Eco-Labelling, Environment, and International Trade

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I. Introduction

In recent years, the concern for the environment has been growing, and protection of the environment is one of the main issues being discussed around the world. In this connection, eco-labelling programs are a set of measures to protect the environment, although there are other kinds of measures such as taxes, subsidies, and standards that are also used. In the past decade, eco-labelling programs have been disseminated since Germany first introduced the eco-label called Blue Angel in 1977. Now more than 26 countries/regions, including developing countries such as India, Brazil, and Zimbabwe, have introduced similar programs. A non-profit association of eco-labelling organizations around the world was also founded in 1994 called the Global Eco-labelling Network (GEN). The purpose of the association is to improve, promote, and develop the eco-labelling of products and services. This suggests that eco-labelling may be expected to be an effective measure to protect the environment.

Eco-labelling programs provide consumers with information on the environmental burdens of products. They may thus affect the behavior of consumers, in particular, who are aware of the importance of the environment. Those consumers tend to purchase environmentally preferable products, which can be identified through the eco-label on the products. Thus, eco-labelling programs will increase demand for environmentally preferable products, and will change resource allocation so as to protect the environment.

Eco-labelling programs are basically voluntary. They establish the environmental criteria that labelled products should satisfy. In this sense, they are similar to standards. The difference between eco-labelling programs and environmental standards is whether the measure is compulsory or voluntary. Eco-labelling programs being voluntary measures allow firms to choose whether or not they affix eco-labels on their products. Environmental standards being compulsory measures mean that firms cannot sell their products in a market
without complying with those standards. The nature of the eco-labelling programs and the diffusion of them in many countries, however, raise new questions related to their effectiveness and trade effects.

First, the effects of eco-labelling programs are not altogether apparent. They affect resource allocation indirectly through a change in consumer behavior. Some consumers are very conscious of the environment, while others are not. Consumer sensitivity to the environment is essential for eco-labelling programs to be effective.

Moreover, eco-labelling may involve a limited number or percentage of firms in a voluntary scheme. Since introduction of the eco-labelling program may be of benefit to a small number of firms who have attained the label, it may result in enhancing the power of firms in setting prices and thus alter industry market structure. Thus, we cannot simply predict the effects of eco-labelling on resource allocation and welfare, assuming a competitive market.

Second, most eco-labelling programs are established independently in each country. The criteria of awarding eco-labels are usually developed and adopted by domestic parties. Then, the criteria may be determined, intentionally or unintentionally, in favor of domestic firms. If domestic firms can adopt the eco-label more easily than foreign firms due to the criteria established, this may cause undesirable trade effects or trade frictions.

In this respect, transparency is very important to avoid unnecessary international frictions. Colombia, Pakistan, Hong Kong China, Korea and others have remarked that the key way to minimize the negative trade effects of eco-labelling is to ensure transparency in the processing and application of eco-labels, that interested parties could participate in their development (WTO 1998a). Eco-labelling procedures tend to be open to public participation, including environmentalists, consumers, industry, trade unions, and foreign interest groups. For example, in a Japanese eco-labelling scheme, called EcoMark, there is a 60-day public-review process.

Mutual recognition of criteria may also reconcile differences in country-based criteria. The concept of equivalencies in the context of eco-labelling implies that when comparable environmental objectives can be achieved in different ways, taking into account the specific environmental conditions of each country, different criteria can be accepted as a basis for awarding eco-labels (Vossenaar 1997, p.31). If both importing and exporting countries have their own eco-labelling schemes and they have accepted different criteria to each another, this is referred to as mutual recognition. Analyzing environmental criteria leading to mutual recognition is one of the purposes of GEN. This issue has also been discussed in the Committee of Trade and Environment (CTE) of the WTO.

Finally, the use of Life-Cycle Approaches (LCA) in eco-labelling programs is designed to evaluate the overall environmental effects of products, including trade effects. The key feature of LCA is to take into consideration all life stages of the product, and it is sometimes called a cradle to grave approach. Generally life cycle assessment covers five phases of the life cycle of
products: (1) acquisition of raw materials; (2) process and production; (3) distribution; (4) use; and (5) disposal. The International Organization for Standardization (ISO) has developed international guidelines for LCA and almost all of the work has been completed (ISO 1997, 1998, 2000a, 2000b, 2000c). LCA may in theory therefore be an ideal way to assess the overall environmental effects of products.

In terms of practical use, however, there are a lot of difficulties. First, there does not exist any clear analytical methodology for LCA. Even experts and scientists cannot identify the clear boundary of the phases of the life cycle and the impacts in each life phase. Second, it is difficult for LCA to take into account such non-environmental factors as resource allocation. Therefore, introduction of eco-labelling schemes based on LCA may lead to inefficient resource allocation and the degradation of the environment. Third, the public may be irritated if a new LCA is developed and the criteria of eco-labelling programs are changed frequently.

Moreover, the eco-labelling programs based on LCA have to consider issues of international trade. In an open economy, a producing country (exporting country) may be distinguished from a consuming country (importing country). However, the use of LCA in eco-labelling schemes theoretically considers all life stages, including acquisition of raw materials, production of materials, and fabrication of products. In the absence of international methodologies and standards, LCA systems could deliberately and unwittingly become barriers to the entry of foreign products, since eco-labelling schemes may reflect the environmental conditions and preferences of the importing country.

This aspect of eco-labelling programs is also discussed in relation to the Agreement on Technical Barriers to Trade (TBT Agreement) at the WTO. Both developed countries and developing countries have argued whether eco-labelling schemes fall under the TBT Agreement. This issue has become complicated due to LCA. As for the product-related process and production methods (PPMs), countries have already reached an agreement that they are covered by the TBT Agreement. However, they have not yet agreed whether the non-product related PPMs fall under the TBT Agreement.

In connection with the point above, the concept of like product is also in dispute. If the TBT Agreement allows for the concept of like product to be extended to cover non-product related PPMs, exporting countries may not be able to set environmental standards based on their own environmental preferences, but may have to adjust their standards to those of importing countries. Therefore, many developing countries have objected to non-product related PPMs to be allowed by the TBT Agreement.

At the present stage, the full use of LCA may be unrealistic, even impossible. The most interesting use of LCA is for the identification of significant environmental impacts in the various phases of the life cycle in order to guide the development of criteria that mirrors those impacts (Neitzel 1997, p.242).

We have briefly reviewed some important issues regarding eco-labelling schemes, but it is difficult to find any rigorous analyses of the effects of these
schemes. The most noteworthy studies include OECD (1997) which investigated some practical effects of eco-labelling schemes operating in OECD countries, and Zarrilli et al. (1997), who surveyed the general issues relating to eco-labelling and international trade for a number of eco-labelling programs.

In what follows in this chapter, we discuss the effectiveness of eco-labelling schemes and their impacts on consumer behavior, the environment, international trade, and investment. We then present a simple oligopoly model of eco-labelling schemes in an international economy. The eco-labelling scheme to be analyzed is assumed to be voluntary and may discriminate against foreign producers. We analyze the effects of an introduction of domestic or foreign eco-labelling programs on the profits of firms and on the environment. We also consider the issue of recognition of foreign eco-labelling schemes. Even with a simple model, our results are complex and depend, in particular, on the change in competitive pressure in the market and the origin of the environmental damages.

Section II following considers the pros and cons of eco-labelling schemes and mutual recognition in terms of the effect on consumer behavior. The effects of eco-labelling programs on the environment and international trade are described in sections III and IV, respectively. In section V, we consider the effects on investment in environmentally sound technology (EST) by firms. In section VI, we briefly describe a theoretical model to analyze the effects of eco-labelling in an international setting, which is fully presented in appendix. Section VII provides some concluding remarks.

II. Effects on Consumer Behavior

The purpose of eco-labelling schemes is to influence consumer behavior by affixing eco-labels to environmentally preferable products and services. In other words, the objective is to induce consumers to buy products that have less negative impacts on the environment than other products. Eco-labelling schemes, however, have intended effects as well as unintended side-effects. In this section we provide a brief review of these effects and extend them to the case of mutual recognition.

First, we consider the effects expected by an introduction of eco-labelling programs. We can infer whether or not eco-labelling programs have changed consumer behavior by looking at the change in market share of labelled products and unlabelled products. The share of labelled products has increased since the introduction of eco-labelling schemes in many countries. For example, with regard to Blue Angel in Germany: For recycled paper products, an increase in market share of eco-labelled products was observed as follows: in 1993, 64 percent for sanitary paper products compared to 32 percent in 1986; and respectively 24 percent for administrative paper products compared to 13 percent (OECD 1997, p.53). Moreover, for varnishes and coatings, market shares of unlabelled products have fallen.
It should be noted that a small share of labelled products does not necessarily mean failure of an eco-labelling scheme. The criteria for assigning eco-labels have been revised at intervals. For example, in Eco-Mark in Japan, the criteria for load-stabilizing devices for energy conservation were abolished and the criteria for paper for communication were revised in May 2000. Some eco-labelling schemes may set the criteria so that the share of labelled products is small to induce firms to compete for labels.

Second, eco-labelling schemes make consumers more environmentally conscious. If eco-labelling schemes did not exist, consumers could not know the information about environmentally unfriendly products, and therefore they could not know how their consumption may damage the environment.

As for the unexpected or negative effects of eco-labelling programs, first, consumers may be confused if they face many kinds of eco-labels. That is, the oversupply of eco-labels may hinder consumption of environmentally friendly products. According to polls conducted in Germany, the share of people who consider the Blue Angel in purchasing products has decreased. A 1990 survey carried out for Tesco, a British market chain, may be another example of the confusion of consumers, in which only about 10 percent of consumers bought labelled products although about 50 percent of consumers said that they were willing to pay extra for labelled-products. Neitzel (1998a, p.17) noted that the Blue Angel program has to accept the competition raised by other environmentally-related labelling activities. This labelling market should be evaluated and compared by independent bodies. The only solutions how to solve confusion are well prepared information campaigns to achieve correct understanding.

A second negative effect is that consumers are skeptical of environmental claims on eco-labelling in general. This may be another explanation for the results in the survey quoted above. As already mentioned, almost all eco-labelling schemes have not been able to take into consideration non-product related PPMs. Consumers know this and may thus question eco-labels. If non-product related PPMs in eco-labelling are not used, it may be very difficult to convince the public about the life cycle approach of a particular scheme (Neitzel 1998b, p.4).

Third, consumers may use labelled products without the necessary care to avoid environmental effects in the use phase (Neitzel 1998a, p.15). Consumers may not completely understand the meaning of eco-labels. Eco-labels are assigned, taking some life stages into account. Therefore, if consumers use and dispose of the labelled products that are environmentally unfriendly at the other life stages, the eco-labelling schemes may be counterproductive.

Therefore, we cannot tell definitely whether or not the original purpose of eco-labelling schemes has been attained since there are both positive and negative effects. There are, however, some factors that may serve to make eco-labelling schemes function properly.

The first is a consumer-information campaign or consumer education. Neitzel (1997) emphasized the importance of this scheme with an example of
campaigns about how to use washing machines in an environmentally sound way. From this campaign, it is clear that the campaigns do affect consumer behavior. He concluded that the future review of environmental labeling criteria programs shall include improved and optimized consumer information and tools on how to wash environmentally sound (p.248). In Japan, many institutions, such as the Hyogo Environmental Advancement Association, have campaigned for the consumption of labelled products.

The second factor relates to retailers or professional purchasers (Neitzel 1998a, p. 12). Eco-labelling does not affect consumer behavior directly. However, eco-labels may affect them significantly when retailers want to stock products with eco-labels (OECD 1997, p.6).

The third factor is government procurement. According to OECD (1997), total public-sector procurement in Canada is more than $75 billion per year. In the United States and Japan, governments, institutions, and universities have been important sources for labelled products. Since the amount of government procurement, including local governments, is very large, their behavior affects the share of labelled products.

Let us finally examine the effects of mutual recognition arrangements on consumer behavior. If mutual recognition is established between two countries, the share of the products awarded eco-labelling will increase in the importing country since eco-labels become affixed to imported products. This gives rise to a price effect: Egypt noted that mutual recognition could, for example, result in an integration of markets and the establishment of a lower equilibrium price for the labelled product. This would encourage environmentally motivated consumers to switch from unlabelled goods and generate a positive income effect in developing countries, thus increasing their capability to improve the environment (WTO 1995). Because of the increase in labelled products and the fall in their price, consumers buy more labelled products. They may also become more environment-conscious since they are able to acquire the information on the environment of the exporting countries.

On the other hand, consumers may be confused and become skeptical more than before insofar as there are two or more different criteria to be determined that are presently equivalent. Or they may use and dispose of the labelled products with less care than before since the labelled products in the market increase, possibly leading to consumers mistakenly believing that products in the particular category have become more environmentally friendly.

The point then is that mutual recognition has both positive and negative effects. Therefore it is very important that eco-labelling schemes are enforced with other appropriate complementary schemes as mentioned above.

III. Effects on the Environment

In this section, we concentrate on the effects of introduction of eco-labelling schemes and mutual recognition of them on the environment. According to a survey conducted by the Federal Environmental Agency of Germany, 56% of
296 companies are of the opinion that the Blue Angel is very beneficial or beneficial to the environment. However, OECD (1997, p.38) noted that most eco-labelling programs are relatively new and their environmental effectiveness has not been evaluated. Also, the environmental benefit of eco-labelled products is difficult to differentiate from the environmental benefit achieved through other environmental measures.

Only with respect to certain products is it possible to estimate the effect of eco-labelling schemes. For example, in the Nordic Swan program, a study conducted in 1995 showed that the eco-labelling of fine paper had resulted in an 11 percent reduction in sulphur emissions from Swedish pulp and paper mills, a 21 percent reduction in COD emissions and a 50 percent reduction in AOX emissions (OECD 1997, p. 48).

We can infer the environmental effects of eco-labelling programs by analogy with the effects on consumer behavior, although accurate evaluation of the effects will depend on surveys to be carried out in the future. If consumers can know the accurate impact on the environment by consuming the products and change their behavior in favor of the environment by the introduction of a eco-labelling scheme, eco-labellings will be useful schemes for conservation. However, if consumers are confused and become skeptical because of the increase in the number of eco-labelling schemes, they may deteriorate the environment rather than conserve it.

A similar analogy holds on the effect of mutual recognition. Moreover, we should not overlook another essential point about mutual recognition, which is related to LCA. Generally existing eco-labelling schemes have excluded only the non-product related PPMs. Hence they cannot reflect the impacts both in the acquisition and the production phases. This incomplete consideration of LCA in conjunction with mutual recognition may expand the negative effects. On the other hand, if each eco-labelling scheme takes into consideration the environmental impacts that cannot be identified in the product itself based on its own damages and preferences, mutual recognition works in favor of the environment, since the eco-labelling schemes give producers both in exporting and importing countries proper incentives to improve the environment. The standardization of LCA has almost been completed in ISO, although Neitzel (1998b) has pointed out that the lack of standardization tools has made it difficult to achieve mutual recognition.

IV. Effects on International Trade

WTO members have discussed the trade effects of eco-labelling schemes at CTE meetings. They have focused on whether or not eco-labelling schemes give rise to technical barriers to trade (TBT). Canada, the EC, Argentina, India, the ASEAN countries, the United States and others have noted that the recent increase in the use of eco-labelling schemes raised concerns about transparency, unfair burdens and high competitive costs on foreign producers of like products eco-labelling schemes could lead to protectionist abuse (WTO
In March 1998, Colombia presented a document (WTO 1998b), which showed that some environmental measures adopted by particular developed countries, such as eco-labelling or packaging regulations, have negative effects on its exports in spite of the introduction of strict environmental standards in Colombia. Moreover, Colombia insisted that despite this effort towards environmental protection, Colombia’s flower sector had encountered difficulties with market access due to the fact that private organizations in certain importing countries had promoted a campaign to denigrate Colombian flowers (WTO 1998a). Colombia demonstrated this effect using data comparing the percentage change in volume of flower exports to the whole world with that to Germany (WTO 1998b). Korea, Pakistan, and Egypt also noted that in some cases developing country exporters must bear 5 to 20 per cent of additional costs on exported products (WTO 1998a) in the existence of an eco-labelling scheme in the importing country.

OECD (1997, p. 38) has mentioned four possible points on whether circumstances potentially leading to trade concerns exist in the absence of evidence of specific trade effects:

1. the number of eco-labels developed for product groups of particular export interest to developing countries;
2. the eco-label criteria based on life-cycle analysis;
3. the proportion of eco-labelled products manufactured or produced in foreign countries and in particular developing countries; and
4. the proportion of foreign licensees who have obtained an eco-label for their products.

We consider the Blue Angel as an example. The criteria of the Blue Angel do not generally include the non-product related PPMs. Moreover, foreign producers form about 13 per cent of the total of producers awarded the label. This number underestimates the actual ratio of foreign producers since there exist cases in which domestic retail chains apply for the label on foreign products that they import. Thus, at the present stage, the first point can be considered as the best explanation for eco-labelling schemes having negative trade effects.

The industries that raise concerns about trade effects are especially textiles and paper products. The EU eco-label criteria for textile industries include the environmental impacts from the use of pesticides in growing cotton, the harmful process during the production of polyester, and the use of harmful substances during the processing, making up, and finishing of products. It is difficult for producers in developing countries to comply with these criteria. The criteria for paper products in several eco-labelling schemes include the requirements on the ratio of recycled paper and that of renewable resources, which can be technical trade barriers.

The key point is to what extent the criteria are based on LCA. If the criteria include the environmental impacts in the acquisition and production phases, they can easily become points in dispute. The reason is that, although the environmental impacts from the same production method are different between the
exporting country and the importing country, which leads to the difference of strictness of environmental standards, the criteria usually reflect the impact in the importing country. Scarlett and Morris (1996) have referred to this fact and attributed it to political processes, in which stakeholders in the importing country have an advantage over those in the exporting country.

Now considering mutual recognition, there are two positive effects. First, if mutual recognition is established between countries, the cost of complying with the criteria falls, since the cost of meeting the different criteria required by different schemes is likely higher than that of meeting only one set of criteria.

Second, if mutual recognition is established with the full LCA, it achieves efficient resource allocation. The reason is as follows. With the full LCA, the environmental impacts in the acquisition and production phases are respected not only in the importing country but also in the exporting country. Although mutual recognition in all categories between any two eco-labelling schemes cannot be attained in the short term, there are two alternatives to consider. First, as in the case of Nordic Swan, which is an eco-labelling program common to Sweden, Norway, Finland, and Iceland, the criteria should be set so that a product is awarded the label if the method of producing the product complies with all relevant provisions in the legislation/laws of the place/country of production, since those laws reflect the preference for the environment in the place/country. Second, as noted by Neitzel (1998b), the criteria should include the requirements on non-product related PPMs according to specific international, or regional agreed certification systems, only if they are available. Sustainable forest certification organized by the Forest Stewardship Council and Codex Alimentarius complete texts on food labelling are among them.

V. The Effects on Investment

The introduction of eco-labelling schemes may have both positive and negative effects on investment in environmentally sound technologies (EST).

The positive effect is as follows: the producers with labelled products profit more than those with unlabelled products since the eco-label puts a premium on the products. This market condition gives rise to the competition for eco-labels. Producers have to invest more in EST to put an eco-label on their products. According to a survey in Germany in 1998, 76% of companies believe that the eco-label has increased competition for environmental innovation in their branch (Neitzel 1998a, p.12).

On the other hand, technical options and innovations, which may be a breakthrough for future developments, and which may require support from labelling activities, may be restricted by LCA because of status-quo scenarios and present data (Neitzel 1997, p.242). Moreover, when new criteria are being developed, producers of eco-labelled products may try to ensure that cri-
teria favor the current technology (Scarlett and Morris 1997, p.32) they have, which also may distort the direction of innovation.

In terms of the international aspects, there are two factors that may distort innovation: one is about transparency and the other relates to non-product-related PPMs. If the decision-making process is not transparent, it costs much time and money for the producers in the exporting country to collect the information, which hinders them from investing in EST. Furthermore, if it is very difficult for the producers to comply with the criteria for the non-product related PPMs, they may also give up innovation.

Mutual recognition accelerates the positive effect since potential entrants to the market of labelled products increase and reduce the negative effect in terms of the international aspect. This permits the producers to collect the information and comply with non-product related PPMs more easily.

One point should be noted on mutual recognition. As GEN (1999) has noted, mutual recognition is attained more easily when the exporting country's environmental criteria are similar to the importing country's program requirements. We may say that the more similar technologies the two countries have, the similar requirements the eco-labelling schemes of those countries become. Therefore technology transfer from developed countries to developing countries plays an important role in mutual recognition. At CTE meetings, several countries have pointed this out. For example, Egypt recommended that developing countries should be provided with technical assistance to improve environmental performance (WTO 1998b).

VI. A Theoretical Analysis of Eco-labelling

To analyze the relationship between eco-labelling and international trade, we construct a simple oligopoly model in which there exists trade between domestic and foreign countries. Since the full description of the model and analysis is given in Appendix, we briefly describe the model and discuss the essence of its implication in this section.

The model has the following specific features. First, domestic and foreign firms compete in quantities with Cournot conjecture. The oligopolistic framework is adopted, because eco-labelling could lead to some market power as was mentioned above. With respect to supply side, we also assume for simplicity that the numbers of firms are fixed; all firms are identical; marginal costs are constant; and the domestic market is supplied by all firms but the foreign market is by only foreign firms.

Second, to capture a characteristic of eco-labelling that eco-labelling is voluntary and open to any producers, we assume that the number of firms that obtain eco-label is endogenously determined such that the profits between those firms that will obtain eco-label and those that will not obtain eco-label are equalized. However, to reflect another characteristic that eco-labelling may discriminate against foreign producers, it is assumed that the domestic eco-label is available to only the domestic firms. The reason why we impose such
an extreme assumption is to examine whether foreign firms could gain regardless of such an unfair program.

Third, to reflect the effect of eco-labelling on consumer behavior, we assume that once the eco-labelling is introduced, consumers are decomposed into two groups: those who consume only the labelled good (and never consume the unlabeled good any longer) and those who are indifferent between the labelled and unlabelled goods. That is, the eco-labelling divides a market into two markets: the unlabelled-good market and the labelled-good market.

Fourth, the production (or consumption) emits pollution that is proportional to the output (or consumption) level and damages the environment. Both domestic and foreign firms can abate the emission by incurring an extra MC. This MC is related to the emission level. The higher the MC, the lower the emission level per unit. When eco-labelling is introduced, the government sets a certain target level of emission per unit. Those firms which intend to obtain the eco-label have to incur an extra MC to attain the target level.

In the model, we consider and compare the following four cases. In Case 0, there is no eco-labelling. In Case 1, only domestic country introduces eco-labelling. In Case 2, both countries independently establish eco-labelling schemes, while in Case 3, the domestic country recognizes the foreign label. We are particularly interested in the effects on the domestic economy of the introduction of eco-labelling and the domestic recognition of the foreign eco-label.

The basic results obtained in the model are as follows. First, the effects of eco-labelling on domestic emission crucially depend on whether the pollution is emitted during production or consumption. In particular, the introduction of eco-labelling or the recognition of the foreign eco-label could increase the local emission level. When only domestic country introduces eco-labelling, the domestic emission falls if pollution is emitted during consumption but could rise if it is emitted during production (see Proposition 1). When the domestic eco-labelling increases domestic emission in this case, the emission per unit of production of the firms with the eco-label becomes less, but the total domestic production becomes larger. That is, the direct effect of eco-labelling (i.e., the decrease in the emission of per unit of production) is dominated by the indirect effect (i.e. the increase in the total domestic production). Moreover, the recognition of foreign eco-labelling may raise the domestic emission (see Propositions 2 - 4). This is basically because the recognition leads the foreign firms with the foreign label to enter the domestic labelled-good market and hence the number of domestic firms that obtain the eco-label falls. In an extreme case, no domestic firm will obtain the eco-label and the labelled good is supplied by the foreign firms alone.

Second, even if the foreign firms cannot obtain the domestic eco-label, this does not necessarily mean that the foreign firms lose from it. Moreover, the domestic firms may not benefit from such eco-labelling. When only domestic country introduces eco-labelling, there are three possible outcomes: all firms lose or gain from the domestic eco-labelling; the domestic firms gain
while the foreign firms lose (see Proposition 1). The reason why these three cases are possible is that the domestic eco-labelling basically leads to two opposing effects on profits. The introduction of the domestic eco-labelling makes the market that each firm faces smaller but the competitive pressure in each market weaker. Since the market power for the foreign firms rises, the domestic eco-labelling is not necessarily bad for foreign firms.

The following should be noted with respect to the result that no firm may gain from eco-labelling. This result suggests a reason why the government needs to initiate eco-labelling. In fact, there are three types of eco-labels. Type I is criteria-based, third-party certification programs. Type II is information self-declaration programs. Type III is quantified product information label programs, using preset indices. One may argue that type II is sufficient as eco-labels. However, our analysis shows that no firm may have an incentive to introduce type II or the emission levels set by a firm or an industry may not be socially optimal. Furthermore, some third party such as the government may be necessary for monitoring.

VII. Concluding Remark

In this chapter, we have provided a comprehensive description of the effects of eco-labelling programs and have constructed a simple theoretical model to analyze the effects of these programs. As there are positive and negative aspects for eco-labelling programs, our theoretical model also reveals various consequences of them. At present, we may say that we should carefully evaluate the introduction and mutual recognition of eco-labelling programs. They may degrade the environment instead of improving it. In terms of trade effects, however, the eco-labelling programs may not hurt foreign firms. It may be too much to say that eco-labelling programs become trade barriers.

While we have focused on the effects of eco-labelling programs in this chapter, it would be useful to compare eco-labelling programs with other policy instruments such as standards. Since eco-labelling programs are voluntary, they may distort the firms’ optimal decisions less than compulsory policy instruments. On the other hand, the eco-labelling programs may not be as effective as compulsory measures. Further analysis is needed therefore to provide a more authoritative evaluation of eco-labelling programs.

Appendix

In this appendix, we present a simple international oligopoly model that can specifically take account of the following characteristics of eco-labelling:

- Eco-labelling is voluntary and open to any producers.
- Eco-labelling may discriminate against foreign producers.
- Eco-labelling affects consumer behavior.
We are particularly interested in the effects on the domestic economy of the introduction of eco-labelling and the domestic recognition of the foreign eco-label.

The Basic Model

We begin with the case where there is no eco-labelling. This case is referred to as Case 0. To avoid unnecessary complication, we impose several assumptions. There are $d$ domestic firms and $f$ foreign firms. All firms are identical and the numbers of firms are fixed. Firms produce a homogeneous good with constant marginal cost (MC), which is assumed to be zero. The production (or consumption) emits pollution that is proportional to the output (or consumption) level and damages the environment. Both domestic and foreign firms can abate the emission by incurring an extra MC. This MC is related to the emission level. The higher the MC, the lower the emission level per unit. There are two segmented markets, domestic and foreign. To mainly focus on the domestic market, however, we assume that the domestic market is supplied by both domestic and foreign firms, while the foreign market is supplied by only foreign firms. The firms compete in quantities with Cournot conjecture in each market.

The inverse demand function of the domestic markets is given by:

\[ P = 1 - X \] (1)

where $P$ and $X$ are, respectively, the price and the total demand. Variable profits from the domestic market for the domestic firm (firm $d$) and the foreign firm (firm $f$) are, respectively, given by

\[ \pi^d = P x^d, \quad \pi^f = P x^f, \] (2)

where $x^i$ is the supply of firm $i$ ($i = d, f$).

We can then determine the Cournot equilibrium in the domestic market:

\[ x_0^d = x_0^f = \frac{1}{n^d + n^f + 1}, \quad P_0 = \frac{1}{n^d + n^f + 1}, \quad \pi_0^d = \pi_0^f = \frac{1}{(n^d + n^f + 1)}. \] (3)

In the following, we consider three cases to examine the effects of eco-labelling on the domestic economy. In Case 1, only the domestic country introduces eco-labelling. In Case 2, both countries independently establish eco-labelling systems. In Case 3, the domestic country recognizes the foreign eco-label which is not recognized in Case 2.

Introduction of Domestic Eco-labelling

In Case 1, eco-labelling is introduced in the domestic country alone. The domestic government sets a certain target level of emission per unit. Those firms which intend to obtain the eco-label have to incur an extra MC, $c^d$, to attain the target level. To capture the feature of discrimination against foreign pro-
ducers, however, we assume that the eco-labelling is available only to the domestic firms. It is also assumed that any firm can produce only one type of good, i.e., either the labelled good or the unlabelled good.13

To reflect the effect of eco-labelling on consumer behavior, following Mattoo and Sigh (1994), we assume that once the eco-labelling is introduced, consumers are decomposed into two groups: those who consume only the labelled good (and never consume the unlabelled good any longer) and those who are indifferent between the labelled and unlabelled goods. The share of the former consumers is \( \lambda \), which is assumed to be constant. That is, the domestic inverse demand for the labelled good and that for the unlabelled good are, respectively, given by14

\[
P_l^f = 1 - \frac{X_l^f}{\lambda}, \quad P_u^u = 1 - \frac{X_u^u}{1 - \lambda}.
\]  

In the following analysis, we focus on the parameter values under which \( P_l^f > P_u^u \) always holds.

To capture the voluntary feature of eco-labelling, we assume that the number of domestic firms that obtain eco-labeling, \( n_{d}^{l} \), is endogenously determined such that the profits are equalized among all the domestic firms. Different target levels of emission per unit (i.e., different values of \( c^d \)) lead to different numbers of firms that obtain the label. The (variable) profits of the domestic firm with the label are given by

\[
\pi_{d}^{l} = \left( P_l^f - c^d \right) x_l^f
\]

The domestic equilibrium in Case 1 is as follows:15

\[
x_l^f = \frac{\lambda \left( 1 - c^d \right) }{n_{d}^{l} + 1}, \quad P_l^f = \frac{1 + n_{d}^{l} c^d }{n_{d}^{l} + 1}, \quad \pi_{d}^{l} = \frac{\lambda \left( 1 - c^d \right)^2 }{\left( n_{d}^{l} + 1 \right)^2},
\]

\[
x_u^u = x_1^f = \frac{1 - \lambda}{n_{u}^{d} + n_l^f + 1}, \quad P_u^u = \frac{1}{n_{u}^{d} + n_l^f + 1},
\]

\[
\pi_{d}^{u} = \pi_{d}^{l} = \frac{1 - \lambda}{\left( n_{u}^{d} + n_l^f + 1 \right)^2}.
\]

Specifically, we consider two cases. One is the case where the domestic firms are divided into two groups, those with the eco-label and those without the eco-label. The other is the case where all domestic firms obtain the eco-label.16 We have:

\[
\pi_{d}^{l} = \frac{\lambda \left( 1 - c^d \right)^2 }{\left( n_{d}^{l} + 1 \right)^2} = \frac{1 - \lambda}{n_{u}^{d} + n_l^f + 1} = \pi_{d}^{u} = \pi_{d}^{l}
\]

in the former case and
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The domestic prices of both labelled and unlabelled goods are higher than the domestic price without eco-labelling. With respect to the effect on profits, the following three cases could arise:

(1) All firms lose from domestic eco-labelling.

With \( n^d = n^f = 10 \), \( \lambda = 0.5 \), and \( c^d = 0.533333 \),

\[
\pi_1^d = 6 \quad \text{and} \quad \pi_0^d = 0.0022675 > 0.00222222 = \pi_1^f = \pi_1^{du} = \pi_1^f, \quad i=d,f.
\]

(2) All firms gain from domestic eco-labelling.

With \( n^d = n^f = 10 \), \( \lambda = 0.5 \), and \( c^d = 0.166667 \),

\[
n_1^{dl} = 9 \quad \text{and} \quad \pi_0^d = 0.0022675 < 0.00347222 = \pi_1^{dl} = \pi_1^{du} = \pi_1^f.
\]

(3) The domestic firms gain while the foreign firms lose.17

With \( n^d = n^f = 10 \), \( \lambda = 0.8 \), and \( c^d = 0.25 \),

\[
n_1^{dl} = 10 \quad \text{and} \quad \pi_1^f = 0.0016528 < \pi_0^d = 0.0022675 < \pi_1^{dl} = 0.003719.
\]

The reason why three cases are possible is that the domestic eco-labelling leads to two opposing effects on profits. It makes the market that each firm faces smaller but the competitive pressure weaker. It should be noted that although the foreign firm cannot obtain the domestic eco-label, the foreign firm could benefit from the domestic eco-labelling system.

We now consider the effect of the domestic eco-labelling system on environmental damage. Since we are primarily concerned with the domestic economy, we focus on the local pollution. When the pollution is emitted during production, the total emission in the domestic country is given by

\[
E^p = \beta(0) n^d x^d + \beta(c^d)n^{dl} x^{dl} ; \quad \beta'(<0),
\]

where \( \beta \) measures the level of emission per unit of production. \( \beta \) decreases as the MC of abatement rises. When it is emitted during consumption, on the other hand, the total emission is given by

\[
E^c = \gamma(0) (c^d) n^{dl} x^{dl} + \gamma(c^d) n^{dl} x^{dl} ; \quad \gamma'(<0).
\]

Since the domestic prices of both labelled and unlabelled goods are higher than the domestic price without eco-labelling (i.e., \( P_0^d < P_0^u < P_1^f \)), \( E_0^c > E_1^c \) clearly holds. However, whether \( E^p \) declines or not is ambiguous. For example, suppose that \( n^u = n^f = 10 \), \( \lambda = 0.8 \), and \( c^d = 0.25 \). As we have seen above, all domestic firms obtain the label in this case (i.e., \( n_1^{dl} = n^d = 10 \)). Then \( E_0^p = \beta(0) n_0^d x_0^d = \beta(0) \times 0.4761904 \) and

\[
\pi_1^d = \frac{\lambda (1 - c^d)^{n^d}}{(n^d + 1)^2} > \frac{1 - \lambda}{(n^f + 1)^2} = \pi_1^f
\]
in the latter.
If $\beta(0)$ and $\beta(0.25)$ are close enough, thus, $E_0^p < E_1^p$ holds. Although all domestic firms produce the labelled good, the domestic eco-labelling system makes the total domestic emission higher. This is because the emission per unit of production becomes less, but the total domestic production becomes larger. This case is likely to arise when $e_d^{\text{ind}}$ is small and $\lambda$ is large.

**Proposition 1** Suppose that only the domestic country introduces eco-labelling. All domestic consumers face higher prices. The foreign firm does not necessarily lose. All firms could gain or lose at the same time. The foreign firms alone are hurt only if all domestic firms obtain the label. The domestic emission is mitigated if the pollution is emitted during consumption but may be magnified if it is emitted during production.

**Recognition of Foreign Eco-labelling**

We next consider Case 2 where the foreign country also introduces the eco-labelling system. To obtain the foreign eco-label, the foreign firm has to incur an extra MC, $c_f$. However, the foreign eco-label is not recognized in the domestic country. That is, the domestic consumers cannot distinguish the foreign labelled good from the foreign unlabelled good and hence regard the foreign labelled good as the unlabelled good. We assume $e_d^{\text{ind}} = e_f = e$ for simplicity.

The domestic equilibrium is given by

$$x_2^{dl} = \frac{\lambda(1-c)}{n_2^{dl} + 1}, \quad p_2^{dl} = \frac{1 + n_2^{df} c}{n_2^{df} + 1}, \quad \pi_2^{dl} = \frac{\lambda(1-c)^2}{(n_2^{df} + 1)^2},$$

$$(12)$$

$$x_2^{fl} = \frac{(1-\lambda)}{n_2^{fu} + n_2^{fl} + 1}, \quad x_2^{fu} = \frac{(1-\lambda)(1 + n_2^{df} c)}{n_2^{df} + n_2^{fu} + 1},$$

$$(13)$$

$$p_2^{fu} = \frac{1 + n_2^{df} c}{n_2^{df} + n_2^{fu} + 1}, \quad \pi_2^{fu} = \frac{(1-\lambda)(1 + n_2^{df} c)}{(n_2^{df} + n_2^{fu} + 1)^2}. \quad (14)$$

To compare Case 1 and Case 2, suppose $n_2^{df} = n_2^{dl}$ for the moment. We have two cases: one with $n_2^{df} < n_2^{dl}$ and the other with $n_2^{df} = n_2^{dl}$. In the former case, we have $\pi_2^{df} < \pi_2^{dl}$, because those foreign firms that obtain the foreign eco-label have to incur the higher MC to produce the labelled good. That is,
the foreign eco-labelling system affects not only the competition in the foreign markets but also that in the domestic markets.

As a result, \( n_{1}^{dl} \) falls (i.e., \( n_{1}^{dl} > n_{2}^{dl} \)). This, in turn, raises the price of the domestic labelled good and decreases its total supply. It should be noted that the supply and profits rise for each domestic firm that still obtains the eco-label.\(^{20}\) As all domestic firms obtain the same profits, \( \pi_{fu}^{d} \) and hence \( \pi_{fu}^{d} \) actually increase. The price of the unlabelled good becomes higher. \( E^{c} \) is reduced. This reduction is due not only to the decreases in the demands for both goods but also the supply of the foreign good with the foreign eco-label. Since \( n_{1}^{dl} \) falls and \( n_{1}^{du} \) rises, \( E^{p} \) is likely to increase. Thus, the recognition of the foreign eco-labelling may affect the domestic environment reversely.

When \( n_{1}^{dl} = n_{1}^{d} \) initially holds, \( n_{1}^{dl} \) may or may not fall. If it falls, the effects are the same as the case with \( n_{1}^{dl} < n_{1}^{d} \). If \( n_{1}^{dl} \) does not change, there is no effect on the domestic market of the labelled good. With respect to the market of the unlabelled good, \( P^{u} \) and \( \pi_{fu}^{u} \) rise and \( \pi_{fu}^{d} \) falls. \( E^{c} \) falls but \( E^{p} \) does not change.

**Proposition 2** Suppose that the foreign country also introduces the eco-labelling system, which is not recognized by the domestic country. Then \( \pi_{fu}^{d} \) increases, but \( \pi_{fu}^{u} \) decreases. \( n_{1}^{dl} \) either decreases or remains unchanged. When \( n_{1}^{dl} \) falls, all domestic firms gain and the domestic emission decreases if the pollution is emitted during consumption but is likely to increase if it is emitted during production. When \( n_{1}^{dl} \) remains constant, the profits of all domestic firms remain unchanged, and the domestic emission falls if the pollution is emitted during consumption but does not change if it is emitted during production.

We next consider Case 3 where the domestic country recognizes the foreign eco-label. We assume for simplicity that \( n_{1}^{fu} \) remains constant (i.e., \( n_{1}^{fu} = n_{3}^{fu} \equiv n_{2}^{fu} \)).\(^{21}\) Then the equilibrium in Case 3 is given by

\[
\begin{align*}
x_{3}^{dl} &= x^{fu} = \frac{\lambda(1-c)}{n_{3}^{dl} + n_{2}^{fu} + 1}, \\
p_{3}^{u} &= \frac{1 + (n_{3}^{dl} + n_{2}^{fu})c}{n_{3}^{dl} + n_{2}^{fu} + 1},
\end{align*}
\]

\[
\pi_{3}^{d} = \pi_{fu}^{u} = \frac{\lambda (1-c)^{2}}{(n_{3}^{dl} + n_{2}^{fu} + 1)},
\]

\[
x_{3}^{du} = x^{fu} = \frac{1 - \lambda}{n_{3}^{du} + n_{2}^{fu} + 1}, \\
\]

\[
p_{3}^{u} = \frac{1}{n_{3}^{du} + n_{2}^{fu} + 1},
\]

\[(15)\]
\[ \pi_{3}^{du} = \pi_{3}^{fu} = \frac{1-\lambda}{(n_{3}^{du} + n_{3}^{fu} + 1)^2}. \]  

(16)

To compare Case 3 with Case 2, suppose \( n_{3}^{dl} = n_{3}^{d} \) for the moment. \( \pi_{3}^{du} \) and \( \pi_{3}^{fu} \) rise but \( \pi_{3}^{dl} \) falls, because the total number of firms in the domestic market of the labelled good increases and that of the unlabelled good decreases.

Again, we examine the two case: \( n_{2}^{dl} < n_{2}^{d} \) and \( n_{2}^{dl} = n_{2}^{d} \). With \( n_{2}^{dl} < n_{2}^{d} \), \( n_{2}^{dl} \) clearly falls. We first show:

**Lemma 3** If \( n_{2}^{dl} \geq n_{2}^{d} \), then the decrease in \( n_{2}^{dl} \), \( -\Delta n_{2}^{dl} \), is less than \( n_{2}^{d} \).

**Proof:** Suppose in contradiction that \( -\Delta n_{2}^{dl} \geq n_{2}^{dl} \). Then \( \pi_{2}^{dl} \geq \pi_{2}^{d} \) and \( \pi_{2}^{dl} < \pi_{2}^{du} \) hold, because the domestic firm does not need to incur \( c \) anymore when it decides not to obtain the label. Since \( \pi_{2}^{dl} = \pi_{2}^{du} \) and \( \pi_{2}^{dl} = \pi_{2}^{du} \) hold in equilibrium, this is a contradiction. (Q.E.D.)

The lemma implies \( n_{3}^{dl} + n_{2}^{d} > n_{2}^{dl} \). Thus, \( \pi_{3}^{dl} \geq \pi_{3}^{du} \) and \( \pi_{3}^{dl} < \pi_{3}^{fu} \) hold, because the domestic firm does not need to incur \( c \) anymore when it decides not to obtain the label. Since \( \pi_{2}^{dl} = \pi_{2}^{du} \) and \( \pi_{2}^{dl} = \pi_{2}^{fu} \) hold in equilibrium, this is a contradiction. (Q.E.D.)

It should be noted that if \( n_{2}^{d} \leq n_{2}^{d} \), the domestic labelled good may completely be replaced by the foreign one, i.e., \( n_{3}^{dl} = 0 \) may hold. The larger \( n_{2}^{d} \) is, the more likely this is to occur. If this is the case, \( P^{l} \) decreases while \( P^{u} \) may increase. When it does increase, \( \pi_{2}^{du} \) and \( \pi_{2}^{fu} \) also increase. The effect on \( E^{p} \) is ambiguous. \( E^{c} \) increases if \( P^{u} \) does not rise but may decrease if \( P^{u} \) rises.

With \( n_{2}^{dl} = n_{2}^{d} \), the recognition of the foreign label may not decrease \( n_{2}^{dl} \). If this is the case, \( P^{l} \) falls but \( P^{u} \) rises. The recognition reduces \( \pi_{2}^{dl} \) but raises \( \pi_{2}^{fu} \). Since the output of each domestic firm falls, \( E^{p} \) falls. The effect on \( E^{c} \) is not clear.

**Proposition 3** Suppose that the domestic country now recognizes the foreign eco-label that has not been hitherto recognized. The price of the labelled good falls. \( n_{2}^{dl} \) either decreases or does not change. With \( n_{3}^{dl} = 0 \), the effects on the profits and emission level are ambiguous. With \( 0 < n_{2}^{dl} < n_{2}^{d} \), the domestic firms lose and the domestic emission rises if it is emitted during consumption. With \( n_{3}^{dl} = n_{2}^{d} \), the domestic firms lose and the domestic emission falls if it is emitted during production.
We can compare Case 1 with Case 3. This corresponds to the situation in which the domestic country recognizes the foreign eco-label as soon as it is established. Again, \( n_3^{dl} \) either decreases or does not change. The following three cases are possible. First, \( n_3^{dl} + n_i^{dl} = n_1^{dl} \) holds if \( n_i^{dl} \leq n_1^{dl} < n_d \). That is, the number of foreign firms that obtain the eco-label is equal to that of the domestic firm that stops obtaining the eco-label. If this does not hold, \( \pi_3^{dl} = \pi_3^{dl} \) does not hold, either. With \( n_3^{dl} + n_i^{dl} = n_1^{dl} \), the foreign eco-labelling does not affect the prices and profits in both markets. Although \( E^c \) is not affected at all, \( E^d \) obviously goes up.

Second, if \( n_1^{dl} < n_d \) and \( n_i^{dl} < n_i \), then \( 0 < n_3^{dl} = 0.0 \). In this case, the price of the labelled good falls while that of the unlabelled good rises. Although no domestic firm obtains the label, the domestic firms gain. The effect on the emission is ambiguous whether the pollution is emitted during consumption or production.

Lastly, \( n_3^{dl} \) may remain unchanged with \( n_1^{dl} = n_d \). In this case, the price of the labelled good falls, but that of the unlabelled good rises. The domestic firms lose. Since the output of each domestic firm declines, \( E^d \) falls. The effect on \( E^c \) is not clear.

**Proposition 4** Suppose that the domestic country recognizes the foreign eco-label once it is established. \( n_3^{dl} \) either decreases or does not change. With \( n_3^{dl} = 0 \), the price of the labelled good falls, the price of the unlabelled good rises, the domestic firms gain, but the effect on the domestic emission is ambiguous. With \( 0 < n_3^{dl} < n_d \), there are no effects on the prices and profits at all. The domestic emission does not alter if it is emitted during consumption but rises if it is emitted during production. With \( n_3^{dl} = n_d \), the domestic firms lose and the domestic emission declines if it is emitted during production.

**Notes**

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1 http://www.gen.gr.jp/whats.html

2 There are many international organizations that discuss eco-labelling programs themselves, or their relation to international trade. These include the WTO, OECD, Codex Alimentarius Commission, International Trade Center (ITC), United Nations Conference on Trade and Development (UNCTAD), United Nations Environment Programme
(UNEP), United Nations Industrial Development Organization (UNIDO), and International Organization for Standardization (ISO).

3 For the classification of environmental policies, see Oates and Baumol (1975). Bensako (1987) and Oates et al. (1989) analyze standards.

4 See WTO(1996).

5 For example, it is difficult to know how long consumers may use and how they dispose of the products. For details, see Scarlett and Morris (1996) and Neitzel (1997).


7 According to GEN (1999), criteria or requirements in the manufacturing process that have no impact at the product use or disposal stages are referred to as requirements arising from non-product related PPMs. In an environmental context, non-product related PPMs normally refer to situations where the environmental damage caused by the PPM is not transmitted by the product itself. In the WTO context, non-product related PPM requirements may become a fundamental challenge to the basic GATT/WTO concept of like products.

8 We simply assume the demand structures without specifying the preferences underlying them. Our demand structures may be somewhat extreme because those consumers who are concerned about the environment will not consume the unlabelled good with eco-labelling. A more realistic situation is that the consumption choice between labelled and unlabelled goods is endogenously determined depending on the price difference of those two goods. We deal with this case elsewhere [Abe et al. (2000)]. But even with these more realistic preferences, we conjecture that the main results are still valid. Mattoo and Singh (1994) also impose the same assumption in their analysis. Our discussant, Stephen Salant, wonders why consumers cannot infer that the product must be produced using an environmentally unfriendly technology without eco-labelling. He argues that if they can, those consumers who care about the environment will not consume the product even without eco-labelling. With respect to this point, some informational aspect of eco-labels should be emphasized. Consumers usually know very little about processes and production methods (PPMs). For example, most consumers did not know much about genetically modified organisms (GMO) until quite recently. The presence of eco-labels themselves often provides consumers with information on PPMs.

9 For details, see Markandya (1997).

10 The essence of the main results will not change even if the demand is not linear.

11 Subscript $j$ denotes Case $j$ in the following.

12 We will not specify any welfare function in our model. Thus, the welfare-effects of eco-labelling are not examined. Our concern is how we should evaluate environmental damage (for this point, see Sen (1995), for example). In particular, the pollution could be transboundary in the framework of an open economy. In this case, the degree of damages caused by cross-border pollution is crucial for the result. However, it is not easy to measure that degree. Thus, we focus on the local emission level.

13 This may be because of the presence of fixed costs.

14 Superscripts $l$ and $u$, respectively, denote with and without the eco-label in the following.
The domestic eco-labelling does not affect the foreign market at all in this case, because the two markets are segmented and MCs are constant.

Also, no domestic firm may have an incentive to obtain the eco-label, but this case is not interesting.

With \( n^d = n^f = 10 \), \( \lambda = 0.8 \), and \( c^d = 0.5 \), we have \( n^d_{1l} = 10 \) and \( \pi_0^l = 0.0022675 > 0.0016528 = \pi_1^d = \pi_1^f \). Thus, if \( c^d < 0.5 \), then \( n^d = n^d_{1l} \) and \( \pi_1^d > \pi_1^f \).

\( c^f \) will be defined later.

The total world emission becomes less, because the domestic eco-labelling system does not affect the foreign market.

We can verify that the price rises if and only if the output and profits rise. This is valid even with more general demand and cost structures. For details, see Ishikawa (1997).

This could be the case if the domestic markets are very small relative to the foreign ones. Even if \( n^d_0 \) is endogenously determined, the essence of the following analysis will not change.

References


