfare is considered).

When the standard is enforced, the market allocation is modified as represented in figure 1 with the bold curves $p^S(Q\ ,1)$ and the equilibrium point H (consumers are not informed with a demand $p^d(Q,0,r)$). As the standard increases variable costs of production of foreign producers, supply is reduced. The supply shifts increases the equilibrium price to p^H, which reduces consumer surplus with $p^HaH < p^EaE$. For these domestic consumers, the initial damage (or cost of ignorance represented by the area $0(-r)tQ_F^E$) fully disappears once the standard is enforced. The overall effect of a stricter standard is ambiguous for consumers since it depends on the comparison between the surplus reduction and disappearance of the damage. For foreign producers, the gross profits are $0Hp^H$ and the net profits withdraw the sunk costs $M\bar{K}$ from these gross profits. Sunk costs are not passed into the price on to consumers.

The regulatory tools have different impacts on foreign producers and domestic consumers. Depending on its international or domestic objective, the regulator will take into accounts surpluses exhibited in figure 1 for choosing instruments.

Definition of protectionism

The domestic regulation is selected by a policymaker seeking to maximize the domestic welfare defined by the consumers' surplus. In Fisher and Serra (2000), the domestic standard is compared to the international standard that a social planner would have implemented by taking into account welfare inclusive of foreign profits. As there is only one instrument in Fisher and Serra (2000), protectionism occurs when the welfare-maximizing domestic standard is higher than the international standard maximizing welfare inclusive of foreign profits.

In our case, protectionism occurs when the welfare-maximizing domestic instrument is different from the international instrument maximizing international welfare inclusive of foreign profits. It means that this domestic instrument is detrimental for foreign producers. The international welfare is a reference for determining whether or not a domestic regulation is protectionist or not. We use the term protectionist in a broad sense, since our framework does not include domestic producers.

Results

From developments linked to figure 1, the label is better than the absence of regulation because the damage is internalized in the demand and the label is not costly, which is an assumption selected for simplicity. The absence of regulation is not optimal under these assumptions, which allows us to focus on the choice between both instruments. As the standard fully eliminates the damage (or the cost of ignorance), the label is useless when the standard is selected. As a consequence, the regulator never combines both instruments.

Before detailing regulatory choices, recall that the standard impacts variable costs and sunk costs. For facilitating the presentation, we distinguish between two extreme cases for which the standard (*i*) only impacts the variable cost with $\lambda > 1$ and $\bar{K} = 0$ or (*ii*) only impacts the sunk cost with $\lambda = 1$ and $\bar{K} > 0$. The comparison between domestic welfare $CS(I,S)$ and international welfare $W(I,S)$ for the different scenarios (*S=1* or *I=1*) leads us to the following propositions.

PROPOSITION 1. *Consider the case where the standard only impacts variable costs with* $\lambda > 0$ *and* $\bar{K} = 0$. *If* $r_1 < r < r_2$, *then the label is protectionist. Otherwise there is no protectionism.*

Proof: The international comparison leads to $W(I=0,S=1) < W(I=1,S=0)$ for $r < r_1$ with $r_1 = a - a\sqrt{\frac{b+c}{b+\lambda c}}$. The domestic comparison leads to $CS(I=0,S=1) < CS(I=1,S=0)$ with $r < r_2 = \frac{ac(\lambda-1)}{b+\lambda c}$ with $\lambda > 1$. As $r_1 < r_2$, the domestic choice imposing a label is protectionist when $r_1 < r < r_2$.□

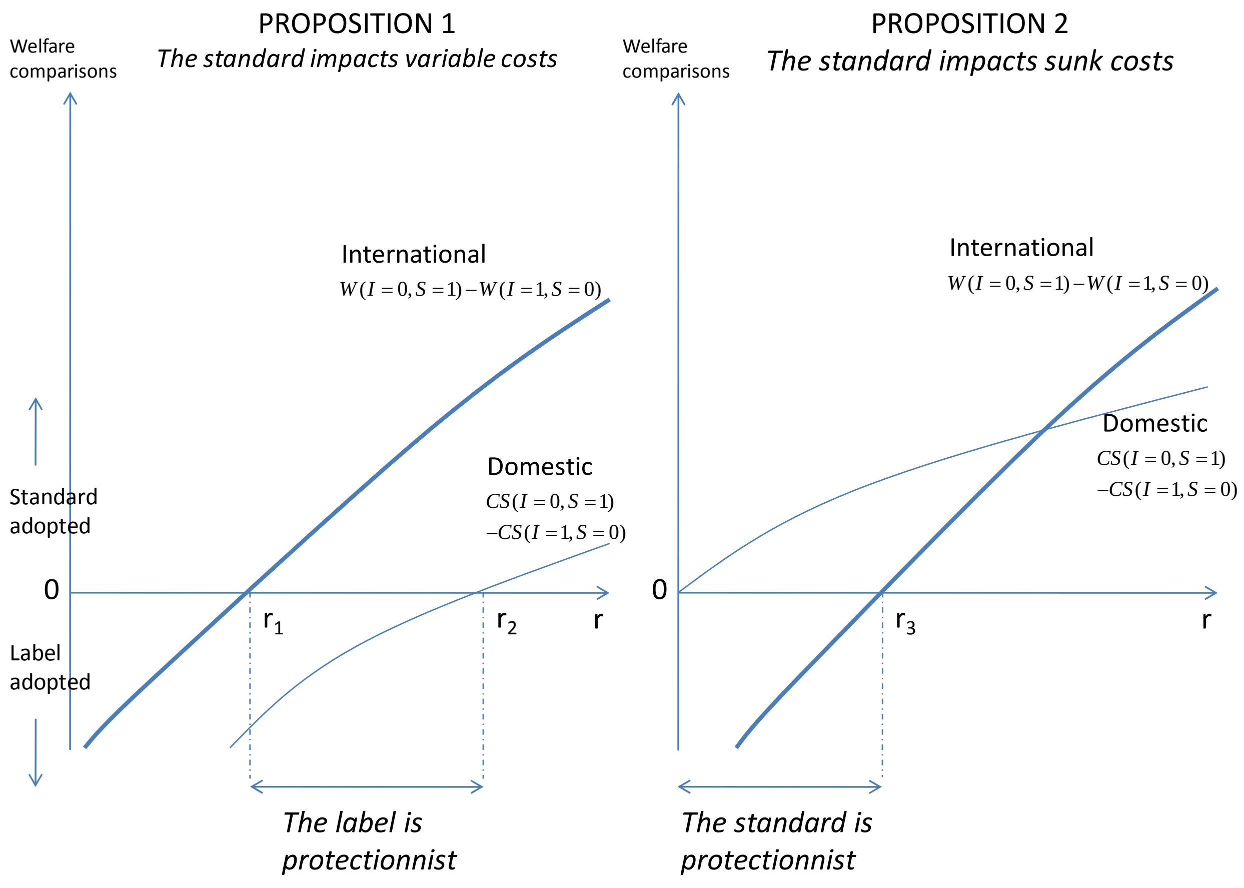
We now turn to the case where only the sunk cost is impacted by the standard.

PROPOSITION 2. *Consider the case where the standard only impacts sunk costs with* $\lambda = 0$ *and* $\bar{K} > 0$. I*f* $r < r_3$, *then the standard is protectionist. Otherwise there is no protectionism.*

Proof: The international comparison leads to the inequality $W(I=0,S=1) < W(I=1,S=0)$ for $r < r_3$ with $r_3 = a - \sqrt{a^2 - 2(b+c)M\bar{K}}$. The domestic comparison leads to the inequality $CS(I=0,S=1) > CS(I=1,S=0)$ is always satisfied which leads to a systematic choice of the standard by the domestic regulator. The domestic choices imposing a standard are protectionist when $r < r_3$.□

Proposition 1 is illustrated by the left chart of figure 2 and proposition 2 is illustrated by the right chart of figure 2. For each chart, the per-unit damage, *r*, is located on the horizontal axis. The welfare comparisons with domestic and international objectives are represented on the vertical axis.

Figure 2. Regulatory Instruments and Protectionism



On figure 2, the incentives to adopt a standard are represented by $CS(I=0,S=1)-CS(I=1,S=0)$ for the domestic regulator and by

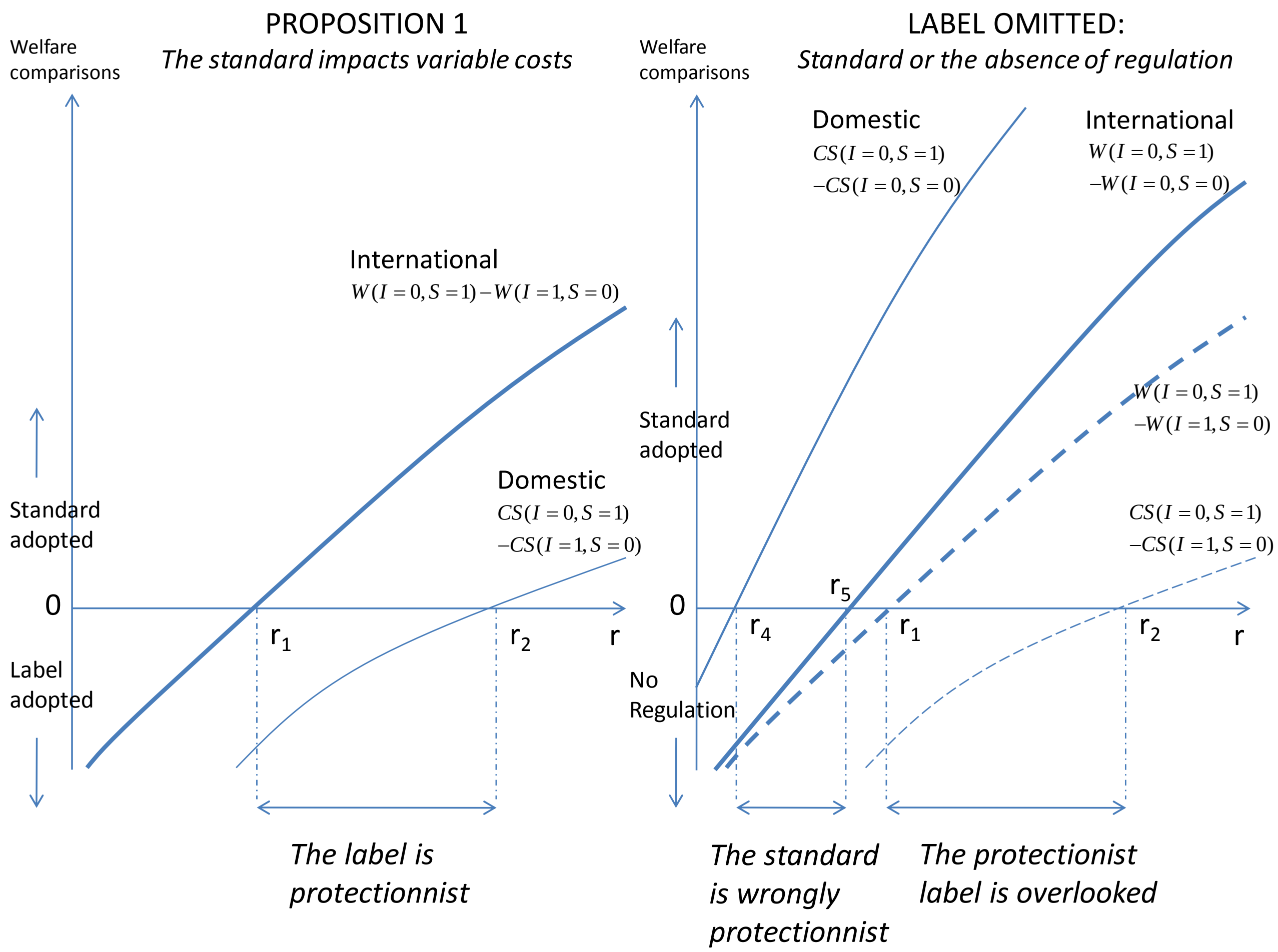
$W(I=0,S=1)-W(I=1,S=0)$ for the international regulator with a bold curve. A positive value of $CS(I=0,S=1)-CS(I=1,S=0)$ leads to the standard adoption by the domestic regulator. A positive value of $W(I=0,S=1)-W(I=1,S=0)$ leads to the standard adoption by an international regulator. Conversely a negative value of these curves indicates a preference for the label.

The label allowing the damage internalization by consumers tends to be selected for relatively low values of the per-unit damage, r, since the price increase linked to the standards would be too costly relatively to the price decrease coming from the label and the damage internalization. The standard tends to be selected for relatively high values of the per-unit damage r since this damage is fully eliminated. The effect of instruments on domestic consumers and foreign producers differ (as previously shown in figure 1). Figure 2 shows when protectionism emerges. For some values of the per-unit damage, r, the welfare-maximizing domestic instrument is different from the international instrument maximizing international welfare inclusive of foreign profits.

When the standard only impacts variable costs as shown by the left chart of figure 2, the mandatory label imposed by the domestic regulator is protectionist for $r_1 < r < r_2$, since the standard would be selected by the regulator maximizing the international welfare. The fact that the standard leads to a price increase tends to influence international choices towards the standard, because foreign producers would benefit from the related price increase compared to the price decrease linked to the label and the damage internalization. As the damage is relatively low for $r_1 < r < r_2$, consumers benefits from having the information leading to a lower consumption with the internalized r compared to the standard, which leads the domestic regulator to choose the label. For $r > r_2$, the damage is higher and the consumer benefit from the standard, which leads to a domestic choice for the standard similar to the international choice.

When the standard only impacts sunk costs as shown by the right chart of figure 2, the standard is protectionist for $r < r_3$, since the mandatory label would be selected by the regulator maximizing the international welfare. The label influences the demand and the consumers' surplus. When the standard only impacts the sunk cost, consumers always prefer the standard compared to the label, because sunk costs are not passed into the price on to consumers who benefit from the absence of damage without any additional price increase.

Figure 3. One Regulatory Instrument and Protectionism



Starting from figure 2, it is also possible to see how a NTM can be mischaracterized, when one instrument is forgotten in the analysis as shown on the figure 3. Consider a configuration in which the label is overlooked in the welfare comparison. In this case, the regulator compares the welfare with the standard (*S=1*) to the absence of regulation (*S=0*). The left chart of figure 3 directly comes from the left chart of figure 2, for which the standard only impacts variable costs and both instruments are considered (proposition 1). In a similar context, the right chart of figure 3 shows the optimal regulatory choice regarding the standard versus the absence of regulation, when the label is omitted. Domestic and international choices are represented by the new plain curves, while the dashed curves represents the optimal choice of the left chart for allowing comparison.

When the label is omitted, both domestic and international choices would be similar when $r < r_4$, with no regulation because of a relative high cost of the standard, and when $r > r_5$, with an implemented standard (*S=1*) because of a relative high damage deserving to be eliminated by the standard. When $r_4 < r < r_5$, a positive value of $CS(I=0, S=1) - CS(I=0, S=0)$ would lead to the standard adoption by the domestic regulator, while the international regulator would choose the absence of regulation with a negative value of $W(I=0, S=1) - W(I=1, S=0)$ represented by the bold curve. In other words, the standard could appear as a protectionist NTM for $r_4 < r < r_5$, when the label is omitted. However, the complete welfare comparison including the label shows that the standard is not protectionist for $r_4 < r < r_5$. Alternatively, the dashed lines of the right chart show that the label is protectionist for $r_1 < r < r_2$. Figure 3 shows the importance of being exhaustive in welfare analysis for avoiding wrong conclusions.

Extensions of the theoretical framework

Our model was obviously very simple and various extensions could be considered. First, the complete configuration in which the quality effort impacts both variable costs and sunk costs can be studied. In this case, with $\lambda > 1$ and $\bar{K} > 0$, the standard is protectionist for relatively low values of the damage and the label is protectionist for medium values of the damage.

Moreover, domestic producers could be considered in the analysis (as it will be made in the next section for domestic producers). The more numerous domestic producers, the closer are the curves of both charts of figure 2, since domestic and international welfares appear as close. Moreover, a standard that does not fully eliminate the characteristic could be introduced. Sunk cost impacting entry/exit could be considered, with the supply curve pivoting with producers' exit because of a large sunk cost (Marette and Beghin, 2010). Alternatively, an initial situation with some consumers aware of the damage but unable to inspect the product quality under the absence of regulation could be tackled. Alternatively, administrative costs linked to the regulation or the label could be taken into account, which would lead to the absence of regulation for relatively low values of the per-unit damage.

Alternatively, foreign consumers could be also considered with related foreign surpluses integrated in equation (7). Different values regarding the per-unit damage *r* between different countries may reinforce disagreements regarding the type of regulation implemented by these countries.

Eventually, a configuration in which a *Pigouvian* per-unit tax equal to the per-unit damage *r* replaces the public label indicating the negative characteristic leads to the same welfare as the one with the label. This tax allows the internalization of the damage via the market price without any revelation of information. In other words, figure 2 can be reinterpreted for understanding the regulatory choice between the per-unit tax and a standard. Recall that this question is important for understanding the link between carbon taxes and trade (see McAusland and Najjar, 2014).

Despite limitations, this model can be used for empirically evaluating whether or not future regulation can be considered as protectionist. The empirical applications will also tackle some assumptions overlooked in this section. In particular, the following section will consider the possibility of private producers to react to the public label, by promoting a positive label signaling an individual effort for having high-quality products. We now turn to the empirical application of the model.

4. Empirical results: An application to the shrimp market

In this section, we focus on the shrimp market and simulate the impact of possible future regulations for improving the environment.

The environmental impact of shrimp production is particularly acute, since production and trade of shrimp products have boomed over the last decade (Disdier and Marette, 2012). Almost, half of tropical shrimps comes from farms located in China, Thailand, Indonesia, India, Vietnam or Ecuador (...) However, this expansion of farmed tropical shrimps entails major environmental costs (see Debaere, 2010 and WWF, 2014). In particular, natural habitat has been destroyed to create ponds for shrimp production. Shrimp farming has destroyed mangroves areas in some Asian countries. These mangroves are particular vital for wildlife protection and also serve as buffers to effects of storms. The supply of water to farms have contaminated some coastal-land areas with salt water. Eventually, the high concentration of shrimps in ponds leads to serious pollutions with possible outbreaks of disease for shrimps (WWF, 2014). Producers use antibiotics for thwarting pollution and disease, which led to international bans of some antibiotics (see Disdier and Marette, 2010, and Beghin et al., 2012).

Regarding wild shrimps, captured by boats, they represent half of tropical shrimps and also other miscellaneous shrimps. There are many questions regarding the sustainability of fisheries (Eumofa, 2014). For restricting overfishing, there are debates for promoting or even imposing Marine Stewardship Council (MSC) labels guaranteeing the fisheries sustainability (CBI, 2010). Eventually, the recent headlines about slavery on fishing boats off Thailand for getting cheap prawns tarnishes the reputation of the shrimp business (Hodal et al., 2014).

We now estimate the impact of possible regulations that could be adopted by the EU for protecting the environment. By using the model of section 2, we will compare the impact of a standard improving the environment or a public label signaling the environmental damages of regular shrimps sold on the EU market. Recall that the per-unit tax on regular shrimps is equivalent to this public label in terms of welfare (see the end of the previous section).

We particularly study two scenarios. With the first scenario (I), the environmental problem comes from farmed shrimps. In this case, the producers' effort with the parameter $\lambda_F > 1$ in equation (2) potentially concerns the sub-segment of farmed shrimps, while for other producers no effort is necessary with $\lambda_F = 1$ and $\lambda_O = 1$. A mandatory standard imposes the norms equivalent to the organic process to all farms. Alternatively, the negative label informs about the environmental damage coming from farmed tropical shrimps.

With the second scenario (II), the environmental problem comes from all shrimps. In this case, the producers' effort for improving quality potentially concerns all producers with $\lambda_F > 1$ and $\lambda_O > 1$. The standard imposes the norms equivalent to organic process to all farmed shrimps and the norm equivalent to the MSC label to all wild shrimps. Alternatively, the negative label informs about all shrimps. Note that, for both scenarios, we only focus on the EU market and the foreign producers exporting to the EU, without taking into account other big importers like the US or Japan.

In this section, private producers can react to the public label informing about the damage (or alternatively the per-unit tax impacting the shrimp price), by promoting a positive label, like the organic or MSC label, signaling an individual effort for having high-quality products. These producers avoid the public label focusing on the negative characteristic. It means that the proportions β_O and β_F of domestic and foreign suppliers choosing the effort and differentiating their products can be positive when the negative label is imposed. For simplicity, these values β_O and β_F will be exogenously given in the simulations.

Calibration of the model

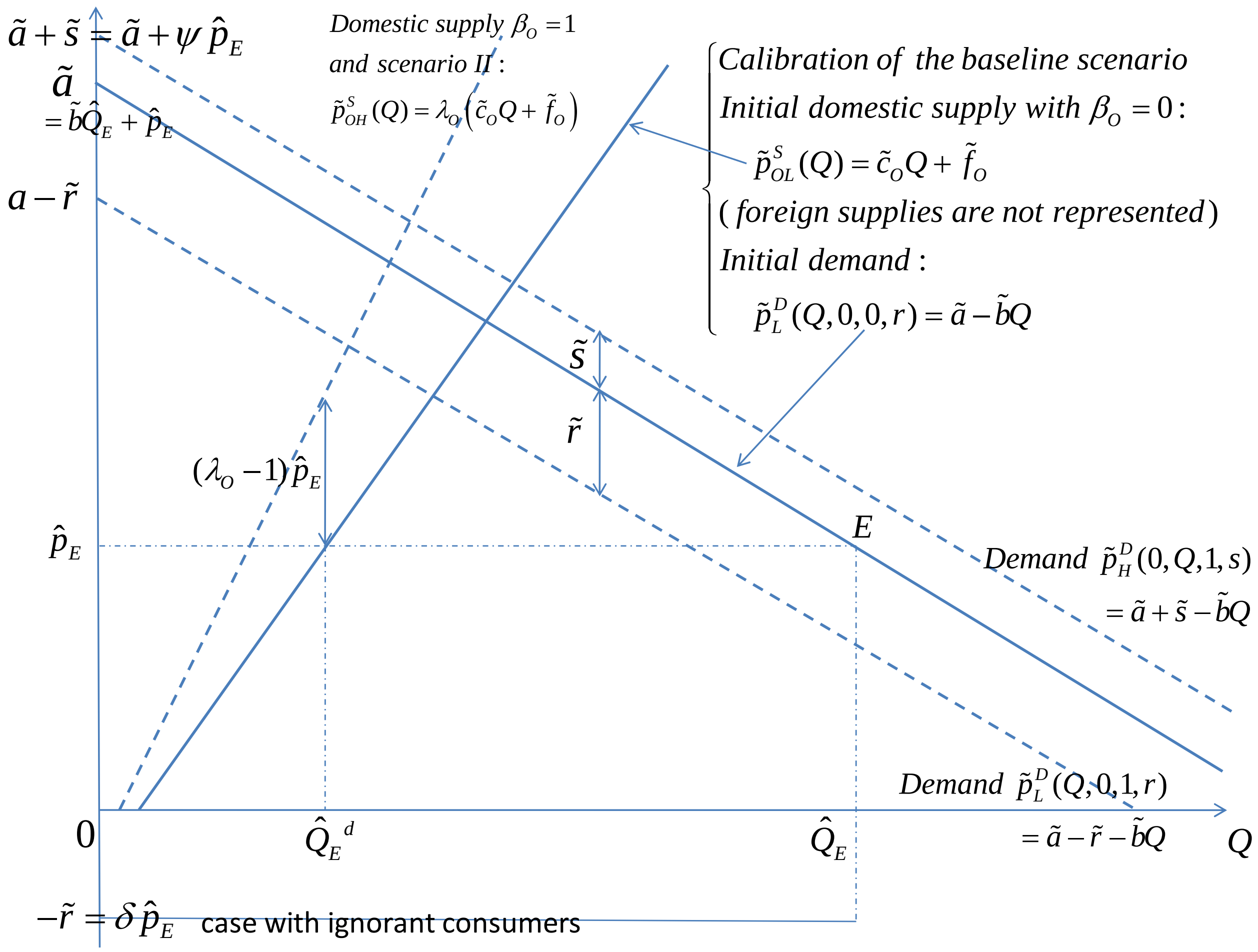
With the initial situation preceding an enforcement of the regulation, parameters of the model are calibrated in such a way as to replicate market prices and quantities for the year 2012 in the EU-27 and with consumers assumed to be unaware of environmental damage. With the baseline scenario, namely before the enforcement of any regulation, it is assumed that the organic market is not existing (since organic shrimps only represent 0.5% of market share in 2013). For simplicity, we also assume that origins of shrimps do not matter for consumers. With this baseline scenario, products appear as non-differentiated, which leads to a demand $p_L^D(Q,0,0,r) = p_H^D(0,Q,0,s) = a - bQ$ by ignorant consumers.

The calibration is illustrated by figure 4 that directly comes from figure 1, where the price, *p*, is located on the vertical axis and the quantity, *Q*, is shown along the horizontal axis. The baseline scenario is represented by the point *E* in figure 4 (exactly as the point E in figure 1). With the observed overall quantity $\hat{Q}_E$ purchased over 2012, the average price $\hat{p}_E$ observed over the period, and the direct price elasticity $\hat{\varepsilon}$ obtained from econometric estimates, the calibration leads to estimated values equal to $1/\tilde{b} = -\hat{\varepsilon}\hat{Q}_E / \hat{p}_E$ and $\tilde{a} = \tilde{b}\hat{Q}_E + \hat{p}_E$.[2] This gives the initial inverse demand $\tilde{p}_L^D(Q,0,0,r) = \tilde{a} - \tilde{b}Q$ represented by

[2] From the demand $Q(p) = (a-p)/b$, the values $1/\tilde{b}$ and $\tilde{a}$ are determined by solving the system of two equations $(dQ/dp)\times(\hat{p}_E / \hat{Q}_E) = \hat{\varepsilon}$ and $Q(\hat{p}_E) = \hat{Q}_E$.

the plain and decreasing curve on figure 4.

Figure 4. Calibration of the shrimp market



The supply segments given in equation (2) are calibrated for $\beta_O=\beta_F=0$ along with $\lambda_F=1$ and $\lambda_O=1$, and by using the similar methodology as the previous one used for the demand. For simplifying the representation, only the calibration of the domestic supply is represented on figure 4, but foreign supplies are also calibrated. With the domestic quantity $\hat{Q}_E{}^d$ produced over 2012 and the average price $\hat{p}_E$, the calibration of the domestic supply leads to $\tilde{p}^S_{OL}(Q)=\tilde{c}_O Q+\tilde{f}_O$ represented by the plain and increasing curve on figure 4.

Values r and s in equation (3) are determined with results from a lab experiment. In the lab experiment, information about the environmental characteristics of the products was provided in the form of ‘negative’ or ‘positive’ messages.

First, the parameter r defining the non-internalized damage is linked to the regular product. The parameter r is determined by WTP data coming from the group receiving the negative information with values WTP_1^i and WTP_2^i indicating consumer i’s WTP for shrimps before and after the revelation of information. The relative variation in WTP provides a measure of the inverse demand shift, $\delta = \left[E(WTP_2) - E(WTP_1)\right] / E(WTP_1)$, where E denotes the expected value over participants (see Marette et al., 2008). This relative variation is extrapolated to measure the variation of overall demands defined by (4). The inverse demand curves can be viewed conceptually as maximum WTP curves, where the price can be replaced with WTP. Thus, using the inverse demands in equation (4) and the equality $\hat{p}_E = \tilde{p}_L^D(\hat{Q}_E, 0, 0, r) = \tilde{p}_H^D(0, \hat{Q}_E, 0, s) = \tilde{a} - \tilde{b}\hat{Q}_E$ coming from the initial calibration, the relative price variation is equal to the inverse demand shift defined by $[\tilde{p}_L^D(\hat{Q}_E, 0, 1, r) - \tilde{p}_L^D(\hat{Q}_E, 0, 0, r)] / \tilde{p}_L^D(\hat{Q}_E, 0, 0, r)] = \delta$. From the equality $[\tilde{p}_L^D(\hat{Q}_E, 0, 1, r) - \tilde{p}_L^D(\hat{Q}_E, 0, 0, r)] = -r$ coming from (4) and with $\tilde{p}_L^D(\hat{Q}_E, 0, 0, r) = \hat{p}_E$, the estimated value is $\tilde{r} = -\delta \hat{p}_E$, as represented at the bottom of figure 4 when consumers are unaware, leading to a cost of ignorance as the one detailed in equation (3) and explained in figure 1. The demand $\tilde{p}_L^D(Q, 0, 1, r)$ with aware consumers and when no high-quality products are offered is represented on figure 4 by the dashed curve below the plain curve.

From the group receiving the positive information on the environment, it is possible to compute s. The relative variation in WTP following the positive information provides a measure of the inverse demand shift, $\psi = \left[E(WTP_2) - E(WTP_1)\right] / E(WTP_1)$, where E denotes the expected value over participants. From $\hat{p}_E = \tilde{p}_L^D(\hat{Q}_E, 0, 0, r) = \tilde{p}_H^D(0, \hat{Q}_E, 0, s) = \tilde{a} - \tilde{b}\hat{Q}_E$, the relative price variation is equal $[\tilde{p}_H^D(0,\hat{Q}_E,1,s)-\tilde{p}_H^D(0,\hat{Q}_E,0,s)]/\tilde{p}_H^D(0,\hat{Q}_E,0,s)]=\psi$. From the equality $[\tilde{p}_H^D(0,\hat{Q}_E,1,s)-\tilde{p}_H^D(0,\hat{Q}_E,0,s)]=s$ coming from (4) and with $\tilde{p}_H^D(0,\hat{Q}_E,0,s)=\hat{p}_E$, the estimated value is $\tilde{s}=\psi\,\hat{p}_E$. The demand $\tilde{p}_H^D(0,Q,1,r)$ with aware consumers and when no low-quality products are offered is represented on figure 4 by the dashed curve above the plain curve. When consumers are unaware of the quality improvement $\tilde{s}=\psi\,\hat{p}_E$ coming from the standard, the non-internalized benefit is accounted in the welfare as shown in equation (3) with $Js_i q_{H\_i}$.

The substitution parameter θ between products of different qualities in demands (4) is exogenously given for simplicity. The configuration with both levels of qualities is not represented on figure 4. For the scenario I, there are even 3 segments of quality with the following inverse demands $a-Ir-b(Q_{L,T}+\theta Q_{H,T}+\theta Q_W)$ for the low-quality tropical shrimps, $a+Js-b(Q_{H,T}+\theta Q_{L,T}+\theta Q_W)$ for the high-quality tropical shrimps and $a-b(Q_W+\theta Q_{L,T}+\theta Q_{H,T})$ for the tropical shrimps.

The choice of high quality by producers only impacts variable cost as defined in equation (2), since it is assumed that the sunk cost $\bar{K}$ in equation (1) is equal to zero. Figure 4 only represents the supply shift for all domestic producers (with $\beta_O=1$) under scenario II.

Data

Table 1 details the parameters used for calibrating the baseline scenario with *I*=0 and *J=0*, namely when consumers are not aware of environmental problems. This table also gives details regarding parameters coming from the lab experiment

As explained above, the value of the per-unit damage r, and the per-unit benefit *s* linked to high-quality shrimps in equations (3) and (4) are determined by using results from a consumer choice experiment (see Disdier and Marette, 2012). This experiment was conducted in Paris, France, in multiple one-hour sessions in December 2009. The sample included 160 participants randomly selected by phone based on the quota method and was representative for age groups and socio-economic status for the population of Paris.

Table 1. Values of parameters for the calibrated model of shrimps in 2012

Variable	EU-27
From time series and observed data	
Domestic production sold on the domestic market (tons) [a], $\hat{Q}_E^{\,d}$	65 049
Imports of farmed shrimps (tons) [a]	145 800
Imports of wild (fished) shrimps (tons) [a]	361 200
EU 27 Consumption in 2012 (tons), $\hat{Q}_E$	572 049
Price per kg in 2012 (€)[a] , $\hat{p}_E$	5.98
Own-price elasticity of demand [b], $\hat{\varepsilon}$	- 0.67
Own-price elasticity of supply (domestic and foreign)[c]	0.97
Substitution parameter in equation (3), θ	4/5
From the lab experiment	
Relative WTP variation from consumers with negative info., δ	- 0.39
Relative WTP variation from consumers with positive info., ψ	0.25

[a]: Eufoma (2014).
[b]: Asche and Bjørndal (2001) for crustaceans in the EU.
[c]: Dey et al. (2004) for the aquaculture of shrimps by taking the average of own-price elasticities of supply over the top 5 world producers of shrimps in table 3 (p. 5).

In this lab experiment, a multiple price list was used for eliciting consumers' WTP for a 100g plastic package of farmed, midsize, shelled, cooked, and refrigerated shrimps. Cooked and refrigerated shrimps are the most common form of shrimp consumption in France. Participants were asked to choose whether or not they would buy the product for prices varying from €0.25 to €4 with a 25-cent interval between possible choices (Disdier and Marette, 2012). Here, we use two of WTPs elicited during this experiment: A first one before the revelation of any information and a second one after the revelation of information on environment for shrimps produced in non-European countries. These two WTP estimates allow measuring the marginal impact of information.

Information about the environment before choice #2 was revealed as following. Positive information for group I with a posted organic label close to the picture of shrimps was the following: "Organic shrimps: In some countries, shrimp producers develop environmentally friendly production scheme. Discharges are limited and pollution is controlled. Furthermore, the quality of water and ecosystems around the farms is preserved. These practices, on average, significantly increase the production costs. These products are sold with an organic label in France." The average WTP expressed by participants of this subgroup, before the information revelation, is equal to €2.35 for tropical shrimp, while the average WTP after the revelation is equal to €2.94. The relative variation of the WTP is therefore equal to ψ = (2.94 - 2.35)/2.35= 0.25, as indicated in table 1.

Negative information for group II was the following: "Environmental concerns: Shrimp farms can generate serious environmental problems. In particular, the discharges coming from farms are a source of pollution: deterioration of water quality and of fertility of soils, which were converted into breeding pools. Given the difficulties and the cost of inspection of imported products, it is likely that the production of a large share of shrimps sold in France generated such a pollution." The average WTP expressed by participants of this subgroup, before the information revelation, is equal to €1.91 for tropical shrimp, while the average WTP after the revelation is equal to €1.16. The relative variation of the WTP is therefore equal to δ = (1.16 - 1.91)/1.91= - 0.39, as indicated in table 1.

Eventually, a quality effort for a producer leads to a cost increase. Based on an analysis of burgeoning organic shrimps in Madagascar, Hervieu (2009) notes that the switch from non-organic to organic shrimps increases the variable cost of production (farm price) from 5€/kg to 8€/kg. We use this change in variable unit cost to estimate the shift of the supply function by setting $\gamma = (8-5)/5 = 0.6$ that is applied to the foreign and domestic supply curves presented in equation (2). For a given quantity, a relative increase of $\gamma = 0.6$

leads to the parameter $\lambda_u = 1 + \gamma = 1.6$ multiplied to the variable cost in equation (1), with *u={ $F_{Tropical}$}* for scenario I and *u={O, F}* for scenario II .

Estimates

Table 2 presents the impact of the regulation related to scenario I. With the first scenario (I), the environmental problem comes from farmed shrimps. In this case, the producers' effort with the parameter $\lambda_F > 1$ in equation (2) potentially concerns the sub-segment of farmed shrimps, while for other producers no effort is necessary with $\lambda_F = 1$ and $\lambda_O = 1$. A mandatory standard imposes the norms equivalent to the organic process to all farms. Alternatively, the negative label informs about the farmed tropical shrimps. Note that compared to equations (4) with two quality segments, there are 3 possible segments, namely the segment of regular farmed shrimps with the negative label, the segment of organic farmed shrimps and the rest of wild shrimps without any label.

The first column of table 2 corresponds to the market adjustment when the standard without any label is selected. The program using the *Mathematica* software can be provided upon request. The second column corresponds to the market adjustment with the label signaling the negative characteristic (*I*=1), but with no private label signaling an effort (*J=0* and $\beta_O = \beta_F = 0$). The third column corresponds to the market adjustment with the label signaling the negative characteristic (*I*=1), with half of producers ($\beta_O = \beta_F = 0.5$) choosing the effort (*J=1*) for having high-quality products signaled by private labels and/or private advertising.

The results of table 2 show that, when the standard is implemented (first column), farmed shrimp producers decrease their output and the related imports. Their profits decrease because their costs shift. As the farmed shrimp output declines, the shrimp price increases. The domestic producers and the foreign producers of wild shrimps benefit from this standard with a profit increase, since they enjoy this better price without suffering the cost increase. The negative variation in consumers' surplus linked to the price increase is offset by the positive variation in the cost of ignorance for consumers, since the cost of ignorance is eliminated by the standard. The domestic and international welfares linked to the standard increase (last line of table 2), while the imports decrease (see the second line of table 2). It means that considering only trade volumes or values can be insufficient for characterizing an NTM as protectionist.

Table 2. Welfare changes for the year 2012 coming from an environmental regulation imposed on tropical shrimp farm (scenario I) compared to the absence of regulation

EU – 27	**Standard** $\beta_O = \beta_F = 1$ $I = J = 0$	**Label** $\beta_O = \beta_F = 0$ $I = 1, J = 0$	**Labels** $\beta_F = 0.5$ $I = 1, J = 1$
Change in quantity consumed (1000 tons)	- 22.4 (-3.9%)	2.0 (0.3%)	6.8 (1.1%)
Change in imports (1000 tons)	- 26.0 (- 5.1%)	- 1.4 (- 0.2%)	3.8 (0.7%)
Price change (€ per kg)[1]	0.35 (5.8%)	0.34 (5.7%)	0.29 (4.9%)
Price change for farmed shrimps with the negative label (€ per kg)		- 0.94 (- 15.8%)	- 0.82 (- 0.13%)
Price change for farmed shrimps with the organic label (€ per kg)			3.0 (50.3%)
Change in domestic consumers surplus (without the cost of ignorance) (million €)	- 196.8 (- 7.7%)	- 152.8 (- 5.9%)	- 132.8 (- 5.2%)
Change in cost of ignorance[2] (million €)	479.2	333.5	333.5
Change in domestic producers profits (million €)	22.7 (11.7%)	22.3 (11.5%)	19.1 (9.8%)
Change in domestic welfare (million €)	305.3 (12.6%)	203 (8.4%)	219 (9.1%)
Change in profits for foreign exporters with wild shrimps (million €)	132.1 (11.7%)	130.1 (11.5%)	111.1 (9.8%)
Change in profits for foreign exporters with farmed shrimps[3] (million €)	- 122.4 (- 27.7%)	- 125.3 (- 28.4%)	36.9 (8.3%)
Change in international welfare (million €)	315.0 (7.9%)	207.7 (5.2%)	367.8 (9.2%)

Note: relative changes (%) compared to the baseline scenario in parentheses.

[1] The initial price in the baseline scenario is the same for all products appearing as non-differentiated. For this line the price variation concerns the segment of products with no label.

[2] The value is positive since the cost of ignorance disappears leading to a benefit for consumers. As the initial cost of ignorance is negative, we do not report relative variation.

[3] Profits are pooled when farmed shrimps are signaled with negative or positive labels (third column).

The case with only the negative label (second column) leads to a new segment with a reduction in price and profit for farmed shrimp because of the negative label. Profits and surpluses variations change compared to the first column dedicated to the standard, but many qualitative results of the first column does not change. When half of farmed shrimp producers choose organic (high-quality) products and signal them for avoiding the public label (third column with $\beta_F = 0.5$ for the farmed shrimps producers), the positive label boosts the demand for organic farmed shrimps, which explains the positive variation of quantity consumed, imports and profits for farmed shrimps. In particular, the positive profit variation for the farmed shrimps comes from the organic segment. For the three columns of table 2, regulation is domestically and internationally beneficial compared to the absence of regulation. The following figure is useful for knowing which instruments would be selected by the regulator.

The figure 5 shows the welfare comparisons between the welfare with the standard and the welfare with the negative label, represented on the Y-axis, for different values of the proportion of farmed producers choosing high-quality products signaled with the organic label, β_F, represented on the X-axis. The welfare comparison for scenario I is represented on the chart at the top of figure 5.

The top of figure of 5 shows domestic and international welfare comparisons between the welfare with the standard and the welfare with the negative label. When very few producers of farmed shrimps turn to the organic process and label, namely with β_F relatively low, the standard is domestically and internationally optimal. Conversely, when at least one third of producers of farmed shrimps turn to the organic process and label, namely with β_F relatively high, the standard is domestically optimal, but the international welfare would be maximized with the negative label signaling the damage of the producers who do not change the process for producing farmed shrimps. Based on the definitions of section 3, the standard can be considered as protectionist. The top of figure 5 confirms that the tool maximizing domestic welfare does not systematically correspond to the tool maximizing international welfare.

Figure 5. Standard versus Label for the EU-27 Shrimps Market

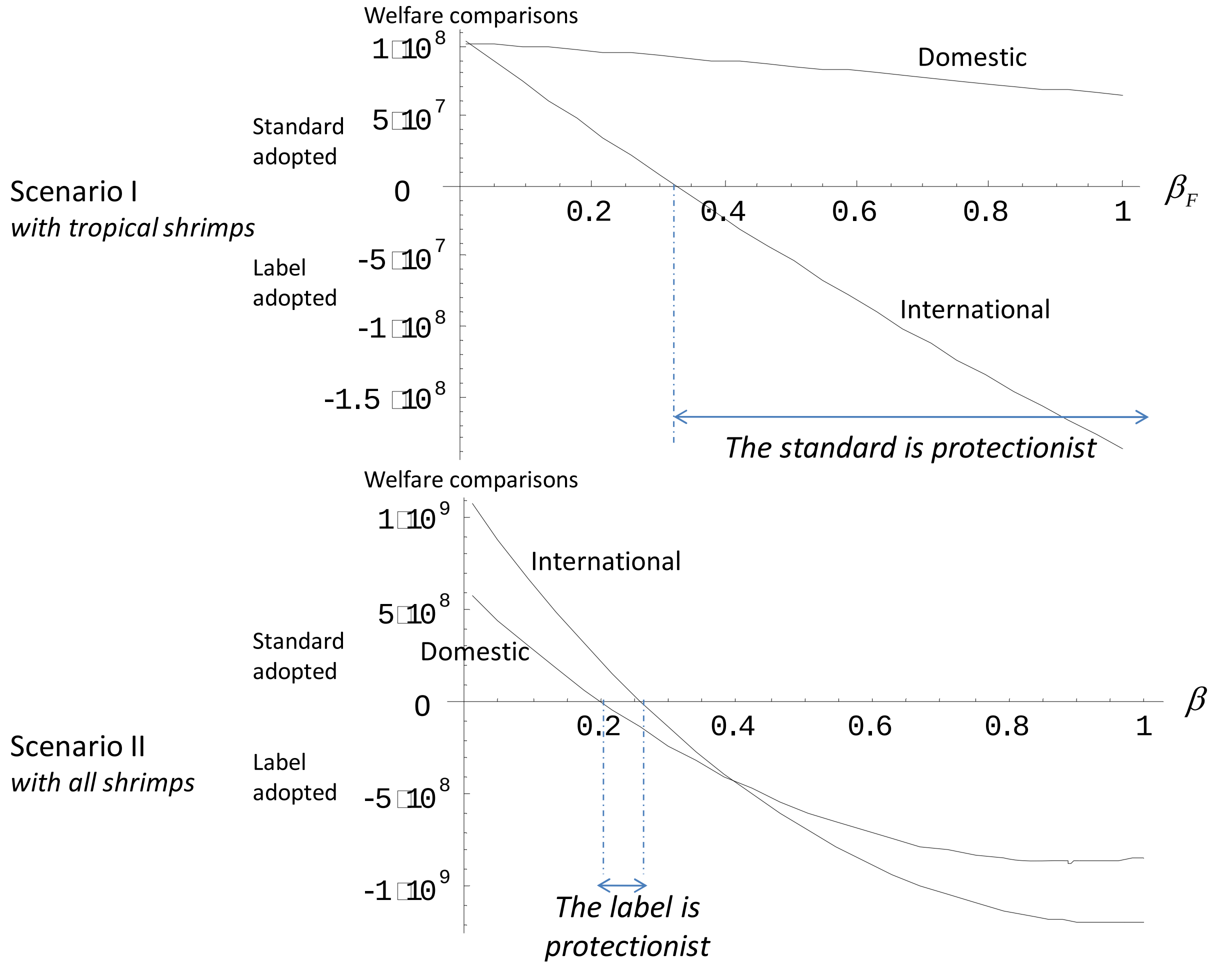


Table 3 presents the impact of the regulation related to scenario II. With the second scenario (II), the environmental problem comes from all shrimps. In this case, the producers' effort for improving quality potentially concerns all producers with $\lambda_F > 1$ and $\lambda_O > 1$. The standard imposes the norms equivalent to organic process to all farmed shrimps and the norm equivalent to the MSC label to all wild shrimps. Alternatively, the negative label informs about all shrimps. Experimental results focusing on farmed shrimps are extended to all shrimps by assuming that sustainability problems are equivalent to problems coming from farms.

Table 3. Welfare changes for the year 2012 coming from an environmental regulation imposed on all shrimps (scenario II) compared to the absence of regulation

EU – 27	**Standard** $\beta_O = \beta_F = 1$ $I = J = 0$	**Label** $\beta_O = \beta_F = 0$ $I = 1, J = 0$	**Labels** $\beta_O = \beta_F = 0.5$ $I = 1, J = 1$
Change in quantity consumed (1000 tons)	- 109.2 (-19.0%)	- 88.4 (-15.4%)	- 48.7 (-8.5%)
Change in imports (1000 tons)	-97.2 (-19.0%)	- 78.6 (- 15.4%)	- 8.5 (0.7%)
Price change (€ per kg) [1]	1.70 (28.5%)		
Price change for shrimps with the negative label (€ per kg)		- 0.95 (- 15.9%)	-0.72 (-12.1%)
Price change for sustainable shrimps with the organic/MSC label (€ per kg)			3.06 (51.2%)
Change in domestic consumers surplus (without the cost of ignorance) (million €)	- 881.9 (- 34.5%)	-728.1 (- 28.5%)	397.5 (-15.5%)
Change in cost of ignorance[2] (million €)	1890.3	1187.3	1187.3
Change in domestic producers profits (million €)	9.16 (4.7%)	- 55.3 (- 28.5%)	20.7 (10.6%)
Change in domestic welfare (million €)	1 017.6 (65.2%)	403.9 (25.9%)	1 605.6 (102.9%)
Change in profits for foreign exporters with shrimps[3] (million €)	74.1 (4.7%)	-447.6 (-28.5%)	167.8 (10.6%)
Change in international welfare (million €)	1 091.8 (34.8%)	-43.6 (-1.3%)	1 773.5 (56.6%)

Note: relative changes (%) compared to the baseline scenario in parentheses.

[1] The initial price in the baseline scenario is the same for all products appearing as non-differentiated. For this line the price variation concerns the segment of products with no label.

[2] The value is positive since the cost of ignorance disappears leading to a benefit for consumers. As the initial cost of ignorance is negative, we do not report relative variation.

[3] Profits are pooled when shrimps are signaled with negative or positive labels (third column).

Table 3 shows results that can be interpreted as results from table 2. However, the main difference is that surplus/profits variations in table 3 are often higher in absolute value than variations in table 2, since all shrimps with scenario II are concerned by the regulation improving the environmental regulation. For the case with the label providing negative information and $\beta_O = \beta_F = 0$ (second column), the international welfare variation is negative compared to the absence of regulation, since many producers are negatively impacted by this label, without firms' reaction for turning towards high-quality products.

The bottom of figure 5 shows domestic and international welfare comparisons between the welfare with a standard and the welfare with the negative label (while table 3 showed the welfare with one instrument versus no regulation). As all producers are concerned with $\beta_O = \beta_F = \beta$ represented on the X-axis, the regulatory choice between the domestic and international regulation does not differ a lot (except the case on the label on the small segment indicated on the chart at the bottom of figure 5). The chart shows that, when enough firms turn to clean products under the mandatory label, the mandatory label signaling an environmental damage is domestically and internationally better than a standard.

The results under scenarios I and II shows that this particularly important to precisely characterize the possible future changes coming from future regulation. Empirical analyses and case-by-case studies are therefore needed to highlight the overall effect linked to NTM and for characterizing the presence or the absence of protectionism.

Extensions related to estimates

It should be kept in mind, though, that the numerical magnitudes of the estimated welfare effects presented in tables 2 and 3 depend crucially on the underlying functional forms (linear demand and supply functions) and on the quality of data and parameters. Because of flaws and biases coming from lab experiments, the results of this study only provide suggestions for environmental policies.

Many extensions to the relatively simple illustration discussed here can be considered. The shrimp demand should be refined with a complete econometric estimation of the demand in the 27 countries and for also accounting for different geographic origins, different size of shrimps and various qualities of shrimps. An export demand for the EU could be estimated and considered since the EU is a relatively large actor. Gravity results linked to the previous regulation enforcement could be also considered for calibrating changes in trade coming from the previous regulation (Disdier and Marette, 2010).

An extension could also study the configuration for which proportions of producers turning to high quality products, β_O and β_F are endogenous. Extensions could also include entry and exit of firms in the face of fixed (through additional investments) and variable (through additional activities) compliance cost. If compliance with standards and regulations implies large investments that are sunk once undertaken, economies of scale become an important characteristic of the industry structure (Rau and van Tongeren, 2009). Sunk investments do not figure in the firms' optimal pricing decisions and have more indirect effects on market prices through entry and exit of firms.

5. Concluding remarks

Characterizing protectionism or contentious regulations can be difficult, because this is not only the level of one instrument that should be considered, but also the choice between different instruments that should be considered for fully characterizing a NTM as protectionist. The theoretical section shows that a clear examination of the producers' cost structure is also very important, since it matters for characterizing the type of protectionism.

The empirical section shows that an *ex ante* evaluation of the impact of future NTM is possible and could be undertaken for controversial questions or decisions. Because of different limitations raised in the previous section, this is important to underline that the empirical study on shrimps only provides suggestions for environmental policies. This type of cost-benefit analysis is not a panacea, but it helps the public debate regarding the best way to improve domestic regulation compatible with trade promotion.

Despite limitations, the simple model of this paper suggests that it is especially imperative for governments and/or international authorities to examine risks of protectionism, by comparing all possible regulatory tools when regulations are promoted.

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The FOODSECURE project in a nutshell

Title	FOODSECURE – Exploring the future of global food and nutrition security
Funding scheme	7th framework program, theme Socioeconomic sciences and the humanities
Type of project	Large-scale collaborative research project
Project Coordinator	Hans van Meijl (LEI Wageningen UR)
Scientific Coordinator	Joachim von Braun (ZEF, Center for Development Research, University of Bonn)
Duration	2012 - 2017 (60 months)
Short description	In the future, excessively high food prices may frequently reoccur, with severe impact on the poor and vulnerable. Given the long lead time of the social and technological solutions for a more stable food system, a long-term policy framework on global food and nutrition security is urgently needed. The general objective of the FOODSECURE project is to design effective and sustainable strategies for assessing and addressing the challenges of food and nutrition security. FOODSECURE provides a set of analytical instruments to experiment, analyse, and coordinate the effects of short and long term policies related to achieving food security. FOODSECURE impact lies in the knowledge base to support EU policy makers and other stakeholders in the design of consistent, coherent, long-term policy strategies for improving food and nutrition security.
EU Contribution	€ 8 million
Research team	19 partners from 13 countries

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