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A Note on Three Qualities:
Search, Experience and Credence Attributes

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Abstract: Food safety uncertainty is explored using three types of quality – search, experience and credence attributes – represented in game-theoretic models. In particular, for the credence attribute case, a verification process is added. This converts an informational problem into a problem of cost. With this refinement market solutions other than information-based policies such as labeling can be assessed.

Keywords: Food safety, credence attributes, game theory

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1. Introduction

As discussed by Weiss (1995), food safety economics is closely linked to information issues with consumers confronted with quality uncertainty. Accordingly, economists have suggested various information-based policies and tried to evaluate their efficacy. In this paper, a more fundamental question is posed; what form of quality uncertainty leads to food safety problems? Before answering this question, three popular sets of quality characteristics, search, experience and credence attributes, are re-examined using game theory. This leads to a focus on credence attributes that are difficult to take into account in economic models. The inability to confirm the veracity of claims concerning credence attributes is considered to be a problem of the prohibitive cost of verification. By introducing such a cost experience attributes can be better distinguished from credence attributes.

In the case of search attributes, there is no quality uncertainty given careful pre-purchase inspection assuming that the cost of search is negligible. This is a full information case. For both experience and credence attributes, the information set that the consumer faces becomes important. Allowing for repeat purchases influences the experience attribute case providing incentives to supply safe food. However, in the case of credence attributes, this repeat purchase assumption does not work since the consumer cannot judge quality even after consumption. This fact leads most researchers to prescribe some form of food safety policy, including mandatory labels, based on a failure of the market to provide sufficient information. However, in the model introduced here consumers can verify the attribute at a cost leading to alternative policy recommendations. At the individual level, a high cost of verification prevents consumers from fully resolving the quality uncertainty at a reasonable level thereby preventing the transformation of credence attributes into experience attributes. Where feasible though such verification may

lead to a market solution, previously ignored by the literature. In the case where the cost of verification is prohibitive the provision of information by the government is still appropriate, with the cost of verification serving as a reference. Such a label may serve to reduce the verification cost, thereby combining a subsidy and information role.

Returning to the original research question, namely what is the form of quality uncertainty in food safety, it is possible to define food safety as a combination of experience and credence attributes in food. Two distinct methodologies – a quality-differentiated product approach and risk analysis – become appropriate in these respective cases, based on whether a food safety illness is associated with a particular food product (experience) or is never associated with a food product (credence). The quality differentiation approach requires the ability to transparently identify safety differences between products. The risk analysis technique forwards policy recommendations based on distributions of unobservable (credence) risk in food.

Consumers, through careful inspection prior to purchase, can detect certain adulterated foods. Other items with elevated residues, contaminated with pathogens or even inappropriately prepared foods cannot be easily distinguished. Thus, consumers depend heavily on firms' claims such as brands, labeling or advertising. This kind of problem originates from the fact that food quality characteristics are not directly observable or perceivable by consumers at a reasonable cost or without invasive testing of the products. In this sense, as discussed in Weiss (1995), an information issue is the central tenet of food safety economics. Hence, to fully understand quality as an information structure between firms and consumers in the food market it is necessary to model the problem from the viewpoint of asymmetric information. Such an approach can begin with a careful examination of the information characteristics of food traded in the market. In addition, as Antle (2001, p.1130) highlights, "a deeper understanding of the nature of the

information regimes that exists or could exist in food markets with changed or new policies and institutions is needed." That is, appropriate policy regarding asymmetric information can (only) evolve from an understanding of the nature of the information structure among the food market participants (consumers, firms and the government).

In this paper food safety issues are confined to be problems of risk in food. That is, improvements in food safety are achieved through the reduction of risk such as the minimization of microbiological pathogens. The firm is characterized as making efforts to reduce risk in food, the consumer is assumed to avoid risk as much as possible and the government acting as a benevolent agent in the economy is concerned about public health. In addition, any stochastic variation in risk is ignored thus simplifying food safety to be completely deterministic. There are no consumer misperceptions.

Which characteristics of risk in food or food safety lead to the asymmetric information problem? From the consumer's viewpoint, risk in food is uncertain because it is not observable prior to purchase or consumption. In analyses of quality uncertainty, three popular sets of quality attributes are used to answer this question. Due to Nelson (1970) and Darby and Karni (1973), three kinds of qualities - search, experience and credence quality- are distinguished. Search attributes for food can be directly observed through consumers' careful inspection prior to purchase, resolving all uncertainty. The other two sets of attributes are not easily verifiable to consumers. Experience attributes, by definition, can only be known after purchase and use. Foodborne illness causing attributes such as pathogens or pesticide residues found to be present after consumption can be classified into this category regardless of whether they have a long-or short-term effect. However, this requires consumers to be able to correctly determine quality after consumption. This qualification leads to credence attributes that remain controversial in the

sense that these characteristics are not verifiable until they are revealed by experts or other professional services. Organic products are among the most popular examples of these quality attributes (McCluskey, 2000).

For food safety, it is hard to definitively say which sets of attributes correctly describe quality uncertainty. Instead, it may be suggested that food safety issues follow both avenues: experience and credence attributes. This is because whether food is safe is difficult to assess, but may be verified *ex post* by an outbreak of foodborne illness. Like a coin, food safety has two sides. We can observe only one aspect[1].

For a safe food supply system, the experience attribute approach does not add much because the problem is simply reduced to one of preventing foodborne illnesses assumed here to be unavoidable. Enhancements in food safety technology research and development will permit a strengthening of the ability to identify food safety experience attributes, moving many into the realm of search attributes. The role of public policy within this environment is mostly that of providing funds for research that provides public goods. Yet, consumers, firms and the government remain interested in precautionary measures that avoid risk prior to purchase or consumption. Alternatively, the credence attribute approach offers a more interesting opportunity for analysis. As such, most food safety policy has focused on the credence attribute problem, providing various solutions but often centering on information-based regulations.

The credence attribute problem is not new in agricultural economics. McCluskey (2000) offers similar game theoretic models for each attribute set. She proposed that the credence attribute problem arises through the violation of common knowledge. Yet the author does not

[1] Like flipping a coin, only one aspect of food safety can be observed at a time. That is, following a foodborne illness outbreak quality uncertainty is resolved and food safety can be understood as an experience attribute. However, regardless of whether food is actually safe or not in a scientific sense, if nothing is revealed even after consumption, then the food is considered to be safe but the true safety is not easily assessed. In this sense, food safety uncertainty remains and can be understood as a credence attribute.

suggest the implications of, not solutions to, this market failure, other than to discuss that a repeat purchase behavior and monitoring are important for high-quality credence goods to be available. These goods retain their credence attributes.

Caswell and Mojduszka (1996) argue that food safety is most likely a credence attribute and admit that there is no appropriate model to handle such quality uncertainty. Rather they suggest that it may be possible to transform experience and credence attributes into search attributes by providing information as a policy tool. Their paper motivates not only the use of labels but also more generally information-based policy.

Building on this literature, this paper provides amended game-theoretic models for each attribute. In particular, in order to further explore the credence attribute problem, a refinement centers on verification. Using this assumption information-based and alternative policy recommendations can be compared and combined. The main purpose of this paper is to propose a new framework to understand the three attributes and their related policy implications.

2. Comparing Three Different Qualities; Search, Experience and Credence Attributes

In this section of the paper, game theory models similar to McCluskey (2000) are developed. This technique is appropriate to explain the strategic interactions of players and allows the representation of asymmetric information using the extensive forms of the games. In particular, for credence attributes, the behavior of consumers is shown to rely on the expectation of payoffs. In such games with incomplete information, equilibrium concepts incorporate the beliefs of the players either explicitly or implicitly to assure sequential rationality. In this sense, the optimal behavior of the players in equilibrium can help explain consumer's choices.

First, a game with two players (a consumer and a firm) is constructed to show how

uncertainty in food safety can be modeled. As shown in figure 1, the firm decides whether to produce safe or less safe food first[2]. Since the consumer is assumed not to know whether food is safe or less safe prior to purchase or consumption a decision must be made under uncertainty. This is represented as an information set (dotted line) in the extensive form of the game.

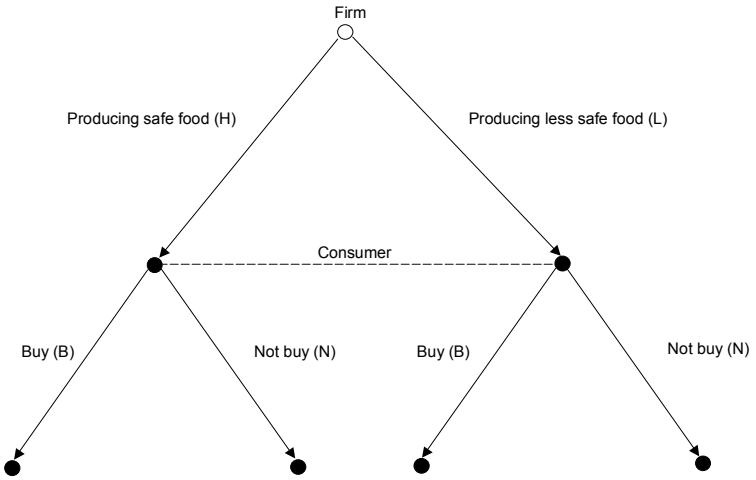

Figure 1 Extensive Form Game (Basic Model) The consumer cannot observe whether the firm sells safe or less safe food. The dotted line represents the consumers' information set.

For food safety, search attributes can include the color or smell of a clearly adulterated food. However, these attributes provide very limited representations of the potential risk. In this sense, the search attribute case can be best used as a full-information benchmark where uncertainty in food safety can be resolved with minimal search effort, if any, at low cost. Any consumer-level uncertainty does not arise through a strategic choice of the firm, simply through the selection of consumer not to respond to safety indicators or not to engage in the necessary

[2] For simplicity, until discussing equilibrium concepts, the payoffs observed at the terminal nodes are suppressed.

search. For example, consumers may choose to consume an undercooked hamburger or raw oyster. The search attribute case does not require a complex relationship between the firm and the consumer in this framework.

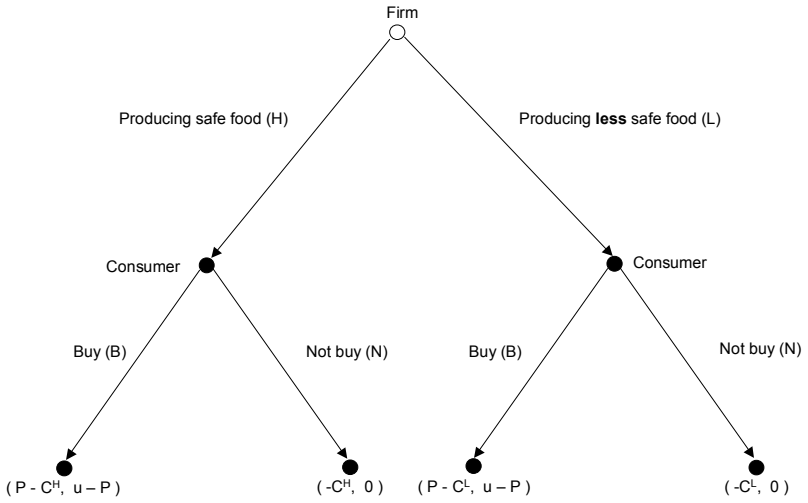

Figure 2 Extensive Form Game (Search Attribute) Search attribute is observable prior to purchase.

The payoffs are shown in parentheses (Firm, Consumer) at the terminal nodes in terms of firm profit and consumer utility. The firm receives revenue when food is purchased at a price (P) and production cost varies with the safety level (C^H or C^L). For example, when the firm produces a safe food and the consumer buys it, the firm gets $P-C^H$ and the consumer receives u-P. Note that when the consumer does not buy the food the payoff is normalized to $(-C^i, 0)$.

Once quality is no longer directly observable or accessible at the time of decision-making, uncertainty matters. In the case of experience attributes, quality is not directly observable or accessible for many reasons. For example, in the original paper of Nelson (1970), canned tuna was used as an example of an experience good. This product is not directly

observable or accessible because the contents of a can cannot be seen and the product cannot be sampled until the consumer takes possession. In this sense, one can distinguish between these two qualities as follows. A search attribute is any aspect of quality publicly accessible while experience attributes are privately accessible only through consuming, tasting and examining the good in person. For example, the color of apples in the grocery store can be considered search attributes as can the color of apple jam in a transparent container. However, the sweetness of apples in either case is an experience attribute since they are uncertain prior to purchase, in general[3]. Once the good is purchased and the experience attributes assessed, quality uncertainty is resolved. Thus, uncertainty for experience attributes originates from the fact that consumers may not have the appropriate property right for critical product information prior to purchase. That is, experience quality is related to *ex ante* uncertainty. In making a decision to purchase a good with experience quality, consumers must rely on their own beliefs which may be updated though additional experience or the provision of any other relevant information. However, though consumers can experience the quality through consumption, experience quality is still uncertain (is not completely converted to search attributes) prior to subsequent purchases. Experiencing does not get rid of uncertainty itself but helps update consumers' beliefs. Thus, it is useful to understand experience attributes in the context of repeated purchases. As in the search attribute case, a game can be constructed for experience attributes. Once again the players are the consumer and the firm. The firm moves first and then the consumer decides whether or not to buy. However, unlike the search attribute case, the consumer now faces quality uncertainty, as the choice of the firm is not known. Compared to the game for search attributes, note that there is an information set for the consumer (Figure 3).

What is different from the search attribute case in terms of the payoffs is the introduction

[3] In this sense, free trial promotion can be considered an effort to convert experience attributes to search attributes.

of a new parameter **e** which refers to the additional utility from the realization of the experience attribute, with u representing the utility from all other attributes. In this case of an experience attribute, e is realized upon consumption. Thus, when the firm produces less safe food the consumer receives a negative additional utility offset by the utility from the other attributes.

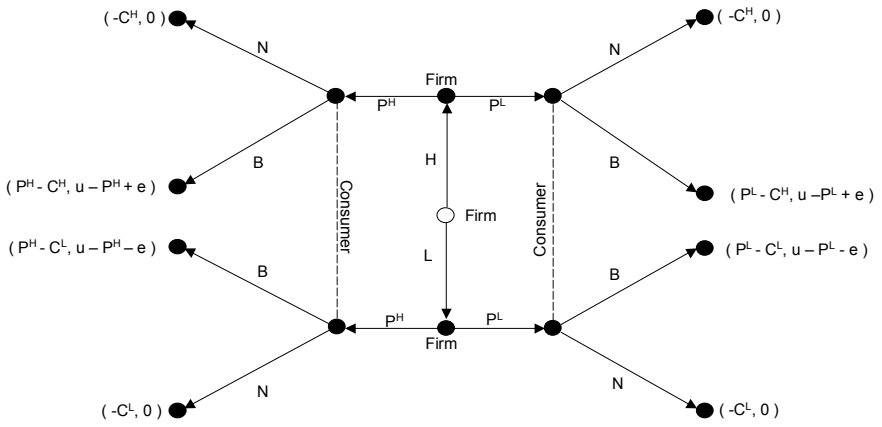

Figure 3 Extensive Form Game of Experience Attribute The consumer can determine the attribute upon consumption. Consumer receives reservation utility (u) upon consumption of all other quality attributes.

In the experience attribute case, the firm has two selections to make: whether to produce safe or less safe food and choosing the price. Price is a signal to the consumer about the safety level. In applying a forward-induction analogy and assuming that producing safe food is costly, a higher price can be a signal for safer food. The consumer, observing only the price, must move and decide to buy or not. Upon consumption of the food the attribute can be determined.

Credence attributes also involve uncertainty prior to purchase. In a game representation, the experience attribute and credence attribute cases share a similar format as the consumer does

not know whether food is safe or less safe prior to purchase. However, the difference is that the consumer has an additional node to move: verification[4]. Quality uncertainty due to the presence of a credence attribute is unresolved even after the purchase and consumption of the good. The only way that the attribute can be assessed is through verification that incurs a cost. For credence attributes, the following game can be modeled. First, the firm chooses whether to produce safe or less safe food, and then selects the price. Given this price, the consumer chooses whether to buy or not. If no purchase is made, the game ends. If a purchase is made the consumer must choose to verify the attribute or not. This verification can include any process assessing the characteristic of the product[5]. In this sense, any attribute that cannot be assessed instantaneously by the consumer can be analyzed in this model. As such, the experience attribute case is nested in this game when the parameter **c** equals **e** (Figure 3) and where **vc** is zero. Note that verification is now an action choice for the consumer (Figure 4).

In the case of a credence attribute, the payoffs include two further parameters: vc and c. The parameter c refers to the additional utility derived from the credence attribute much like e in the experience attribute case. The parameter vc refers to the cost of verification, ranging from zero to infinity, which is assumed to be incurred when the consumer chooses the verification process. Note that the additional utility c can be realized only after verification. Thus, these two parameters are only relevant for the payoffs at the terminal nodes following verification (V).

[4] Verification is different from search effort. It is the *ex post* effort to verify the attribute which cannot be easily assessed by the consumer. *Ex-ante* effort resolves search attribute uncertainty.
[5] For simplicity, the verification process is assumed to be perfect, providing the consumer with true information about the quality attributes. Extensions to this model can consider the incomplete or inaccurate resolution of quality uncertainty through verification.

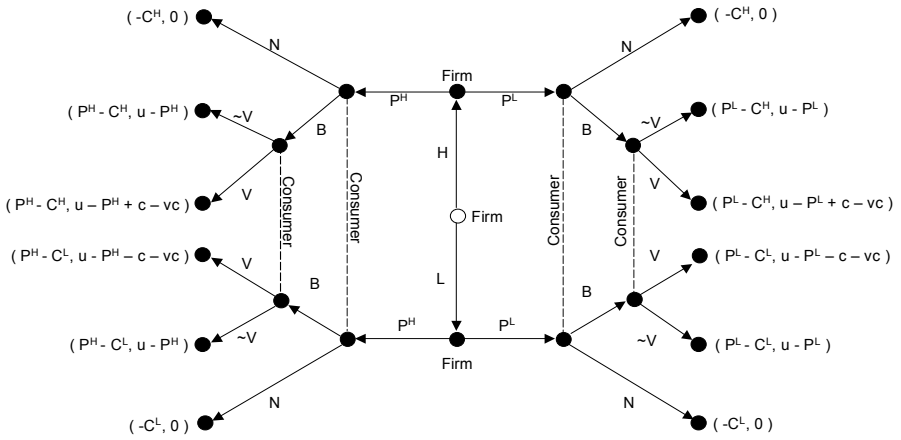

Figure 4 Extensive Form Game for Credence Attribute Firm has two nodes to move. At the first node selects whether to produce safe or less safe food. At the second node, the signal of high or low price is chosen. Consumer also has two nodes: to buy or not, then to verify the presence of the credence attribute or not at a cost **vc**.

Up until this point the three attributes have been modeled using the extensive form of the games. With the exception of the search case, these games each exhibit quality uncertainty prior to purchase. This uncertainty highlights several points worth pursuing. First, it may be argued that in the case of credence quality consumers have (little or) no incentive to purchase the good as there is no ability to assess the quality, even through consumption. Therefore no additional utility can be gained from goods with significant credence quality. That some consumers buy such products may be explained by their belief systems. That is, such consumers believe that firms sell safe food.

Second, in the dynamic context of repeat purchases, unobservable quality does not provide any additional information about quality. Consumers have no opportunity to update beliefs where credence quality exists. Thus, consumers can only rely upon their prior beliefs

made at the first purchase. Since individual consumers cannot evaluate quality by themselves, all the information sources consumers depend on are external. In this sense, the choice of the consumer depends not only on utility from consuming the underlying product but also on their beliefs about the quality of these information sources.

Third, comparing experience and credence attributes in terms of the cost of verification is a break from the research to date. Traditionally the three attributes are viewed as differing based on whether the consumer can determine the attribute or not. However, these models suggest that all quality attributes can be distinguished through verification. The problem is then reduced to one of the cost of information, not the ability to observe quality. Search attributes can be determined with least cost, credence attributes with the highest cost.

For example, suppose you are at a BBQ party. You can see the color of the steak on the broiler and can smell it. Color and smell are typical examples of search attributes. You can easily detect them. How about tenderness or juiciness? After you select a piece of meat and have a bite of it, you resolve this uncertainty. Even though these characteristics can be categorized as experience attributes, they can be determined with a small cost (the effort of picking up and using a knife and fork). What about the inner temperature of the steak? Is it above 165˚F? The exact temperature is uncertain but may be resolved at cost though the purchase and use of a thermometer. Can a concerned partygoer know whether this steak is from a cow raised organically? This challenging problem is an example of a credence attribute. It can be argued that (at high cost) this uncertainty may be resolved partly by sending a sample to a laboratory for evaluation[6]. Even in this simple example, a range of costs and implicit values of information are contained in the resolution of quality uncertainty for each of the sets of attributes.

[6] The limit of such a test would be to state that no (detectable) pesticide/chemical residues were present, this would not guarantee that an organic production method was used

The approach adopted here shows some promise for future research. First, the transformation of the problem of credence attributes (under certain situations) from one of information content to a cost problem allows a new focus on the cost of verification. Related to this as such costs are reduced through scientific advances, credence attributes may become experience attributes. If the price of reliable and simple GMO test kits can be lowered, quality uncertainty previously thought of as credence may be better modeled as search with a relatively low information cost.

In these models the resolution of credence attributes does not rely on the provision of information by the government. Alternatively, the resolution may be market based offered by the private sector. If the marginal utility from the determination of the credence attribute is large enough to justify then consumers will incur the verification cost. Such a purchase of a GMO test kit, for example, provides a market-based solution to credence attribute uncertainty. This provides the consumers with another avenue to acquire information. This does not necessarily mean that the public sector can be replaced by the private sector, rather that additional solutions from the private sector may exist. Once credence attributes become verifiable at a cost, the credence attribute can be considered to be analogous to an experience attribute. As long as the cost of verification is reasonable, repeat purchase and verification will allow for a strategic relationship between the firm and the consumer to emerge. Of course, the mere existence of the verification market does not guarantee that the verification cost is low enough for all consumers to access it. Either because of an imperfect competitive market or because of the high development cost, the cost of verification may remain high. In such a case government can play an important role either subsidizing such verification costs or providing information that allows for the reduction of vc.

Returning to the game theoretic model, equilibria can be developed for each construct.[7] For the search model, a sub-game perfect equilibrium can be applied, which has the firm selling high quality food that the consumer buys. This is an optimal and efficient solution. However, once uncertainty enters the model, this result cannot be achieved. In the experience attribute case, a pure strategy Nash equilibrium has the firm pricing low-quality food at the high price and the consumer buying it when the utility from consuming the food dominates the disutility of the experience attribute and payment ($u - d - P^H > 0$). In the credence attribute case, two possible pure strategy Nash equilibria exist. One has the firm again pricing low-quality food at a high price, the consumer buying it, and not verifying the attribute when $u-P^H$ is greater than zero. The other has the firm pricing low-quality food at a high price and the consumer not buying it when $u-P^H$ is less than zero. Both outcomes show that in a one-shot game the additional (dis)utility arising though credence attributes does not matter. In this case, the consumer cares only about the utility from the other attributes. In a static game, a pure strategy Nash equilibrium of either model (experience or credence) is not efficient. However, in a repeated purchase version of the experience attribute case, the perfect Folk theorem suggests that any outcome is feasible and enforceable. Thus, a firm pricing high-quality food at a high price and the consumer buying it can be achieved though some form of model specification. However, the credence attribute case may never lead to an optimal solution, even with a repeat purchase relationship, if the high cost of verification prevents disclosure of the attribute.

3. Summary and Policy Implications

Focusing on food products, it is not easy to say which category food safety belongs in. As mentioned above, food safety may be characterized as being composed of both experience and

[7] See appendix for further detail.

credence attributes. This reflects the fact that food safety is more like credence attributes because it cannot be assessed upon consumption but may be verified at a cost. Alternatively, if a negative effect occurs food safety can be viewed as experience attribute.

In the model of credence attribute, a verification process and its' cost are newly introduced. This converts the typical problem of the under-provision of information into a problem of the cost of acquisition of information. Further, the experience attribute model can be understood as a special case of a credence attribute where the verification cost is negligible.

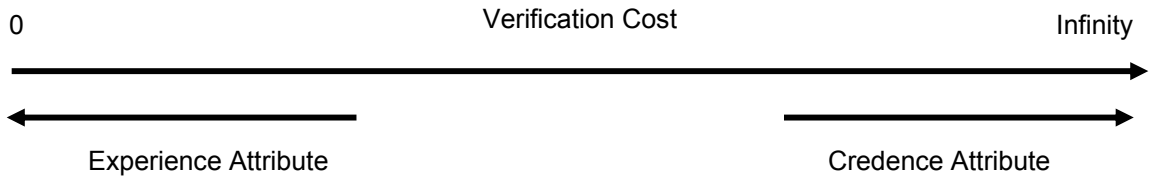

Figure 5 summarizes this relationship between the cost of verification and the two attributes.

Figure 5 Verification Cost We can think of experience attribute as the special case that the verification cost is very small.

Certain aspects of risk in food require some time to be realized while other microbiological hazards in food such as *Salmonella* or *E. coli:O157:H7* are realized relatively quickly. Thus, risk factors such as chemical input residues related disease or endocrine disruptor related disease should be thought of credence attribute whereas more rapidly detected (and attributed) risks (eventually) act more like (lagged) experience attributes. Lagged experience attributes can be considered to effectively be credence attributes, particularly for a commonly purchased item for which the lag is of sufficient duration to not affect subsequent purchases. When a long-term effect is involved, no learning occurs which can influence consumption choices. Thus, in a strict sense, any experience attribute with a long-term effect must be considered to be a credence attribute. Food safety cannot be simply defined, yet a specific risk in

food may be grouped as either an experience or credence attribute. This leads to several implications for each attribute:

In the case of credence attributes, as discussed above, at the individual level, the cost of verification is assumed to lead the consumer in selecting whether to resolve quality uncertainty. As a result, the introduction of an additional node – verification – brings a new policy implication other than information provision. That is, public sector reduction or subsidization of the verification cost may be optimal and at a reasonable level of cost a market solution may be an efficient resolution of the food safety problem. Once the result of the verification is allowed to be stochastic, so the implications change. Credence attributes may only be imperfectly transformed into experience attributes. Some form of quality uncertainty remains and the consumer should view the verification result with caution. This may suggest a continued role for the public sector in assuring the verification results of third parties.

In this extension, for credence attributes, two policy options exist. One attempts to change player behavior by altering the payoff matrix such as reducing verification costs. The other adds one more node through a monitoring or labeling program. The former may be said to be a market resolution the latter a typical mandatory / policy resolution.

4. Conclusion

In this paper, the traditional food safety credence attribute problem is refined. The change is through the introduction of a verification process and its' cost. This transforms an information problem, who-knows-what problem into an economic problem, how-much-it-costs-to-get-to-know. This cost problem can be resolved either through a market mechanism or through governmental intervention.

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Appendix

Pure Strategy Nash Equilibrium

1. Credence Attribute Case

Producer \ Consumer	Not Buy (N)	Buy, Verify (BV)	Buy and Not verify(B,~V)
Selling Safe Food at P^H	($-C^H$, 0)	($P^H - C^H$, $u - P^H + c - vc$)	($P^H - C^H$, $u - P^H$)
Selling Safe Food at P^L	($-C^H$, 0)	($P^L - C^H$, $u - P^L + c - vc$)	($P^L - C^H$, $u - P^L$)
Selling Less Safe Food at P^H	($-C^L$, 0)	($P^H - C^L$, $u - P^H - c - vc$)	($P^H - C^L$, $u - P^H$)
Selling Less Safe Food at P^L	($-C^L$, 0)	($P^L - C^L$, $u - P^L - c - vc$)	($P^L - C^L$, $u - P^L$)

u: utility from buying the product (>0), c: additional utility from the attribute (>0), vc: the cost of verification (>0)
V: any action to verify the attribute
Note: Producer: monopolist pricing the product as a signal where $P^H > P^L$.

1) Best response function for producer (BSP)

BSP(N) = (LS, P^H) or (LS, P^L) $\rightarrow$either selling less safe food at P^H or selling less safe food at P^L
(Because $C^H > C^L > 0$, $-C^L > -C^H$) But P^H is assumed greater than P^L so that (LS, P^H) is more likely.

BSP(BV) = (LS, P^H) $\rightarrow$ Selling less safe food at P^H
(Because $C^H > C^L$, selling safe food at P^H is dominated by selling less safe food at P^H. By the same analogy, selling safe food at P^L is dominated by selling less safe food at P^L. Therefore, first and third strategies are dominated. Since $P^H > P^L$, $P^H - C^L > P^L - C^L$)

BSP(B,~V) = (LS, P^H)$\rightarrow$Selling less safe food at P^H

2) Best response function for consumer (BSC)

Case A. Assuming that BSC(S, P^H) = BSC(S, P^L) (for simplicity, set $P^H = P^L = P$)

a) Case 1: when (u-P) > 0 and (c-vc) > 0, BSC = BV
b) Case 2: when (u-P) >0 and (c-vc) < 0, BSC = B, ~V
c) Case 3: when (u-P) < 0 and (c-vc) > 0 BSC = BV if |c-vc| > |u-P|
N Otherwise
d) Case 4: when (u-P) < 0 and (c-vc) < 0, BSC = N

Case B. Assuming that BSC(LS,P^H) = BSC(LS,P^L) (for simplicity, set $P^H = P^L = P$)

a) when (u - P) > 0, BSC = (B, ~V)
b) when (u - P) < 0, BSC = N

3) Equilibrium

From the best response functions of each agent, we know that there are two equilibria. One is (B, ~V) and (LS, P^H) when (u - P) > 0. The other is (N) and (LS, P^H) when (u - P) < 0. Therefore Nash equilibrium is that the producer sells less safe food at a high price and the consumer either buys food and does not verify the attribute or does not buy at all. Consumer's strategy depends on whether marginal utility from the attributes except credence attribute exceeds the price or not. From this result, the one shot play in credence attribute case shows that credence attribute is not important in the game. It is a typical result in the one shot game.

2. Experience Attribute

Producer \ Consumer	Not Buy (N)	Buy (B)
Selling Safe Food at P^H	($-C^H$, 0)	($P^H - C^H$, u + e - P^H)
Selling Safe Food at P^L	($-C^H$, 0)	($P^L - C^H$, u + e - P^L)
Selling Less Safe Food at P^H	($-C^L$, 0)	($P^H - C^L$, u – e - P^H)
Selling Less Safe Food at P^L	($-C^L$, 0)	($P^L - C^L$, u – e - P^L)

1) Best response function for producer (BSP)

BSP(N) = either selling LS at P^H or selling LS at P^L

BSP(B) = selling LS at P^H

2) Best response function for consumer (BSC)

BSC (S, P^H) = B if U + e - P^H > 0
N Otherwise

BSC (S, P^L) = B if U + e - P^L > 0
N Otherwise

BSC(LS, P^H) = B if U - e - P^H > 0
N Otherwise

BSC(LS, P^L) = B if U - e - P^L > 0
N Otherwise

3) Equilibrium

In a one-shot game, when u - e – P^H is greater than zero, the consumer buying food and the producer selling a less safe food at P^H. But when u – e - P^H is less than zero, the producer selling a less safe food at P^H, the consumer not buying food. This means that when the consumer buys food when the consumer expects utility from consuming food greater than zero in a static sense.