Can Eco-Labeling Do More Harm Than Good? A Comparative Statics Analysis

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Abstract
This paper uses a two-product partial equilibrium model with demand- and supply-side substitution effects to identify supply and demand conditions under which eco-labeling would be most and least effective. The results suggest that eco-labeling is most effective at reducing environmentally harmful production when it leads to a decrease in demand for unlabeled products and producers respond to non-price incentives in adopting the certified methods. The analysis demonstrates that consumer willingness-to-pay a premium and the potential demand for an eco-labeled product do not provide the best indication of an eco-labeling program's effectiveness at reducing adverse environmental impacts.

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Can Eco-Labeling Do More Harm Than Good? A Comparative Statics Analysis

Environmental labeling programs have proliferated as part of a market-oriented approach to reducing the environmentally harmful impacts of agriculture and industry. Although recent academic literature on the topic has been substantial, very little theoretical or empirical work has addressed the ultimate effect of environmental labeling programs on the environment. The primary goal of this paper is to use a two-product partial equilibrium model to provide insight regarding the ultimate environmental effect of eco-labeling under different circumstances.

Environmental labeling programs take various forms. Labeling programs may rely on first-party or third-party verification. The labels may contain positive, negative, or neutral information. The programs may be mandatory or voluntary. A label may be a seal-of-approval, verify that a single environmental criterion has been met, provide a hazard warning, or disclose information in a report card format (U.S. EPA 1998). The criteria used for environmental certification and labeling may include a full life-cycle assessment or apply only to one stage in the product life-cycle (e.g., production or consumption only).

This paper considers voluntary, third-party verified labeling programs that present positive information in the form of a seal-of-approval pertaining to the environmental impact of the production process. The label or seal-of-approval is awarded by a third party (governmental or non-governmental organization) certifying that production of a good meets certain environmental standards. The seal-of-approval implies that the labeled good's production caused less environmental harm than the production of its unlabeled counterpart. This type of label, referred to as an eco-label, is used for a variety of agricultural products.

Examples of eco-labels used in agriculture include the Marine Stewardship Council label for certified seafood, the Forest Stewardship Council label for certified wood products, the

Rainforest Alliance label for certified bananas, and the Food Alliance label for food products. Various organizations certify and label bird-friendly or shade-grown coffee as well. The dolphin-safe label for canned tuna is a classic eco-label, although the U.S. embargo on tuna caught with high dolphin mortality rates made the program essentially mandatory. USDA organic is considered an eco-label by most definitions. Consumers may purchase organic products for non-environmental (health or quality) reasons, however, and the ultimate environmental benefits are not well-documented and are disputed by some.

Eco-Labels and Market Efficiency

Two features make eco-labels unique from most other types of labels. First, an eco-label conveys information about the production of a good, but not necessarily about the product itself. For example, the eating quality of a salmon from an Alaska fishery certified by the Marine Stewardship Council may not be any different than that of a salmon from an uncertified fishery. Likewise, there is no physical difference between uncertified wood and wood that has been certified by the Forest Stewardship Council. The certification and label apply only to the environmental impact of the harvesting process and the sustainable management of the resource.

Second, an eco-label informs consumers about a public attribute (environmental impact) tied to a private good. In other words, the environmental impact (or lack thereof) from the production of a good enters the utility function of more people than just the individual consumer. For example, benefits (or reduced disutility) from the purchase of dolphin-safe tuna accrue (in a marginal sense) not only to the individual consumer but to all those who are concerned about the killing of dolphin. Similarly, everyone who enjoys birds that migrate to coffee-growing regions is affected marginally by one individual's choice of bird-friendly vs. uncertified coffee.

These two features of the environmental attributes embodied in eco-labels have implications for the efficient functioning of markets. Market failure or inefficiency often surrounds the transmission of environmental values through the market. The environmental impact of a good's production is information that cannot be easily verified by most consumers. Therefore, these types of environmental characteristics are considered credence attributes (Caswell and Padberg; Darby and Karni). Unlike search and experience attributes, credence attributes are unobservable to the average consumer, even after purchase and consumption.

Markets for credence attributes tend to be vulnerable to problems of asymmetric information and adverse selection. As Akerlof (1970) demonstrated, asymmetric information regarding product quality can result in market failure and erode incentives for producers to provide quality attributes that cannot be credibly conveyed to consumers. According to McCluskey, third-party monitoring is necessary for most producers to have incentive to provide high-quality credence goods, such as environmentally friendly food products. Eco-labels, especially when supported by a trusted, independent, third-party organization (usually a non-profit, but sometimes a government agency), can improve the efficient functioning of markets, enable environmental attributes to be valued appropriately, and encourage the production and consumption of environmentally preferable products. According to Teisl and Roe (p.141):

> This removal of information asymmetry or subsidization of search costs is clearly beneficial to consumers as they are now more informed as to the exact attributes of the product. Choices will be more closely in line with preferences, and uncertainty regarding the nature of product attributes is minimized during the choice process. Firms that produce goods with desirable attributes also gain, as they are rewarded for marginal improvements in the quality of various attributes.

Thus, a primary function of eco-labels is to transmit credible information to consumers, improve the efficiency of markets, and provide incentives for the private provision of environmental protection.

Low levels of consumer awareness regarding the environmental impacts of production practices may limit demand for eco-labeled goods and reduce their economic viability. In particular, positive eco-labels do not directly inform the consumer about the negative impacts of alternative (unlabeled) products. It is likely that most consumers know very little about the specific impacts of agriculture on the environment. "One of the primary limitations in environmental labeling programs to date has been a lack of awareness on the part of consumers" (U.S. EPA 1998).

The fact that attributes represented by eco-labels are public goods has implications for market efficiency and social welfare as well. As Samuelson (1954, 1955) demonstrated, the optimality condition for provision of public goods differs from that of private goods. As a result public goods are typically underprovided by the free market. If consumers do not fully account for the aggregate (public) costs and benefits of their individual actions, a market system without appropriate institutions will result in an erosion of common resources and public goods such as environmental quality. There is no evidence to suggest that eco-labels can help overcome this second type of market failure. For this reason, eco-labels that combine public and private attributes, such as the organic label, may be most successful.

The Question of Eco-Label Effectiveness

Despite the limitations of eco-labeling programs as environmental policy alternatives, governments and non-profit organizations are showing increasing interest in eco-labels as a means of creating market-based incentives to reduce the adverse environmental impacts from agriculture and industry. Academics disagree as to the potential effectiveness of eco-labels. Antle provides an especially optimistic assessment of the potential for labeling and other information-based policies to bring about efficient environmental outcomes in agriculture. "[Antle's] hypothesis is that this kind of product differentiation could—and eventually will—provide an efficient alternative to the complex set of policies that now exist in the United States to promote conservation and protection of the environment" (p.1006).

Other authors cast doubt upon the effectiveness of labeling programs at achieving environmental and social goals. Murray and Abt mention that participation in certification does not necessarily translate to significant changes in production practices or to environmental benefits. Kiker and Putz caution that market dynamics are difficult to predict and raise questions about the ability of market institutions to transmit a broad range of environmental and social values from the consumer side, reflect subtle differences in production from the supply side, and effectively protect the environment.

Despite speculation of all sorts, "to date, the effectiveness of labels as a policy tool has not been thoroughly studied" (U.S. EPA 1998 p.59). Several questions remain. Under what circumstances would an eco-labeling program be most effective at reducing adverse environmental impacts? Under what circumstances would eco-labeling be least effective? Is it possible that an eco-labeling program could actually increase environmentally harmful production? These are the primary questions addressed by this paper.

Although consumer awareness and willingness-to-pay, as well as returns to producers, may be important considerations, the ultimate goal of eco-labeling (for those who pay premiums for environmental attributes and for those who advocate eco-labeling as an environmental policy alternative) is to reduce the adverse environmental impacts of production. With this goal in mind, the U.S. EPA (1994 p.5) identified major determinants of effectiveness of eco-labeling programs:

> The specific metrics used to measure environmental label effectiveness include: 1) consumer awareness of labels, 2) consumer acceptance of labels (credibility and understanding), 3) changes in consumer behavior, 4) changes in manufacturer behavior, and 5) improvement of environmental quality. The first four elements can be seen as steps that eventually lead to the fifth element: the reduction of environmental impacts associated with consumer products.

Although the U.S. EPA (1994 p.5) concurs that the "ultimate goal is to reduce environmental impacts," they point out that the ultimate environmental effect is the most difficult to measure and acknowledge that changes in environmental quality as a result of environmental certification and labeling has not been well studied. The U.S. EPA (1994) describes the theoretical link between the effect of eco-labels on consumer demand and environmental outcomes.

> With increased acceptance of an environmental label, consumer behavior changes may take the form of increased demand for products with ECPs, or decreased demand for products carrying negative warning labels. This in turn would effect a market shift toward products that are presumably less damaging to the environment than other similar products in their classes. In theory, a market shift of this sort will reduce the total environmental impacts of consumer products (EPA 1994, p. 5).

The exact linkages between consumer awareness, demand, and environmental impacts are left rather ambiguous however.

Several studies have evaluated consumer demand and willingness-to-pay premiums for eco-labeled products (Blend and van Ravenswaay; Grönroos and Bowyer; Johnston et al.; Loureiro, McCluskey, and Mittelhammer; Ozanne and Vlosky; Teisl, Roe, and Hicks). Others have considered producer responsiveness to certification and labeling programs (Boltz et al.; Gobbi; Murray and Abt). Advocates of eco-labeling programs and academics writing on the subject often assume that consumer willingness-to-pay a premium for an eco-labeled product is the primary indicator of a program's effectiveness. Although consumer willingness to pay is an important factor contributing to the ultimate results of an eco-labeling program, the interaction with other supply and demand factors is usually ignored. Once these market interactions are considered, a wide range of potential outcomes becomes apparent.

Very few studies, however, have attempted to model the effectiveness of eco-labeling by considering the relevant supply and demand factors for both the eco-labeled and unlabeled product and the ultimate impact on the environment. Mattoo and Singh used a graphical analysis to model supply and demand for an environmentally-friendly product and its environmentally-unfriendly counterpart. They produced an interesting result: if the quantity of eco-supply exceeds the quantity of eco-demand at the undifferentiated (pre-labeling) price, the quantity of environmentally-unfriendly production could increase. Their analysis is limited, however, in that it does not account for substitution effects or a direct reduction (shift) in demand for environmentally-unfriendly product after the eco-label is introduced. Sedjo and Swallow use a graphical supply and demand model and consider the possibility of substitution effects. However, they are concerned primarily with the effects of eco-certification on price differentials and returns to producers. Furthermore, the demand- and supply-side substitution effects are not specified explicitly and remain somewhat ambiguous in their analysis.

This paper builds on the analysis of Mattoo and Singh, and Sedjo and Swallow, and contributes a comparative statics framework for analyzing the effect of eco-labeling on production quantities in a two-product partial equilibrium model with demand- and supply-side substitution effects. The main objective is to identify supply and demand conditions under which an environmental certification and labeling program will be most effective in terms of the ultimate goal of reducing environmentally harmful production. The potential for an adverse effect—an increase in environmentally harmful production due to eco-labeling—is considered.

The Model

Comparative statics is used to demonstrate how the equilibrium values of endogenous variables, such as production quantities, change as a result of an exogenous change in a parameter. In particular, the analysis identifies the direction and rate of change in an equilibrium value of one variable with respect to a change in another. Comparative statics does not provide insight regarding the path, process, or timing of adjustment (Chiang).

This model considers competitive markets for a good that can be produced using either environmentally-harmful or environmentally-friendly practices. That is, there are only two alternative production methods. It is assumed that the environmentally-friendly production has negligible environmental impacts and that adverse environmental impacts are directly proportional to the quantity of environmentally-harmful production. Since the ultimate goal of eco-labeling is to reduce the level of negative environmental impacts from production, the effect on the quantity of environmentally-harmful or uncertified production (Q_u) is of primary interest. Other endogenous variables to consider are the quantity of environmentally-friendly or eco-labeled production (Q_e) and the prices of the respective goods, P_u and P_e.

The only exogenous variable considered is the labeling parameter, L. This parameter is assumed to be continuous and could represent various impacts associated with eco-labeling. The parameter, L, could represent information of a similar nature to advertising. Although an eco-labeled product may be introduced in a short time span, the impact could occur over a longer period of time as awareness of the newly labeled product spreads and consumers take time to change their purchasing habits. The parameter, L, could represent the level of credence consumers place on the environmental claim. Before a third-party-verified or government-sanctioned seal-of-approval is introduced, it could be that some producers were already making similar environmental claims. A change (increase) in L would thus represent the added credibility that an eco-label brings to an environmental claim. Finally, L could represent the level or strictness of an environmental standard. The higher the level of L, the greater the environmental benefits (or less environmental harm) and the more utility (or less disutility) consumers would obtain from the eco-labeled product.

Much like advertising, the introduction of an eco-label could shift market shares. In other words, a change in the variable L could increase (shift) the demand for the environmentally-preferable product and decrease (shift) the demand for its unlabeled counterpart. For this reason, the parameter, L, will enter the demand function for both products.

The eco-labeling parameter, L, could enter the supply functions for the two products as well. If the labeling program entails significant certification costs or prevents some producers from continuing to make an environmental claim, the supply of environmentally-preferable product could be reduced. For example, anecdotal evidence suggests that when the USDA organic standard went into effect, it prevented some growers from continuing to market their products as organic. It is feasible that these disaffected producers could switch to cheaper, more environmentally harmful practices as a result. Another possibility is that the introduction of an environmental certification and labeling program causes producers to shift towards more environmentally preferable practices and obtain certification even without price premiums or changes in demand. This shift could be motivated by producer concerns about liability for environmental damages or negative publicity. In this case, environmentally preferable supply could increase (shift) and the less environmentally preferable supply could decrease (shift) as a result of the eco-labeling program.

Prices of both goods enter the supply and demand functions for the eco-labeled and unlabeled product. It is assumed that consumers and producers may switch from one product to the other as a result of price changes in either market. Thus, substitution effects are considered explicitly in this model.

Separate demand and supply functions are assumed to exist prior to eco-labeling. It is certainly feasible that with heterogeneous suppliers, some may be using environmentally preferable practices even before the certification program is implemented. For example, some ornamental plant nurseries in Florida report using integrated pest management (IPM) practices even though no IPM certification program has yet been developed. It is also possible that some demand exists for the environmentally preferable goods before the eco-labeling program is implemented. For example, farmers market shoppers can talk directly to the growers and may trust that their products are organic or pesticide-free without relying on a third-party seal-of-approval.

Two possible scenarios are considered. The first assumes that the quantity of environmentally preferable supply exceeds the quantity of demand for the environmentally preferable product at the undifferentiated price. This scenario is depicted in Figure 1. In this case, excess supply of the environmentally preferable good (ES_e) would be sold on the undifferentiated market and $P_e = P_u$. For example, many smaller coffee producers use shade-growing techniques even though they sell their product on the undifferentiated market (Gobbi).

The equilibrium conditions for this first scenario are:

(1) $$S_e(P,L) + S_u(P,L) - D_e(P,L) - D_u(P,L) \equiv 0$$

(2) $S_e(P,L) - Q_e \equiv 0$

(3) $S_u(P,L) - Q_u \equiv 0$

where S is a supply function and D is a demand function. All other variables besides price, the two quantities, and the exogenous labeling variable are suppressed and assumed constant. Assuming that the supply and demand functions have continuous partial derivatives with respect to all variables and parameters and that the endogenous variable Jacobian determinant is nonzero, the endogenous variables (Q_e, Q_u, P) may be treated as implicit functions of the exogenous variable, L. This is a version of the implicit function theorem. Totally differentiating the three identities produces a linear system of equations, and ratios of differentials (endogenous variables with respect to the exogenous variable) can be obtained and treated as a partial derivatives. Given the above assumptions, a unique solution exists for each of these partial derivatives (Chiang).

First considering that the eco-labeling variable, L, has a direct impact on the demand functions, but not on the supply functions, the resulting comparative statics effect on the quantity of environmentally harmful production is:

(4) $$\frac{\partial Q_u}{\partial L} = \frac{\frac{\partial S_u}{\partial P}}{\frac{\partial S_e}{\partial P} + \frac{\partial S_u}{\partial P} - \frac{\partial D_e}{\partial P} - \frac{\partial D_u}{\partial P}} \cdot \left(\frac{\partial D_e}{\partial L} + \frac{\partial D_u}{\partial L} \right)$$

The coefficient in front of the bracket on the right-hand side of the above equation is positive (assuming supply is a positive function of price and demand is a negative function of price). The direction of impact on Q_u thus depends on the sign of the expression in brackets, which is the impact on quantity demanded of the environmentally preferred product plus the impact on quantity demanded of the undifferentiated product, with price held constant. In other words, if the increase (shift) in eco-demand outweighs the decrease (shift) in undifferentiated demand, the quantity of environmentally harmful production will rise. However, if the reduction in undifferentiated demand is greater than the increase in eco-demand due to the eco-labeling program, the quantity of environmentally harmful production will decrease.

If the direct impact of eco-labeling on supply functions is considered as well, the following result is obtained:

$$(5) \qquad \frac{\partial Q_u}{\partial L} = \frac{\partial S_u}{\partial L} + \frac{\frac{\partial S_u}{\partial P}}{\frac{\partial S_e}{\partial P} + \frac{\partial S_u}{\partial P} - \frac{\partial D_e}{\partial P} - \frac{\partial D_u}{\partial P}} \cdot \left(\frac{\partial D_e}{\partial L} + \frac{\partial D_u}{\partial L} - \frac{\partial S_e}{\partial L} - \frac{\partial S_u}{\partial L} \right)$$

As before, an increase (shift) in eco-demand that outweighs the decrease in undifferentiated demand will have a positive effect on the quantity of environmentally harmful production. An inward shift (decrease) in the eco-supply function will cause the quantity of environmentally harmful production to rise as well. If the development of an environmental certification and labeling program causes the eco-supply to shift outwards (increase) and the environmentally harmful supply to shift inward, ceteris paribus, the amount of Q_u will fall.

This model supports the conclusion of Mattoo and Singh. When the quantity of eco-supply is large relative to the quantity of eco-demand at the undifferentiated price, it is quite possible that eco-labeling could cause an increase in environmental harm. More specifically, any impact that causes eco-demand to increase or eco-supply to decrease will cause an increase in quantity of environmentally harmful production. Not considered by Mattoo and Singh, however, is the possibility that undifferentiated demand could fall at least as much as eco-demand rises or that the eco-labeling program could cause some producers to switch to more environmentally friendly practices (outward shift in eco-supply and inward shift in harmful supply) regardless of the price effect. Such supply-side effects would reduce the amount of environmentally harmful production, even if the initial eco-supply is large relative to the quantity of eco-demand prior to the labeling program.

The second scenario is that a small premium already exists for the environmentally preferable good prior to the eco-labeling program (see Figure 2). For example, organic premiums existed long before the USDA implemented a national standard and introduced the USDA organic label. In this case, the quantity of eco-supply is less than the quantity of eco-demand at the undifferentiated price. The environmentally inferior product cannot be sold on the eco-labeled market, however, so $P_e > P_u$ and supply quantity must equal demand quantity for each market segment.

The equilibrium conditions for the second scenario are:

(6) $$Q_e = D_e(P_e, P_u, L)$$

(7) $$Q_e = S_e(P_e, P_u, L)$$

(8) $$Q_u = D_u(P_u, P_e, L)$$

(9) $$Q_u = S_u(P_u, P_e, L)$$

In this scenario, substitution effects are considered explicitly. That is, both demand and supply functions may shift as the price in the other market changes. The two goods are considered close, but imperfect, substitutes. As the price of the unlabeled product falls, demand for the eco-labeled product may fall as well (as some consumers switch to the cheaper product). Likewise, as the price for the eco-labeled product rises, demand for the unlabeled product may increase (i.e, some consumers may be priced out of the market and switch to the unlabeled product).

All other variables besides prices, quantities, and the labeling parameter in the demand and supply functions are suppressed and assumed constant. As before, the partial derivative representing the impact of eco-labeling on the quantity of environmentally harmful production can be found by using the implicit function theorem, totally differentiating, and solving for the appropriate partial derivative.

First, considering only a demand-side impact of eco-labeling, the resulting comparative statics derivative written using supply and demand elasticities is:

(10) $$\frac{\partial Q_u}{\partial L} = \frac{\left[h_u\left(h_e - e_e\right) + h_{ue}\left(e_{eu} - n_{eu}\right)\right] \cdot \frac{\partial D_u}{\partial L} + \frac{Q_u}{Q_e}\left(h_u e_{ue} - e_u h_{ue}\right) \cdot \frac{\partial D_e}{\partial L}}{\left(h_e - e_e\right)\left(h_u - e_u\right) - \left(h_{eu} - e_{eu}\right)\left(h_{ue} - e_{ue}\right)}$$

where *e* is the demand elasticity and *?* is the supply elasticity. Single subscripts refer to own-price elasticities and double subscripts refer to cross-price elasticities. For example, e_{ue} is the cross-price elasticity of demand for the undifferentiated product with respect to the price of the eco-labeled product. If both goods are normal and have well-behaved supply and demand functions, the denominator of the above expression will be positive. This result follows from the negative semi-definiteness of the substitution matrix. Therefore, the sign representing the direction of change in the quantity of environmentally harmful production will be the sign of the numerator in the right-hand side expression. The coefficient in front of the $\frac{\partial D_u}{\partial L}$ term is positive, since own-price effects outweigh cross-price effects. The positive coefficient indicates that the quantity of environmentally harmful production will move in the direction of the eco-labeling program's impact on undifferentiated demand. However the sign of the second part of the numerator is not so certain. The coefficient on the $\frac{\partial D_e}{\partial L}$ term could be positive or negative. The sign depends primarily on the magnitude of the cross-price elasticity of demand, e_{ue}, relative to the cross-price elasticity of supply, $?_{ue}$. If $h_u e_{ue} \succ e_u h_{ue}$, the coefficient will be positive. In that case, an increase in eco-demand would have a positive effect on the quantity of environmentally harmful production. If the eco-labeling program has a strong negative effect on demand for the undifferentiated product it is likely that the impact on environmentally harmful production, $\frac{\partial Q_u}{\partial L}$,

will be negative. However, if demand for the undifferentiated good is not directly affected by the eco-labeling program, except that a strong substitution effect occurs as eco-demand increases and the price of the eco-labeled good rises, the ultimate impact on environmentally harmful production could be positive.

If the eco-labeling program has a direct impact on the supply functions as well as the demand functions, the comparative statics result is:

(11) $$\frac{\partial Q_u}{\partial L} = \frac{\left[h_u\left(h_e - e_e\right) + h_{ue}\left(e_{eu} - n_{eu}\right)\right] \cdot \frac{\partial D_u}{\partial L} + \frac{Q_u}{Q_e}\left(h_u e_{ue} - e_u h_{ue}\right) \cdot \left(\frac{\partial D_e}{\partial L} - \frac{\partial S_e}{\partial L}\right)}{\left(h_e - e_e\right)\left(h_u - e_u\right) - \left(h_{eu} - e_{eu}\right)\left(h_{ue} - e_{ue}\right)}$$

$$+ \frac{\left[e_u\left(e_e - h_e\right) + e_{ue}\left(h_{eu} - e_{eu}\right)\right] \cdot \frac{\partial S_u}{\partial L}}{\left(h_e - e_e\right)\left(h_u - e_u\right) - \left(h_{eu} - e_{eu}\right)\left(h_{ue} - e_{ue}\right)}$$

The coefficient on the term, $\frac{\partial S_u}{\partial L}$, like the one on $\frac{\partial D_u}{\partial L}$, is positive assuming that the own-price elasticities outweigh the cross-price elasticities, which is consistent with a negative semi-definite matrix of substitution terms. A negative impact on environmentally friendly supply due to the certification program has the same effect as an increase in eco-demand. The coefficient on these two terms could be positive or negative. The potential for an increase in environmentally harmful production occurs when $h_u e_{ue} \succ e_u h_{ue}$, eco-demand is positively impacted, eco-supply is negatively impacted, any reduction in undifferentiated demand is small, and the direct impact on the undifferentiated supply function is nonnegative. Eco-labeling would be most effective when $h_u e_{ue} \prec e_u h_{ue}$, a substantial decrease in undifferentiated demand occurs, or supply functions shift toward more environmentally friendly practices as a direct (non-price) result of the certification program.

Discussion

The main objective of this paper was to identify supply and demand conditions under which eco-labeling would be most and least effective. A two-product partial equilibrium model with demand- and supply-side substitution effects was used. The model considered the impact of eco-labeling on supply and demand for two close substitutes, differentiated only by the environmental impact of their production methods. Comparative statics analysis was used to provide insight as to the effect of an eco-labeling program on the direction and rate of change in production quantity of the good with adverse environmental impacts. The results demonstrate that the rate and direction of change in environmentally harmful production varies according to initial supply and demand quantities, own- and cross-price elasticities, and the direct impacts of eco-labeling on the supply and demand functions.

When many suppliers use environmentally preferable methods, but sell some of their product on an undifferentiated market, an eco-labeling program that increases demand for the environmentally preferable product is likely to increase the quantity of environmentally harmful production as well. This result, similar to that obtained by Mattoo and Singh, can be explained easily. If the undifferentiated market includes both supply from environmentally harmful practices and excess supply from the environmentally preferable market (see Figure 1), any impact which reduces the excess eco-supply would raise the price in the undifferentiated market and lead to an increase in production along the environmentally inferior supply curve. A reduction in excess eco-supply could occur as a result of an increase (shift) in eco-demand or a decrease (shift) in eco-supply. If, however, undifferentiated demand or supply shift inward (decrease) or eco-supply shifts outward (increases), the effect could be a reduction in environmentally harmful production as intended.

If prior to labeling a premium already exists for the environmentally preferable product (i.e., eco-demand exceeds eco-supply at the undifferentiated price), the eco-labeling program is less likely to result in an increase in environmentally harmful production. The possibility for an adverse effect still exists, however, if the cross-price elasticity of demand is significant and undifferentiated demand does not change much. For example, sometimes eco-certification is obtained by producers in order to access foreign markets. When eco-labels are used to access new markets, total demand may increase considerably, and demand for the undifferentiated product may not fall. Consumers in the domestic market that had been paying a small premium for the environmentally preferable product may switch to the environmentally inferior product when the price premium rises. Thus, eco-labeling could increase demand (and ultimately domestic production quantity) for the environmentally harmful product, due to the cross-price substitution effect. Although an eco-labeling program that allows suppliers to access new markets may be popular among both environmentally friendly and non-adopting producers, the program could potentially increase environmentally harmful production.

This analysis demonstrates that consumer willingness-to-pay a premium and the potential demand for an eco-labeled product do not provide the best indication of an eco-labeling program's effectiveness at reducing adverse environmental impacts. A more important consideration is whether the eco-labeling program will significantly reduce demand for the undifferentiated (environmentally harmful) product. Also important are the direct impacts of environmental certification and labeling programs on the supply curves for alternative production practices. Producers may react favorably to eco-labeling programs when they have incentives not directly related to price. Concern about liability for environmental damages or negative publicity could motivate producers to adopt certified practices, even when no significant price premium is anticipated. Likewise, research and extension activities that disseminate knowledge about environmentally preferable practices and reduce the costs of greener production technologies can encourage producers to change their methods. Environmental certification programs accompanied by research and extension can effectively shift supply away from environmentally harmful practices toward more ecologically sound methods. An eco-labeling program will be most effective at reducing environmentally harmful production when it leads to a decrease in demand for unlabeled products and shifts supply curves toward environmentally preferable practices.

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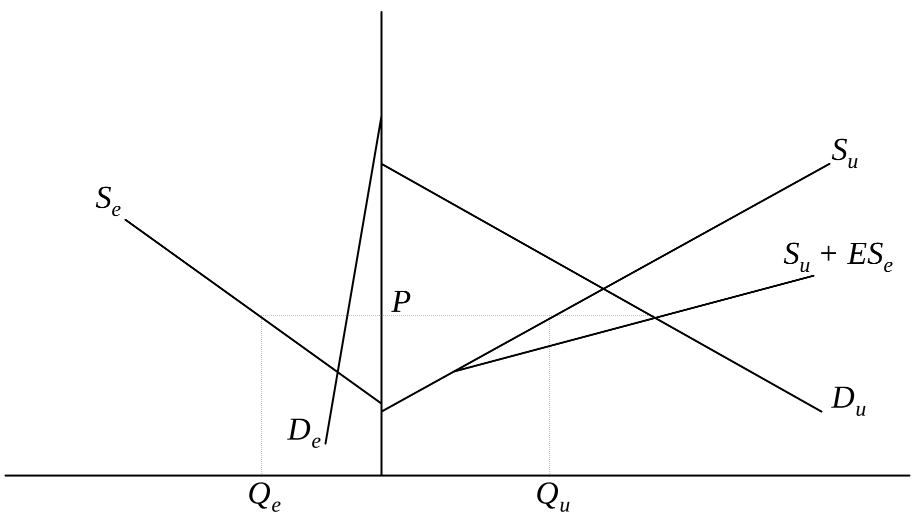

Figure 1. Scenario 1: Eco-supply exceeds eco-demand at the undifferentiated price.

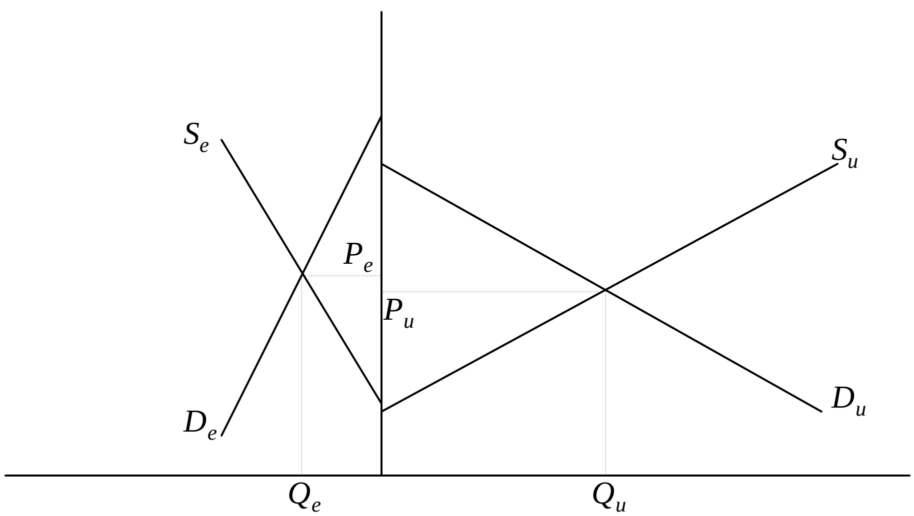

Figure 2. Scenario 2: Eco-demand exceeds eco-supply at the undifferentiated price.