Interaction Between Food Attributes in Markets: The Case of Environmental Labeling

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Some consumers derive utility from using products produced with specific processes, such as environmentally friendly practices. Means of verifying these credence attributes, such as certification, are necessary for the market to function effectively. A substitute or complementary solution may exist when consumers perceive a relationship between a process attribute and other verifiable product attributes. We present a model where the level of search and experience attributes influences the likelihood of production of eco-friendly products. Our results suggest that the market success of eco-friendly food products requires a mix of environmental and other verifiable attributes that together signal credibility.

Key words: environmental labeling, food attributes, food marketing, quality perception

Introduction

Some consumers derive utility from buying and using food products produced under specific processes, such as environmentally friendly practices. Means of verifying the use of these practices are frequently necessary in order for markets to function efficiently and without fraud because consumers cannot evaluate whether particular practices were used. Analysis of eco-labeling has focused to a large extent on the operation of markets for environmental attributes without adequately addressing the total food product.

Our analysis differs by treating eco-friendliness as a component of a product's overall quality rather than as a stand-alone attribute. Some papers have already suggested that eco-certification requires minimum quality standards to command a price premium (Thompson and Kidwell, 1998; Lohr, 1998) but consider these minimum standards as conditions for market access. In contrast, we consider them as informational instruments that determine, at least partially, the credibility of environmental claims in consumers' minds. The types and levels of search and experience attributes required by minimum quality standards may not correspond to those consumers use to infer the credibility of environmental claims. We explore the extent to which the importance and credibility of environmental claims interact with a product's other quality attributes in determining the likelihood of success in marketing eco-friendly food products.

If consumers perceive a correlation between a process attribute, such as eco-friendliness, and other product attributes they can evaluate, the quality levels of such supporting

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supporting attributes can be a substitute for or complement to direct verification of environmental attributes. Verifiable attributes that can be inspected for before purchase or evaluated after use can support the credibility of the process claim, without strictly proving its truthfulness. Similarly, the credibility of an eco-friendly claim can be damaged by a failure to provide adequate levels of other verifiable attributes. Our results suggest the market success of environmentally friendly food products requires a mix of environmental and other verifiable attributes that together signal credibility.

An Overview
of Quality Perception and Assurance

Understanding of the operation of markets for food, and food attributes, has evolved greatly based on analysis of the information environment available to consumers. Consumers' perception of quality is influenced by the product's intrinsic attributes as well as by extrinsic indicators and cues provided by the seller of the product. Intrinsic attributes relate to a broad array of attributes including food safety, nutrition, convenience, composition, and process attributes such as eco-friendliness (Caswell, Noelke, and Mojduszka, 2002). The information environment for different intrinsic attributes may be search, experience, or credence in nature (Akerlof, 1970; Nelson, 1970; Darby and Karni, 1973): the consumer can learn about the quality level prior to purchase (search), after purchase and use (experience), or not at all (credence). Extrinsic indicators (e.g., certification, labeling) and cues (e.g., brand name, packaging, price) convey search information to the consumer since they are available prior to purchase (Steenkamp, 1989). The consumer's perception of quality is formed from a blend of information from these multiple sources.

Caswell and Mojduszka (1996) argue that an experience or credence attribute can be transformed into a search attribute via labeling. More generally, however, an attribute can switch among the categories of search, experience, and credence based on transaction conditions, including the use of extrinsic indicators and cues, the technology of testing and labeling, and the benefits and costs of information acquisition for buyers. Figure 1 illustrates such transformations. For instance, mandatory labeling can change an a priori credence characteristic such as use of genetically modified organisms (GMOs) into a search characteristic. Opaque packaging changes a search attribute such as color into an experience attribute. The transformation of an attribute is sometimes the result of changes in the food distribution system. For example, long, global supply chains may make origin and production practices less transparent to consumers in the absence of traceability and labeling.

The analysis of whether the market will deliver products with different quality levels, particularly higher quality, has also been anchored in the context of the information environment (see, e.g., Stigler, 1961; Akerlof, 1970; Lancaster, 1996). Problems of adverse selection and moral hazard can occur where important product attributes are experience or credence in nature. Adverse selection is ex ante opportunism due to hidden information. It could occur, for example, where some producers provide false labeling about environmental attributes and underlying production practices causing consumers to choose products that do not have the attributes they want. Moral hazard is ex post opportunism due to hidden action. In quality assurance, a moral hazard situation arises when the producer is tempted to not carry out all the practices necessary to achieve a
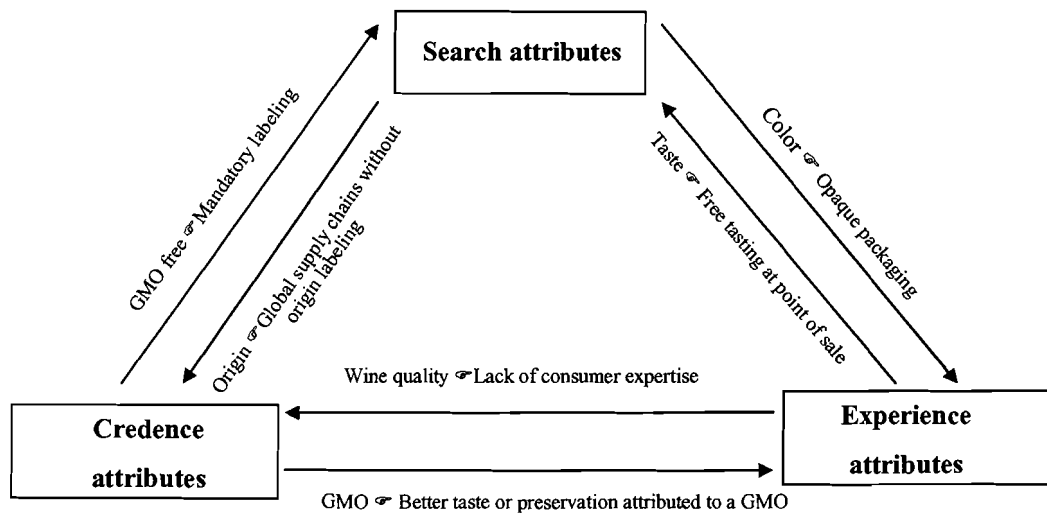
Figure 1. Examples of switching of attributes among search, experience, and credence categories

certain quality level because the consumer cannot or finds it difficult to check whether the actions have been taken.

In cases of both adverse selection and moral hazard, the market will not fully reward high quality producers or adequately punish low quality producers. While moral hazard is a real issue in environmental certification, it may be mitigated to some extent by the need for producers to make significant initial investments in knowledge, skills, materials, and time to become certified. Indeed, acquiring and assimilating environmental abilities implies initial sunk costs and can be considered as a choice made once and for all [see Rogerson (1983) for a similar hypothesis]. Once acquired, these abilities can generate a kind of "self lock-in," partly due to a win-win-win strategy, i.e., a win for the firm, the consumer, and the environment. We focus here on the consumer end of the market where adverse selection, of the type first analyzed by Akerlof (1970), remains a significant problem.

Several mechanisms, such as reputation, efficient quality signaling, advertising, and government standards, can mitigate adverse selection generated by experience goods (Nelson, 1970; Klein and Leffler, 1981; Bagwell and Riordan, 1991; Kirmani and Rao, 2000). Credence attributes, such as environmental friendliness, pose more problems in markets because the cost of defining, measuring, and verifying them can be high, along with the temptation to cheat. A potential remedy to the measurement problem is to use a proxy or a signal. Efficient measurement will be undertaken by that party to the exchange who has easy access to information and lower costs of measurement, provided incentives to cheat are curbed and trust is established (Eggertsson, 1999; Barzel, 1982). For example, because safety output may be too costly to measure (e.g., the absence of pesticide residues), it may be more cost-effective to measure management practices (e.g., organic farming) instead of the final product characteristics. At the end of the food chain, consumers can search for the organic label, which is a signal for the proxy, and thereby avoid excessive transaction costs in finding and evaluating products. Of course, the proxy and signal may convey information about multiple attributes.

Ensuring the credible operation of markets for credence attributes may require external intervention to allow consumers to choose products that correspond to their preferences and for honest producers to credibly signal their products. Macho-Stadtler and Perez-Castrillo (2001) suggest sufficient conditions for a market for credence attributes to function effectively (i.e., for a separating equilibrium to exist), allowing eco-friendly producers to label their products at a non-prohibitive cost. Specifically: (a) eco-friendly producers can acquire the eco-seal at a lower cost than conventional producers; (b) for eco-friendly producers, the expected profit with an eco-seal minus the cost of acquiring the signal is greater than the profit without the eco-seal; and (c) for conventional producers, the expected profit with an eco-seal minus the cost of acquiring the signal is less than the profit without the eco-seal.

If successful in designing and supporting the costs of signaling through a labeling program, eco-friendly producers transform a credence attribute into a search attribute where consumers can make successful selections based on reliable information. In other cases, governmental intervention or credible third-party intervention may be needed to mitigate market failure and guarantee fair trading (McCluskey, 2000).

Even though information about credence characteristics may be disclosed, consumers may have difficulty in processing it because of time constraints or a lack of specific skills. Eco-label design matters because of these information problems. For example, Wynne (1994) shows that environmental report cards (graphical presentation of environmental performance without value judgments) establish symmetrical but useless information for consumers who lack expertise and time to process them. Well-designed eco-labels can serve as cognitive supports that economize on the attention of consumers and on transaction costs (Valceschini, 1999; Wynne, 1994).

Overall, in many cases market mechanisms can be self-enforcing for both search and experience attributes, while credence attributes may require an increased level of external intervention in order for markets for quality to function effectively. Here we focus on the implications for the marketing of eco-friendly products of consumer perception of interactions among the search, experience, and credence attributes of food products.

A Model of Interaction Between Product Attributes in Determining the Likelihood of Eco-Friendly Production

Consider the case of a consumer willing to promote environmentally friendly practices in farming and processing by buying credibly eco-labeled food products. In line with Lancaster's (1966) framework, the consumer's utility from consuming an eco-labeled product is not determined by the product itself but by the bundle of characteristics the product provides. Here these characteristics are both the credence environmental characteristics and the product's related search and experience characteristics.

To model the choice between two products, assume the typical consumer derives utility from: (a) consuming the two bundles of characteristics embodied in the two goods—a conventionally produced product X that does not carry eco-labeling at a price P, and a product with enhanced environmental features X' that is eco-labeled at a price P'; and (b) consuming the quality of the environment Q.

Several factors play a role in the consumer's utility:

- The utility resulting from the consumption of the experience and search attributes of X or X', i.e., $\partial U/\partial X$ versus $\partial U/\partial X'$. Most generally, $(\partial U/\partial X' - \partial U/\partial X)$ could be positive, zero, or negative.

- The environmental improvement resulting from X or X', i.e., $\partial Q/\delta X$ versus $\partial Q/\delta X'$.

- The utility resulting from the environmental improvement, i.e., $\partial U/\partial Q$.

Assume that utility increases with consuming the products X ($\partial U/\partial X > 0$) or X' ($\partial U/\partial X' > 0$), and enjoying the environment ($\partial U/\partial Q > 0$). As noted above, the eco-labeled product could have related search and experience characteristics that are better or worse than the conventional product. X and X' are both harmful to the environment ($\partial Q/\partial X < 0$ and $\partial Q/\partial X' < 0$), but the eco-labeled product (X') is less harmful than the conventional one (X). The quality of the environment Q is decreasing with X and X' but more slowly with X' than with X, so that $\partial Q/\partial X \leq \partial Q/\partial X' \leq 0$. The environmental improvement with X' is $\partial Q/\partial X' - \partial Q/\partial X$. Because of differences in related search and experience characteristics, the expected utility from consuming an eco-labeled product could be higher than ($\partial U/\partial X' > \partial U/\partial X$), the same as ($\partial U/\partial X' = \partial U/\partial X$), or less than ($\partial U/\partial X' < \partial U/\partial X$) the expected utility from consuming a conventional product.

Under these assumptions, the consumer's problem is to:

(1) $$\text{Max } U(X, X', Q(X, X'))$$
$$\text{s.t.:} \quad PX + P'X' = I,$$

where U is a quasi-concave utility function and I is consumer income spent on goods X and X'. The Lagrangian function is written as:

(2) $$F(X, X', Q, \lambda) = U(X, X', Q(X, X')) + (I - P * X - P' * X')\lambda,$$

where λ is the Lagrange multiplier. The partial derivatives are:

(3) $$F_X = \partial U/\partial X + \partial U/\partial Q * \partial Q/\partial X - \lambda * P = 0,$$

(4) $$F_{X'} = \partial U/\partial X' + \partial U/\partial Q * \partial Q/\partial X' - \lambda * P' = 0,$$
and
(5) $$F_\lambda = I - P * X - P' * X' = 0.$$

Rearranging the previous equations, we obtain:

(6) $$F_{X'} - F_X = \partial U/\partial X' - \partial U/\partial X + \partial U/\partial Q * (\partial Q/\partial X' - \partial Q/\partial X)$$
$$- \lambda * (P' - P) = 0.$$

If $(\partial U/\partial X') - (\partial U/\partial X) > 0$ and $\partial U/\partial Q * (\partial Q/\partial X' - \partial Q/\partial X) > 0$, then $P' > P$ as consumers are willing to pay a price premium (α) for an eco-labeled good:

(7) $$\alpha = P' - P = \left[(\partial U/\partial X' - \partial U/\partial X) + \partial U/\partial Q * (\partial Q/\partial X' - \partial Q/\partial X) \right] / \lambda,$$
with

(8)
$$\lambda = \left[\partial U/\partial X + (\partial U/\partial Q * \partial Q/\partial X)\right]/P$$
$$= \left[\partial U/\partial X' + (\partial U/\partial Q * \partial Q/\partial X')\right]/P'.$$

Assume a perfectly competitive market where producers who take the environmental impacts of production into account incur higher production (and transaction) costs. Here the marginal production cost of X', $C_m(X')$, is greater than that of X, $C_m(X)$. Competitive producers adopt the eco-friendly process if the difference between the marginal costs of the two products is strictly less than α, i.e., the marginal value of the utility resulting from the environmental improvement of the last unit $(\partial U/\partial Q * (\partial Q/\partial X' - \partial Q/\partial X))$ plus the marginal utility resulting from the increase of related search and experience attributes of the last unit $(\partial U/\partial X' - \partial U/\partial X)$. In addition to the marginal costs, environmentally friendly production frequently entails sunk costs (e.g., specific equipment, training, certification, and advertising) requiring marginal costs to be further below α to induce production.

If $C_m(X') - C_m(X) > \alpha$, the price of the eco-labeled product would be too high and the consumer would only consume the conventional product X. If $C_m(X') - C_m(X) < \alpha$, then the price fixed by the eco-friendly producer would be low enough that the eco-friendly producer captures the whole demand and there is no demand for X. Finally, if $C_m(X') - C_m(X) = \alpha$, the consumer could be indifferent between consuming the two goods. Nevertheless, rational consumers may always prefer buying an eco-labeled product. Such a rationale is consistent with Andreoni's (1990) arguments that people may voluntarily contribute to a public good due to what he calls impure altruism. The consumer derives utility from both purchasing the eco-labeled product (referred to as "warm glow" by Andreoni) and from the public good in question, i.e., the increased environmental quality.

The likelihood of producing an eco-labeled good and bearing the subsequent extra costs depends on the value of α, which is shaped by consumer preferences. Table 1 shows several cases related to the interaction of different types of attributes. First, consider the situation shown in row B where the level of related search and experience attributes of the two products is equivalent $(\partial U/\partial X' - \partial U/\partial X$ is zero$)$ and the exclusive focus is on the effect of eco-characteristics $(\partial U/\partial Q * (\partial Q/\partial X' - \partial Q/\partial X))$. This is the situation analyzed in most discussions of eco-labeling where attribute interactions are ignored. There are four cases:

- Cell B1. Producing the eco-labeled item generates a high environmental improvement, and consumers value it highly. The overall impact on α is significant, and producers will be likely to produce the eco-labeled product.

- Cell B2. Producing the eco-labeled item has a low impact on environmental quality, but consumers value this small impact highly. The overall impact on α is significant, and producers may be likely to produce the eco-labeled product even though the overall environmental improvement is modest.

- Cell B3. The environmental improvement resulting from producing the eco-labeled product is high, but consumers place a low value on this change in environmental quality. The overall impact on α is weak. Producing an eco-labeled product can improve environmental quality significantly, but the producer is not willing to do so.

Table 1. Likelihood of Eco-Friendly Production for Different Levels of Search, Experience, and Environmental Attributes

		1	2	3	4
		$(\partial Q/\partial X' - \partial Q/\partial X)$ high	$(\partial Q/\partial X' - \partial Q/\partial X)$ low	$(\partial Q/\partial X' - \partial Q/\partial X)$ high	$(\partial Q/\partial X' - \partial Q/\partial X)$ low
		$(\partial U/\partial Q)$ high	$(\partial U/\partial Q)$ high	$(\partial U/\partial Q)$ low	$(\partial U/\partial Q)$ low
A	$(\partial U/\partial X' - \partial U/\partial X) > 0$	Likely to produce (+++)	Likely to produce (++)	Likely to produce (+)	Indeterminate (+/−)
B	$(\partial U/\partial X' - \partial U/\partial X) = 0$	Likely to produce (++)	Likely to produce (+)	Unlikely to produce (−)	Unlikely to produce (−−)
C	$(\partial U/\partial X' - \partial U/\partial X) < 0$	Indeterminate (+/−)	Unlikely to produce (−−)	Unlikely to produce (−−)	Unlikely to produce (−−−)

- Cell B4. Producing the eco-labeled item generates a small environmental improvement, but consumers do not value the improvement. The overall impact on α is insignificant, and producers will be unlikely to produce the eco-labeled products.

Second is the situation where the level of related search and experience attributes of the eco-friendly product is higher than that of the conventional product ($\partial U/\partial X' - \partial U/\partial X$ is positive). In all four cases (cells A1–A4), the higher level of related search and experience attributes for the eco-friendly product has a positive impact on the likelihood that eco-labeled products will be produced compared to the base case of no difference in these attributes (cells B1–B4). Of particular interest is cell A4. If both the effect of the environmental improvement ($\partial Q/\partial X' - \partial Q/\partial X$) and the valuation of the improvement ($\partial U/\partial Q$) are low or close to zero, the marginally eco-friendly product may still be produced if the search and experience attributes are significantly better than for the conventional product.

Third is the situation where ($\partial U/\partial X' - \partial U/\partial X$) is negative, i.e., the level of related search and experience attributes of the eco-friendly product is significantly lower than for the corresponding conventional product. In all cases (cells C1–C4), the lower level of related search and experience attributes for the eco-friendly product has a negative impact on the likelihood it will be produced compared to the base case of no difference in search and experience attributes (cells B1–B4).

Cell C1 is an indeterminate case in terms of whether the eco-friendly product will be produced. The combined effect of a high environmental improvement ($\partial Q/\partial X' - \partial Q/\partial X$) and the high valuation of the improvement ($\partial U/\partial Q$) is likely to encourage the production of the eco-friendly product. However, the lower level of related search and experience characteristics is likely to discourage such production. The stronger effect determines whether the eco-friendly product is produced.

Overall, the scenarios presented in table 1 suggest the impact of different levels of related search and experience attributes on the likelihood of production of eco-friendly products, in cases where this production has different environmental effects and these effects are valued at varying levels by consumers. Within different levels of consumer valuation, eco-friendly production and marketing will be more likely where the search and experience attributes of eco-friendly products are superior to those of conventional products.

When Search and Experience Attributes
Are Used as Indicators of Credence Attributes

The effect on the likelihood of eco-friendly production and marketing of the interaction among search, experience, and credence attributes may be intensified where consumers use search and experience attributes as indicators of credence attributes. Products are bundles of attributes and, in real markets, information on some may serve as indicators of the quality of others. Similarly, extrinsic indicators (e.g., certification, labeling) and cues (e.g., brand name, packaging, price) can be used to provide signals about the level of intrinsic quality attributes.

To market their products more effectively, producers may use the level of and information on search and experience attributes, which consumers can verify, to reinforce signaling about credence attributes. In a multi-attribute/multi-signal atmosphere, attributes and certification systems can reinforce or attenuate each other. As stressed by Armstrong and Rochet (1999), if consumers have preferences over more than one product attribute that a firm can control, then equilibrium requires solving a multi-dimensional screening problem. This has proven to be extremely challenging.

We focus on how quality and information levels for search and experience attributes influence the consumer's evaluation of the credibility of an eco-seal, which signals the credence attribute of environmental friendliness. Figure 2 presents a simplified sequence for this interaction:

- Producers signal the credence attribute of environmental friendliness through use of an eco-seal of approval. The level of this credence attribute is a promise made by producers that is unverifiable by consumers.

- Consumers form expectations on the levels of search (e.g., less packaging) and experience (e.g., better taste) attributes of the product.

- Consumers assess the search and experience attributes by inspecting the product and/or buying and using it.

- Consumers find that (a) the quality of the related search and experience attributes is greater than or equal to their expectations, or (b) the quality of the related search and experience attributes is lower than their expectations.

- Consumers whose expectations are met project positive feedback onto the other promises made by the producer, e.g., the eco-friendly claim. Consumers whose expectations are not met project negative feedback (and distrust) onto other claims made by the producer, especially unverifiable ones such as the eco-label.

The key links in the above sequence are the feedback loops connecting expectations and eventual product evaluation across quality attributes. These expectations and evaluations may not be scientifically proven and objective, as is documented in several empirical studies [North American Commission for Environmental Cooperation (CEC), 1999; Søndergaard, 1999; Union Fédérale des Consommateurs, 1998]. For example, CEC concluded the interest of Canadian, Mexican, and American consumers in shade grown coffee was most influenced by the perception that this type of coffee is superior in taste
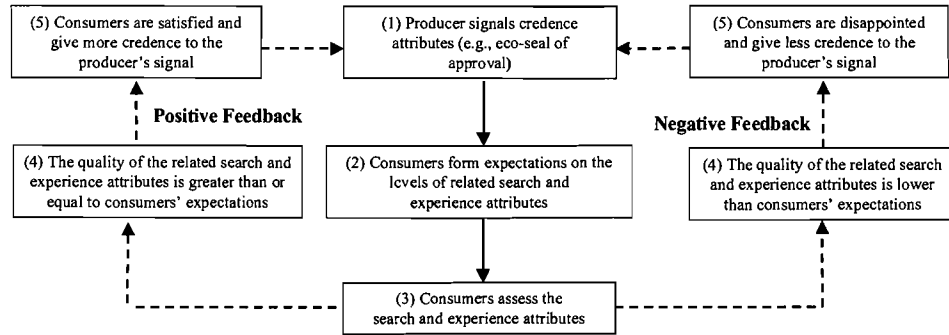
Figure 2. Impact of search and experience attributes on the credibility of signaling for credence attributes

and quality. While related search and experience attributes may be imperfect (or perhaps very imperfect) indicators of the credibility of the credence signal, consumers will use them to form overall quality perceptions.

The sequence shown in figure 2 can be enriched by introducing, as part of the evaluation process, the consumer's comparison of the search and experience attributes of the eco-labeled product to those of conventionally produced products. Using the notation developed in the previous section, suppose that consumers give credence to an eco-friendly claim if the difference in the search and experience attributes between the eco-friendly and conventional products is greater than or equal to an exogenous given level, U^*, i.e., $(\partial U/\partial X' - \partial U/\partial X) \geq U^*$. The likelihood of buying an eco-friendly product (P_e) can be expressed as:

$$(9) \qquad P_e = p * f(\partial U/\partial X' - \partial U/\partial X),$$

where $f(\partial U/\partial X' - \partial U/\partial X) = 1$ if $(\partial U/\partial X' - \partial U/\partial X) \geq U^*$, and $f(\partial U/\partial X' - \partial U/\partial X) = 0$ if $(\partial U/\partial X' - \partial U/\partial X) < U^*$. The probability (p), which describes the level of trust the consumer has in the relationship between the level of the search and experience attributes and the credibility of the eco-friendly claim, is a continuous function ranging from 0 (no trust) to 1 (complete trust). This probability can also be interpreted in the case of informed parties, such as public authorities or environmental activists, as the degree of scientific certainty about the relationship between the achievement of a particular level of related attributes and the achievement of the eco-friendly promise.

Trust may be developed through different means that are not mutually exclusive, such as certification (Caswell and Mojduszka, 1996; McCluskey, 2000), conspicuous expenditures on packaging and advertising (Nichols, 1998), and reputation-building strategies (McCluskey and Loureiro, 2005). For example, consumers who have previously purchased products certified by specific third parties and been satisfied with the level of related non-credence attributes may form trust in future transactions. Consumer trust may be based on a substantial past history or an established reputation (Shapiro, 1982, 1983; McCluskey and Loureiro, 2005). The marketing literature also shows that a producer may rent a reputation, when a seller without a brand reputation uses reputation spillover to sell through a reputable seller (Chu and Chu, 1994).

Table 2. Likelihood of Buying an Eco-Friendly Product Based on Levels of Related Attributes and Consumer Trust in the Relationship to the Eco-Friendly Claim

Level of Consumer Trust	$(\partial U/\partial X' - \partial U/\partial X) \geq U^*$ so $f = 1$	$(\partial U/\partial X' - \partial U/\partial X) < U^*$ so $f = 0$
$p = 1$ (complete trust in the relationship)	$P_e = 1$	$P_e = 0$
$p = 0$ (no trust in the relationship)	$P_e = 0$	$P_e = 0$

Table 2 shows the polar cases for trust, recognizing that intermediate levels are possible (McCluskey and Loureiro, 2005) and may be a more realistic scenario. If consumers wholly trust the relationship ($p = 1$) and the eco-friendly product's search and experience attributes are high enough ($(\partial U/\partial X' - \partial U/\partial X) \geq U^*$), then they will trust the claim and buy the eco-friendly product. In the other three cases, the likelihood of purchasing an eco-friendly product is zero because (a) consumers trust the relationship between the level of search and experience attributes and the credence claim, but the search and experience attributes are not high enough to lend support to the credence claim; or (b) there is no trust in the relationship between search and experience attributes and the environmental claim, regardless of whether the levels of search and experience attributes are high enough. In this simplified analytical framework, results for intermediate levels of trust are indeterminate.

In addition to the relationships among search, experience, and credence attributes shown in table 2, consumers can make more complex connections. They can use inferences across attributes, extrinsic cues, and extrinsic indicators to evaluate attributes they cannot verify, especially when consumers make repeated purchases over time. Doing so reduces the consumer's information and transaction costs by serving as a substitute for expensive gathering and processing of complex information or acquiring costly information from disinterested third parties. For example, consumers commonly make inferences based on the extrinsic cue of price (Stiglitz, 1987; Bagwell and Riordan, 1991). Consumers may distrust environmental claims on low-priced products because they perceive a dissonance between a low price and an environmental promise.

Implications for Marketing Eco-Labeled Products

Our analysis suggests there is a credibility area for eco-friendly food products that depends on how the attributes of a product are differentiated in a particular country or among particular market segments. The level of a product's environmental soundness or stewardship may be vertically differentiated—i.e., at the same price and with identical other attributes, all consumers would prefer the more environmentally sound product, although the degree to which this is the case may be weak among some consumers. The pattern of differentiation is complicated by the existence of a broad range of criteria for environmental friendliness. Other attributes may be differentiated vertically or horizontally (i.e., at the same price and with identical other attributes, some consumers would prefer one quality level while others would prefer alternative levels). Environmental friendliness may not be the dominant driver in consumers' product choices, but instead be an additional and secondary consideration.
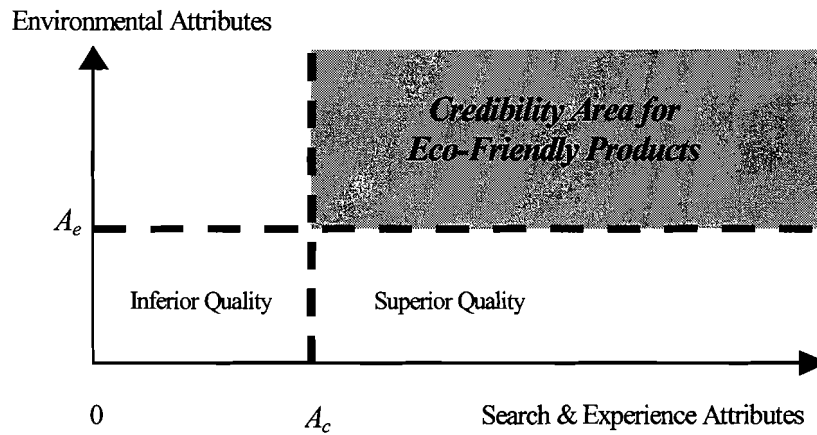
Environmental Attributes

A_e

Credibility Area for Eco-Friendly Products

Inferior Quality   Superior Quality

0   A_c Search & Experience Attributes

Figure 3. Credibility area for eco-friendly products in the attribute space

Figure 3 shows a simplified two-dimensional attribute space for food products. The vertical axis indicates the level of environmental characteristics, while the horizontal axis indicates the level of search and experience attributes. To be certified to a particular eco-friendly standard at time t, a food product must have environmental characteristics with a minimum level A_e. At the same time, to be credible to consumers, an eco-friendly food product may need to have quality levels for search and experience attributes at least as high as A_c, the level of these attributes necessary to lend credence to the eco-friendly claim. The credibility area for eco-friendly food products is the shaded space where $(x, y) \in (A_c, A_e)$. From a conceptual point of view, all the products in this area could be successfully labeled and marketed as eco-friendly. At time $t + 1$, the A_c and A_e thresholds could move to correspond to new consumer requirements.

The market success of an eco-friendly food product is closely linked to the shape and location of this credibility area and to a product's position within it. This takes into account environmental, search, and experience attributes. In a context where consumers have limited processing time and abilities, the credibility of environmental labeling is linked to the transaction environment. Consumer perceptions of these parameters can work together to mitigate or reinforce informational asymmetry and overload. We argue that a high enough level of search and experience attributes detectable by consumers before or after the purchase can support the credibility of environmental claims.

How consumers make inferences between different types of attributes has important implications for the decisions of producers, marketers, and policy makers. To be successful, producers and marketers may not be able to rely only on third-party certification to ensure the credibility of their eco-claims. They may have to invest in the production of related search and experience attributes, even if consumer inferences based on them are subjective. The design of effective eco-labels must include a clear understanding of how consumers make inferences about the credibility of an environmental claim.

An example is the Conservation Grade label developed in response to consumer demand for less intensively produced food. It is marketed in several European countries, including the United Kingdom, the Netherlands, and France. It promises consumers minimal use of agricultural chemicals and pharmaceuticals, optimum animal welfare

in food production, and that the farmer takes care of wildlife environments. Certification standards are less strict than for organic foods. The standards are defined by a union of producers and monitored by independent inspectors. In France, several Jordans breakfast cereals (www.jordans.fr) carry the Conservation Grade symbol. The label text (translated from the French) explains that the Conservation Grade is:

> ... both a label and a standard, defined in England where there are a lot of environmen-
> talists. It ensures that all products produced on farms respecting these specifications are
> farmed without chemical inputs leaving traces either in the soil or in the harvest. It
> means a double guarantee: an authentic taste and a better respect of the environment.

The message conveyed by the label clearly links environmental protection and taste, encouraging the consumer to support the environmental credence claim by tasting the products.

Concluding Remarks

The analysis presented here explores several but not all aspects of the interaction of attributes and suggests several opportunities for research. For example, does the linkage by consumers of search, experience, and credence attributes improve or inhibit market performance? The heuristic procedures used by consumers may reduce transaction costs and prevent the waste of resources on expensive monitoring. On the other hand, consumers' inferences about relationships between attribute levels may lead producers to overinvest in search and experience attributes as signal and/or screening devices rather than in the production of high credence quality itself (Kirchhoff, 2000). In the extreme case, consumers may believe that the production of attractive search and experience related attributes implies the achievement of high quality in credence properties as well. Such switching can be initiated by consumers' beliefs and activated by marketing. Producers may attempt to manipulate consumers' subjective inferences, raising concerns about the accuracy and regulation of such hybrid claims. From a private certification or government regulatory perspective, minimum quality standards may not adequately address related search and experience attributes or may set them at levels that do not correspond to those used by consumers to infer the credibility of environmental claims.

These possibilities deserve empirical investigation, e.g., by properly designed consumer surveys, consumer choice experiments, or experiments. Surveys may discern to what extent consumers form expectations on related search and experience attributes because of the presence of an eco-friendly claim and how they use the degree to which their expectations are met as an indicator of the credibility of the eco-friendly claim. The eco-label design may matter especially if producers attempt to induce certain expectations. Consumer choice experiments could explore how different levels of search and experience attributes, in combination with eco-labels, affect consumer demand (see, e.g., Holland and Wessells, 1998). Experiments could be designed to assess how different levels of search and experience attributes affect demand for conventionally produced versus eco-labeled products.

Our central point is that the credibility of eco-labels among consumers is influenced by the accompanying search and experience attributes of the labeled product. Because of the presence of the eco-label, consumers may expect a certain level of search and

experience attributes. Their subsequent evaluation of these attributes then influences the credibility of the environmental claim and their interest in repeat purchases of the product based on its environmental soundness. Honest environmental differentiation can fail if it does not consider the multi-dimensional character of quality perception.

An important further step is to identify which attributes are most likely to reinforce the credibility of environmental claims among different market segments. While private and public authorities define and enforce standards for eco-labeling, only products with the right array of accompanying quality attributes are likely to be fully credible and successful in the market. Further research is necessary to analyze the possible equilibria and levels of market performance that may emerge under different marketing and regulatory approaches to eco-labeled products.

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References

Akerlof, G. "The Market for Lemons: Quality, Uncertainty, and the Market Mechanism." *Quart. J. Econ.* 84(1970):488–500.

Andreoni, J. "Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving." *Economic J.* 100(1990):464–477.

Armstrong, M., and J. C. Rochet. "Multidimensional Screening: A User's Guide." *Euro. Econ. Rev.* 43(1999):959–979.

Bagwell, K., and M. Riordan. "High and Declining Prices Signaling Product Quality." *Amer. Econ. Rev.* 81(1991):224–239.

Barzel, Y. "Measurement Cost and the Organization of Markets." *J. Law and Econ.* 5(1982):27–48.

Caswell, J. A., and E. M. Mojduszka. "Using Informational Labeling to Influence the Market for Quality in Food Products." *Amer. J. Agr. Econ.* 78(1996):1248–1253.

Caswell, J. A., C. M. Noelke, and E. M. Mojduszka. "Unifying Two Frameworks for Analyzing Quality and Quality Assurance for Food Products." In *Global Food Trade and Consumer Demand for Quality*, eds., B. Krissoff, M. Bohman, and J. A. Caswell, pp. 43–61. New York: Kluwer Academic/Plenum Publishers, 2002.

Chu, W., and W. Chu. "Signaling Quality by Selling Through a Reputable Retailer: An Example of Renting the Reputation of Another Agent." *Marketing Sci.* 13,2(1994):177–189.

Darby, M. R., and E. Karni. "Free Competition and the Optimal Amount of Fraud." *J. Law and Econ.* 16(1973):67–88.

Eggertsson, T. *Economic Behaviour and Institutions.* Cambridge, UK: Cambridge Surveys of Economic Literature, 1999.

Holland, D., and C. R. Wessells. "Predicting Consumer Preferences for Fresh Salmon: The Influence of Safety Inspection and Production Method Attributes." *Agr. and Resour. Econ. Rev.* 27,1(1998):1–14.

Kirchhoff, S. "Green Business and Blue Angels." *Environ. and Resour. Econ.* 15,4(2000):403–420.

Kirmani, A., and A. R. Rao. "No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality." *J. Marketing* 64(2000):66–79.

Klein, B., and K. Leffler. "The Role of Market Forces in Assuring Contractual Performance." *J. Polit. Econ.* 89(1981):615–641.

Lancaster, K. "A New Approach to Consumer Theory." *J. Polit. Econ.* 74(1966):132–157.

———. "Information and Product Differentiation." In *Trade, Markets, and Welfare*, ed., K. Lancaster, pp. 156–168. Cheltenham, England: Edward Elgar, 1996.

Lohr, L. "Implications for Organic Certification for Market Structure and Trade." *Amer. J. Agr. Econ.* 80,5(1998):1125–1129.

Macho-Stadtler, I., and J. D. Perez-Castrillo. *An Introduction to the Economics of Information.* London: Oxford University Press, 2001.

McCluskey, J. J. "A Game Theoretic Approach to Organic Foods: An Analysis of Asymmetric Information and Policy." *Agr. and Resour. Econ. Rev.* 29,1(2000):1–9.

McCluskey, J. J., and M. L. Loureiro. "Reputation and Production Standards." *J. Agr. and Resour. Econ.* 30,1(2005):1–11.

Nelson, P. "Information and Consumer Behavior." *J. Polit. Econ.* 78(1970):311–329.

Nichols, M. W. "Advertising and Quality in the U.S. Market for Automobiles." *S. Econ. J.* 64,4(1998): 922–939.

North American Commission for Environmental Cooperation (CEC). "Measuring Consumer Interest in Mexican Shade-Grown Coffee: An Assessment of the Canadian, Mexican, and U.S. Markets." CEC, October 1999. Online. Available at http://www.cec.org/files/pdf/ECONOMY/shade-e_EN.pdf.

Rogerson, W. P. "Reputation and Product Quality." *Bell J. Econ.* 14,2(1983):508–516.

Shapiro, C. "Consumer Information, Product Quality, and Selling Reputation." *Bell J. Econ.* 13(1982): 20–35.

———. "Premiums for High Quality Products as Returns to Reputations." *Quart. J. Econ.* 98(1983): 659–679.

Søndergaard, H. A. "Consumer Attitudes Towards Sustainable Fishing and Ecological Fish." *MAPP Newsletter* 8(1999):5–6. Online. Available at http://www.mapp.asb.dk/WPpdf/Newsletters/newsletter 08.pdf.

Steenkamp, J.-B. E. M. *Product Quality: An Investigation into the Concept and How It Is Perceived by Consumers.* Assen/Maastricht: Van Grouch, 1989.

Stigler, G. J. "The Economics of Information." *J. Polit. Econ.* 69(1961):213–225.

Stiglitz, J. E. "The Causes and Consequences of the Dependence of Quality on Price." *J. Econ. Lit.* 25(March 1987):1–48.

Thompson, G. D., and J. Kidwell. "Explaining the Choice of Organic Produce: Cosmetic Defects, Prices, and Consumer Preferences." *Amer. J. Agr. Econ.* 80,5(1998):273–287.

Union Fédérale des Consommateurs. Les consommateurs et le monde agricole, 6, Paris, 1998.

Valceschini, E. (1999). "Les Signaux de Qualité Crédibles sur les Marchés Agro-Alimentaires: Certifications Officielles et Marques (Credible Quality Signals in Food Markets: Governmental Certifications and Brands)." Actes du colloque, SFER Signes Officiels de Qualité et Développement Agricole, Clermon-Ferrand (14–15 April 1999):147–166.

Wynne, R.D. "The Emperor's New Eco-Logos? A Critical Review of the Scientific Certification System's Environmental Report Card and the Green Seal Certification Mark Programs." *Virginia Environmental Law J.* 14(1994):51–149.