# Indirect Effects of Eco-labelling of agricultural products on Natural Resources

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## *Summary*

The implementation of eco-labelling schemes for agricultural and food products may represent an opportunity to enhance production technologies compatible with the sustainable economic approach. The paper presents an attempt to design a comprehensive methodological framework in which the consumer behaviour change is the driving force for redirecting the market, the production, and the international trade. This approach focuses on the specification of the most relevant variables necessary to implement a simplified, but comprehensive analysis, from which it is possible to proceeding to a broad estimate of the changes in terms of consumption patterns, revenue distribution, import and export, and natural resources consumption.
On a theoretical basis, the framework highlights that the most relevant conservation effect on natural resources, occurs when the eco-labelling schemes are enforced by two countries, under a market regime of free trade. On the contrary, if only one country adopts the schemes, then the effect is negligible.

KEYWORDS: environmental labelling, natural resources conservation, international trade

## *1. Introduction*

The setting and enforcement of policy measures aimed at natural resource conservation represent a controversial matter since, in the one hand, it is necessary in order to pursue a sustainable economic development by encouraging free trade and fair competition but, on the other hand, the lacking of environmental regulations may negatively affect the future availability of resources, with severe consequences on the wealth for future generations. Among the most common environmental policy measures, the concern of WTO member countries has been focused on the setting of environmental standards and the implementation of environmental certification schemes. Both of them may be used to serve for protectionist purposes, although the mechanisms by which they interfere with production, trade, and consumption are quite different.
Since the 1990s environmental certification has been pointed out as an instrument to support sustainable production methods (Stevens et al., 1998). Eco-labels, in particular, have received great attention in the WTO (WTO, 1999): a voluntary eco-label scheme is present in almost all countries of the world except Australia, Africa and Brazil (Environmental Protection Agency, 1998). Most eco-labels schemes are promoted through a direct initiative of governmental bodies (e.g. the EU eco-label, the US EPA Energy Star) and often the schemes include environmental prescriptions related to environmentally-friendly production methods.
The use of these schemes for food products often implies the imposition of the environmental concerns of importing countries in matter of production methods, to their trading partners, with considerable effects on trade and welfare (Greaker, 2006).
However, we claim that the most relevant issue is to demonstrate whether eco-labelling schemes are effective in order to achieve the preservation of natural resources. In this regard, the literature is still lacking of methodologies and models useful to evaluate the effectiveness of these sort of environmental certification on natural resources preservation,

in order to estimate who gets losses and benefit, within an international economic framework.
The domain of environmental certification is wide, but in this paper we refer in particular to agricultural products, because of the growing world-wide consumer interest in "environment-friendly" food, drink, and natural fibre, and the role that eco-labels may play in rewarding good environmental performance for these production sectors.
In this paper we propose a methodological framework for the investigation and the analysis of the effects of the environmental certification, developed within the neoclassical paradigm, in which we model the interaction of the changes in the demand (consumer demand theory), and the comparative advantage between two countries (Heckscher-Ohlin model). We investigate the effects of the certification under three different scenario: autarky, free trade with certification adopted by one country, and free trade with certification adopted by both countries.
Our hypothesis is that the consumer concern in environmental protection represents the driving force to increase the market share of certified goods, and also causing the emergence of a premium price, in contrast with the standard goods.
The structure of the paper is described as follow. In the next section we briefly describe the background and the state of the art related to the environmental certification and eco-labelling. In the third section, we describe the methodological framework for developing an economic model. We follow the neoclassical theory, in order to model the direct and indirect effects of the certification to consumers, natural resources stock, and income distribution. The last section concludes the paper.

## 2. Background of Eco-Labelling schemes

An eco-label is a tag placed on a product that certifies that it is produced through an environmentally-friendly process. Such tags let consumers make informed choices about what they are buying, so that, if a consumer is concerned with the environment, he can support responsible food production. In essence, eco-label is a device conceived to enhance the market efficiency, aimed at solving the problem of asymmetric information, in order to differentiate a good with different level of environmental quality, for which consumers are willing to pay a premium price. A few years ago, the EU has enacted a specific regulation on this matter (Reg.(EC) 880/92), that has been revised more recently with Reg.(EC) 1980/2000, clearly states which products are eligible for the eco-label award scheme, and the basic rules. At the present, the regulation excludes food, drink, pharmaceutical and some categories of medical devices.
However, there are some example of eco-label schemes applied to fishery products, where the adoption of traditional catching techniques are dangerous for some species (e.g. dolphins are accidentally killed during the tuna fish catching). Recently, the EU has launched the debate in this regards1.
Another example is provided by the forest certification, where companies are requested to demonstrate their sense of responsibility, for adopting good management practices. Third parties certification bodies are providing labels to forest products derived from well-managed forests (Toshiaki et al., 2006). The area of certified forests worldwide amounts to 241 million ha, equivalent to 6.2% of the world's forests (Kraxner and Rametsteiner, 2005).
The reason for which eco-labelling represents a controversial issue during the negotiation process within the WTO partners relies on the fact that importing countries enforcing mandatory eco-labelling schemes, may insist that foreign exporters meet the same labelling

[1] Communication from the Commission to the Council, the European Parliament and the European Economic and Social Committee, launching a debate on a Community approach towards eco-labelling schemes for fisheries products, (COM(05) 275), on July 2005.

requirements, and therefore it might be used as a sort of technical trade barrier (OECD 2003; WTO, 2002).
In fact, the WTO states the principle that similar products are treated equally, irrespective of the country of origin, while the concept of eco-labelling is to differentiate the good made by an environmentally friendly technology, having higher quality for which consumers concerned with the environment are willing to pay a premium price.
On the contrary, several members of the Doha Ministerial Conference agreed on voluntary, participatory, market-based and transparent environmental labelling schemes, as efficient economic instruments to allow consumers to discriminate environmentally friendly products from other products (WTO, 2003).
The most important issue from an economic perspective relies on the fact whether eco-labelling schemes are effective in the preservation of the environment, or not. In fact, the literature referring to this matter is relatively scarce. In particular, we found the study of Melser and Robertson (Melser and Robertson, 2005), in which analyze the environmental effects of eco-labelling by focusing on the externality problem coexistent with the production process of a good. Another study on the effects and relevance of eco-label schemes on the consumer choice has been carried out by Grolleau and Caswell (Grolleau and Caswell, 2005). In their analysis, they focus on the importance of the product labelling, as a mean to convey to consumers the additional quality embedded in a green good, and from which they expect to get an additional utility.
However, in both cases, the analysis is mainly focused on the consumption side, while there is no particular emphasis on the effects on the trade flow of goods among international partners.
On the contrary in the study of Greaker (Greaker, 2006) eco-labels are analyzed, in comparison with environmental standard, in a partial trade model with one domestic firm and one foreign firm. His results suggest that "…may be optimal for the domestic government to introduce an eco-label and get both firms to adopt the label, instead of setting an environmental standard".

# *3. Methodological framework*

The approach we challenge in this paper is based on the assumption that eco-labelling schemes are able to increase the awareness and the responsibility of consumer consumption, such that they are able to affect producer choice. It is a typical *marketing oriented* perspective, where the firm strategy depends on the revealed preferences, tastes, and needs of the consumers.

## 3.1. Effects of the certification on the demand

Under the classical assumption of consumer theory, the set of affordable alternatives is just the set of the bundles that satisfy the consumer's budget constraint. Considering the possible consumption bundles or consumption set, in which x1 is the quantity of a conventional food product and x2 is the quantity of all other goods he wants to consume, if we know the price of goods (p1, p2) and the fixed budget available to a consumer m, the problem of preference maximization can be expressed as:

$$\underset{x_1,x_2}{Max}\, U(x_1, x_2)$$

subject to:

$$p_1 x_1 + p_2 x_2 = m$$

This constrained maximization problem can be solved using the Lagrangian:

$$L = U(x_1, x_2) - \lambda(p_1 x_1 + p_2 x_2 - m)$$

where λ is the Lagrange multiplier.

Differentiating the Lagrangian with respect to x1, x2 and λ, putting the first order conditions, necessary for an interior maximum, we can obtain the implication:

$$\frac{\partial U / \partial x_1}{\partial U / \partial x_2} = \frac{p_1}{p_2}$$

Therefore, the maximization implies that the marginal utility of the two goods is equal to the economic rate of substitution between them. This means that the consumer wants to find the point on his budget line that achieves highest utility, and satisfy the tangency condition that the slope of the indifference curve equals the slope of the budget line.
If these conditions are satisfied we find the utility-maximization point and have the optimal choice of two goods (x1*, x2*) that satisfied the budget constraint.
Suppose a country wish to introduce an environmental certification on food product to obtain a reduction of use of natural resource. The certification have a direct impact on x1, in that we can distinguish a market shared between the certificated product $\alpha x1$, and the non certificated product $(1-\alpha)x1$, where $\alpha$ is the market share.
The certification cause a variation of p1 and, after the certification on good x1, the consumer's budget constraint becomes:

$$\alpha x_1 (p_1 + t) + (1 - \alpha) x_1 p_1 + p_2 x_2 = m$$

So, the problem of preference maximization became:

$$\underset{x_1, x_2}{Max}\, U(x_1, x_2)$$

subject to:

$$\alpha x_1 (p_1 + t) + (1 - \alpha) x_1 p_1 + p_2 x_2 = m$$

In this new condition the optimal choice of two goods is (x1**, x2**), and the level of utility that consumers can achieve will depend on value of $\alpha$ and t, where t represents the increase of price derived from certification and $\alpha$ the penetration of certificated goods in the country and reflects consumer heterogeneity (Greaker, 2006). If consumers give more importance to personal taste rather than to environmental quality of production, the demand function is horizontally dominated, if environmental quality of production is more important than personal taste the demand function is vertically dominated (Neven and Thisse, 1990).
Another important aspect to analyze is consumers' perception of quality: the information for intrinsic attributes may be search (if the consumer can learn about the quality level prior to purchase), experience (after purchase) or credence (not at all). The adoption of an environmental certification can change a credence characteristic into a search characteristic and can reduce the asymmetric information between producers and consumers (Caswell et al., 2002). So certification became an external intervention to allow consumers to choose products that correspond to their preference and honest producers to signal their products. So the consumers' utility from consuming an eco-labelled product is determined by its environmental characteristics and t represents his willingness to pay a price premium for an eco-label-ed good.

## 3.2. Effects of the certification on the supply

We suppose a supply function for each good based on a classic Cobb-Douglas production function, considering two basic factors: a bundle of generic production factors (F), and natural resources (E).
According to the Heckscher-Ohlin model, we assume that both countries adopt the same technology, but they differ in terms of resources' endowment:
Therefore, the supply for any good in each country is given by:

$$S = a F^f E^e$$

In the case of environmental certification, we suppose a change in the production technology, such that the productivity of environmental resources increases, despite of the productivity of the generic production factor:

$$S_{x1}' = a_{x1}\ F_{x1}^{f-\varepsilon} E_{x1}^{e+\varepsilon}$$

If we assume that the environmental certification is not compulsory, we suppose that some firms will differentiate their products, in order to respond to consumer's preferences. Therefore, in our simplified market model, we will consider three goods:

- the standard x1, with supply function

$$S_{x1} = a_{x1}\ F_{x1} E_{x1}$$

- the ecolabelled x1, and the other good (x2), with supply function

$$S_{x1}' = a'_{x1}\ F_{x1}^{f-\varepsilon} E_{x1}^{e+\varepsilon}$$

- the other good, with supply function

$$S_{x2} = a_{x2}\ F_{x2}^{f''} E_{x2}^{e''}$$

The overall supply for the good x1 is provided by a mix of the standard and eco-label goods, such that:

$$S_{x1} = \alpha\ S_{x1} + (1-\alpha)\ S_{x1}'$$

where α is the share of the market hold by the eco-labelled good.

We need also to consider that production process involves also the remuneration of production factors, supposing the existence of an efficient market, either for the generic production factor, and for natural resources. We also consider that these remunerations correspond to the budget available for consumption, that is:

$$m = rF + vE$$

,

with r and v representing, respectively, the price for the purchase of the generic production factor and the natural resource.

The introduction of an environmental certification, causing a change of a certain technology, toward another more respectful of the environment, at least for one good, will cause some effects in terms of a) consumption and production patterns (the ratio between x1 and x2), b) the budget available for consumption, and c) the distribution of income.

## 3.3. Situation with autarky

In the case of autarchy, the consumption of each good (D) cannot by higher than the domestic supply (S) and, therefore, at the equilibrium, there will be the case such that:

$D = S$

The effect of the enforcement of the certification on the demand of two ordinary goods, is similar to that of introducing a tax $t$ on the good $x_1$, causing a reduction of the quantity of good $x_1$, and also the reduction of the quantity of good $x_2$.

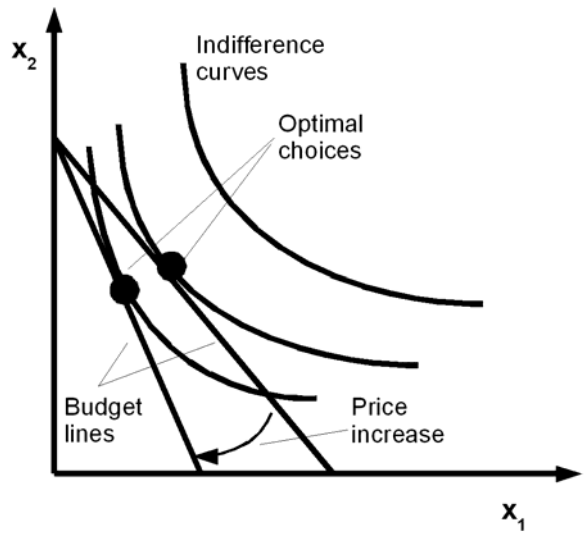

Figure 1 – Effect of price increase in the demand of an ordinary good

The ratio between $x_1$ and $x_2$ changes according to the elasticity of consumption in respect to the consumer revenue ($\varepsilon_R$). If $\varepsilon_{Rx1} > \varepsilon_{Rx2}$, then consumption of $x_1$ will be reduced more than the reduction of $x_2$, therefore the ratio $x_1 / x_2$ will decrease[2]. On the contrary, if $\varepsilon_{Rx1} < \varepsilon_{Rx2}$, then the demand of $x_1$ will lower to a less extent than $x_2$, causing the increase of the ratio $x_1 / x_2$.

In regards to the effects on revenue distribution and on the indirect demand of inputs, we consider the effects caused on $x_1$ and $x_2$. In the case of $x_2$, since the price is unchanged, but the quantity decreases, producers always will lose, therefore there will be a reduction of income, more relevant for owner of the generic production factor, relatively to owner of natural resources. Moreover, there is a more evident reduction in the use of the generic factor, relatively to natural resources.
On the contrary, when we analyze the effects on $x_1$, we need to consider the elasticity in respect to its own price ($\varepsilon_{px1}$). If $\varepsilon_{px1} > 1$, then the effect of the price increase consequent to the certification is offset by the loss for lower consumption. Consequently, producers will lose and, relatively, owner of the natural resources will lose more than the owner of *F*. In contrast, if $\varepsilon_{px1} < 1$, then producers of $x_1$ will get a higher revenue and, relatively, the remuneration of natural resources, in respect of the remuneration for *F*. There will be a lower pressure on the natural resource, due to the change of a more *green* technology.

## 3.4. Situation with free trade

The first difference relies in the fact that consumption of each good (D) may differ from the domestic supply (S), due to import and export flows of goods. Consequently, we define two equations, corresponding to each country:
D = S + Imp - Exp
According to the Heckscher-Ohlin model, one country exports the good in which it has a comparative advantage, since it uses the factor that is relatively more abundant. On the contrary, the same country is better off from importing the good which uses the factor that is relatively more scarce (Basevi et al, 2001; Krugman and Obstfeld, 2003). In our case, we suppose that the Home is more endowed in F, in respect of E, while the Foreign is more endowed in E, in respect of F:

[2] In this analysis we do not consider Giffen goods.

$$\frac{F^H}{E^H} < \frac{F^F}{E^F}$$

This implies that the Home imports food (x1) from the Foreign, which requires relatively more natural resources, while it exports the other good (x2), which uses more of F. Similarly, the Heckscher-Ohlin model states that trade causes a change in the relative prices of the two goods in the two countries, tend to converge into the relative world price:

$$\frac{p_{x1}^H}{p_{x2}^H} = \frac{p_{x1}^F}{p_{x2}^F} \equiv \frac{p_{x1}^W}{p_{x2}^W}$$

As follows, we discuss about the consequences of the environmental certification on both countries, either in the case only one country, or both countries may adopt the certification. The analysis is referred to the effect on the equilibrium.

Case a1) Certification adopted only by the Home

The adoption of a more green technology implies an increase of production costs for x1 that, if compensated adequately by the premium price (t), may still represent an opportunity for product diversification, allowing the firm to be more competitive in respect to other firms. Therefore, to a certain extent, the market in the Home is characterized by two differentiated goods x1, of which the certified good is produced domestically, and exchanged in the domestic market, at price px1+t, while the ordinary good is either produced domestically, or imported, at price px1.

If we assume that the supply of certified good is sufficient to satisfy the domestic consumption, and the premium price is sufficient to cover the additional costs for certification, the mechanism may work as a policy measure for protect from the foreign competitors.

The overall effect might be a reduction of the import flow from the Foreign, despite the existence of the premium price, that may be perceived only by domestic producers.

In this case, in the Home we may observe similar effects as in the case of autarky, while in the Foreign there should not be any relevant effect, as the relative prices between the two goods in the both countries remain basically unchanged, as well as import and export flows.

Case b) Certification in both countries

In this case, it is expected a more relevant effect, in that also producers in Foreign may pursue the achievement of the premium price t, under the condition that it is sufficient to offset the additional cost for the certification. Therefore, in this case, the relative price between the two goods increases in Home, determining an increase of trade from Foreign to Home. However, since the higher price corresponds to the certified product, this implies that in Foreign there is an increase of produce from the green technology. Natural resources will be preserved, but the overall production of the good x1 will be lower, in part due to the increased export to Home, and in part because of the technological change. Consequently, the price for good x1 may increase, to a certain extent, although consumer in Foreign may not be willing to pay for the certification. The price increase for the good x1 may cause a relevant reduction of the purchasing power of the other good (x2), with consequent reduction of imports from Home. In general, effects of the certification in Foreign are similar to the analysis in the case of autarchy, and even more amplified, since the good x1 holds a relevant importance either in the demand and the production mix.

## 4. Concluding remarks

The theoretical analysis has proved that the enforcement of voluntary, participatory, market-based environmental labelling schemes may be potentially efficient economic instruments in order to preserve natural resources. The effectiveness of this measure

depends on the market share of certified products, in comparison with other goods, the elasticity of demand to consumer revenue, and the market situation. In the case of free trade and under the hypothesis that certification scheme is implemented by only one country, the effects are limited to that country, similarly to the impacts in the case of autarky. However, most relevant impacts are expected when both countries agree to enforce voluntary certification schemes.

The implementation of eco-labelling schemes represents a moderate approach, in contrast with other economic instruments. In this regard, they should be preferred, as they cause lower market distortion effects, while consumers concern towards environment may represent the real driving force for the pursuing of a more sustainable development.

However, for the achievement of the preservation of natural resources, a combination of several policy measures may be preferred, in order to face to the complexity of this matter, such as:

- economic measures, such as the introduction of environmental tax, to internalize the externalities originated as a co-product, or the payment of financial incentives, aimed at promoting cleaner production technologies;
- regulatory measures, consisting in the enforcement of rigid environmental standards, indicating the minimum necessary requirements that producers have to comply, in order to enter the world market;
- institutional mechanisms, based on the principle that polluters may establish contracts with those who detain the property rights of natural resources (approach based on the Coase theory).

The integrated use of these policy measures should take into account of the type of the potential environmental damage, but also should consider that enforcing a too rigid environmental regulation may interfere with the market mechanism, causing market failures, and the emergence of economic inefficiencies.

## *References*


Basevi G., Calzolari G., Ottaviano M. (2001): Economia Politica degli Scambi Internazionali. Carrocci Editore, Roma

Caswell,J. A., Noelke C.M., and Mojduszka E. M. (2002): Unifying two frameworks for analyzing quality for food products. Global food trade and consumer demand for quality. Kluwer Academic/Plenum Publisher. NY

Environmental Protection agency (1998): Environmental labelling - Issues, Policies, and Practice Worldwide, Washington, DC: U.S. EPA.

Grolleau G., Caswell J.A. (2005): Interaction BetweenFood Attributes in Markets:The Case of Environmental Labeling. Working Paper no. 2005-5. University of Massachusetts Amherst, Dept. of Resource Economics

Greaker M., (2006): Eco-labels, Trade and Protectionism, Environmental & Resource Economics 33: 1-37

Kraxner F., Rametsteiner E. (2005): Western Europe certifies 50%, and North America 30%, of their forests: certified forest products markets, 2004-2005. UNECE/FAO, Forest Products Annual Market Review 2004-2005, Timber Bulletin, vol.58 (3):8-93. United Nations, Geneva

Krugman P.R., Obstfeld M. (2003): International Economics, Theory and Policy. Pearson Education Inc., Boston

Melser D., Robertson P.E. (2005): Eco-labelling and the Trade-Environment Debate. The World Economy, 28 (1): 49-62

Neven D., Thisse J., F., (1990): On quality and variety competition. Economic Decision Making: Games, Econometric and Optimsation, Elsevier Scienze Publisher B. V.

OECD (1997): Analysis of Non-tariff Measures, The case of Labelling: Overview and Analysis of WTO data. TD/TC/WP(203) 40, 13 November

Owari T., Juslin H., Rummukainen A., Yoshimura T. (2006): Strategies, functions and benefits of forest certification in wood products marketing: perspectives of Finnish suppliers. Forest Policy and Economics, 9: 380-391
Stevens J., Ahmad M., Ruddell S., (2005): Forest products certification: a survey of manufactures. Forest Products Journal 48 (6): 43-49.
Turner R. K., Pearce D. W., Bateman I., (1993): Environmental Economics. An elementary Introduction . Johns Hopkins University Press. Baltimore
Varian H., (2003): Analisi Microeconomica. Cafoscarina
WTO (1999): Trade and Environment, http://www.wto.org
WTO (2002): Labelling for Environmental Purposes (Submission by Switzerland). Committee on Trade and the Environment. WT/CTE/W/219
WTO (2003): Report to the 5th Session of the WTO Ministerial Conference in Cancun. Committee on Trade and the Environment. WT/CTE/8

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