# CONSUMER PREFERENCES
# FOR DIFFERENTIATED FOOD PRODUCTS

By

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To the faculty of Washington State University:

The members of the Committee appointed to examine the dissertation of VUGAR AHMADOV find it satisfactory and recommend that it be accepted.

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Chair

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# CONSUMER PREFERENCES
# FOR DIFFERENTIATED FOOD PRODUCTS


Abstract



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A significant characteristic of most markets is that the commodity being exchanged is differentiated. A differentiated commodity is one where consumers distinguish among its components or attributes. In general, products are differentiated in two dimensions, one being the dimension of varietal (or horizontal) differentiation and the other being a dimension of quality (or vertical) differentiation.

The dissertation consists of three manuscripts, studying consumers' preferences for differentiated products. First manuscript provides theoretical evidence on heterogeneity of consumers' preferences for vertically differentiated products. Second manuscript investigates consumers' perception of quality and safety on product evaluation. Third

manuscript studies consumers' preferences for cold smoked salmon attributes using a conjoint choice experiment.

In first manuscript, the effects of differences in quality perception arising from exogenous technology preferences on firm's profits in domestic and foreign markets were analyzed using one-shot three stage game theoretic approach. Two-country game theoretic model allows only one domestic and foreign firm to exist in both markets. Due to *exogenous preferences for technologies* used by domestic firms in respective markets, consumers perceive foreign firm's products relatively lower than domestic firm's products. To gain a market share, foreign firm sets its price lower than price of domestic firm's products upon export. Differences in quality perception of physically same product across two markets encourage domestic firms to produce relatively low quality for foreign markets or offer the product with technology preferred in foreign market.

In second manuscript, the effects of country of origin, home and foreign region of origins on consumers' perceptions of food safety, quality and willingness to buy were examined. The findings suggest that consumers' perception of food quality and likelihood of purchasing food product is affected by product origin cues through perception of food safety. Estimated results demonstrate that consumers evaluate and perceive food attributes more favorably if they have opportunity to taste its sample. Product sampling significantly improved consumers' perception, especially if food is low priced.

In third manuscript, a conjoint based choice experiment was conducted to elicit consumer preferences for cold smoked salmon attributes. Product attributes include 1) production method (two levels – wild versus farmed), 2) origin of salmon (four levels – two country of origin - USA and Canada) and two region of origin - Alaska and British

Columbia), and 3) price (three levels – premium, high and low). Consumers' preferences for product attributes were estimated using random parameters logit model to overcome the problem of irrelevant independence of alternatives. The results suggest that consumer preferences are positively affected if the origin of product is identified with Alaska and British Columbia. The estimations show consumer preferences for wild smoked salmon over farmed smoked salmon. The study computes the trade-offs between attribute levels showing that consumers are willing to pay premium for wild smoked salmon, and smoked salmon from Alaska but want discount for British Columbia compared to Canada.

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To my wife and lovely children:

Shahla Ahmadova

Leyla Ahmadova

Rashid Ahmadov

# CHAPTER ONE

# INTRODUCTION

The wide array of differentiated products in the marketplace is a response to a growing diversity of consumer tastes involving two taste levels. The first taste diversity is when individuals prefer to consume different products on different occasions, expressing a preference for variety over location and time (e.g., eating a different meal at different restaurant or same restaurant every evening). The second taste diversity is when individuals have some idiosyncratic tastes about their most preferred variants (e.g., choosing the same brand for a specific product). Consumers with idiosyncratic preferences are prepared to pay more for variants that are better suited to their own tastes (Anderson et al. 1992). Idiosyncratic preferences are also explained by consumers' perception of certain product related attributes (e.g., production method – organic versus whole or brand). Heterogeneity of consumers' tastes arising from various factors encourages firms to sell differentiated products in the marketplace. Firms introduce new production methods and techniques to offer products with different attributes to satisfy diverse tastes of consumers.

The main objective of this dissertation is to provide theoretical and empirical evidence on consumers' preferences for differentiated markets. The first manuscript analyzes effects of differences in quality perception arising from exogenous technology preferences on firm's profits in domestic and foreign markets using one-shot three stage game theoretic approach. Differences in consumers' perception of product attributes might be the main reason for different perception of an identical product to exist (Temblay and Polasky, 2002). Product attributes driving consumers' heterogeneous quality perceptions could be physical (e.g., color, taste) or non-physical (e.g., production technology, brand and price) attributes (Brunkart, 1978; Bredahl, 2003). In first manuscript, two-country game

theoretic model allows only one domestic and foreign firm to exist in both markets. Each firm produces a product with a single quality attribute. Due to *exogenous preferences for technologies* used by domestic firms in respective markets, consumers perceive products made by foreign technology relatively lower than made by domestic technology. Upon entry to export market, foreign firm's products are perceived lower quality relative to products made by domestically known technology. Differences in quality perception of an identical product across two markets leads to subjective vertical product differentiation, which reduces foreign firm's profit in foreign market compared to domestic market.

The results suggest that if the technology used by foreign firm is symmetrically promoted in both of export markets upon entry, products of foreign firms could face symmetric quality perception in both markets. Domestic firm needs to supply a high quality food product in the domestic market, but relatively lower quality food products to the foreign market by setting up two production lines in the plant. Finally, findings show that appropriate label matching quality level of the product is preferred since it presents actual quality.

In addition to quality perception of food products (Bredahl et al. 1998; Bredahl, 2003), another important construct in the product evaluation is the food safety perception. Consumers may not enjoy utility of any food product if they do not perceive the food to be safe for consumption. There is a limited research conducted to examine the role of food safety perception in addition to food quality perception in evaluating food products or making food choices. Understanding the importance of food safety perception construct in product evaluations, the present research studies the effects of country of origin and region of origin on consumers' perceptions of food quality and willingness to buy through food safety perceptions.

Findings of the second manuscript show that consumers' food safety perceptions explain the relationship between country of origin and region of origin and food quality. But food quality perceptions do not explain the relationship between food safety perception and willingness to buy. The latter result suggests that consumers' food safety perceptions have a direct impact on their likelihood of purchasing food products.

Results of the second manuscript demonstrate that product sampling and price levels have significant interaction effects with different levels of product origin. Finally, the study reports three way interaction effect of price, product sampling and product origin cues revealing a number of perspectives for further research.

Consumers' preferences for different attributes of food products also lead to the differentiation of food products. In general, consumers make trade-off between those attributes upon choosing the most preferred product. Third manuscript in the dissertation analyzes consumers' preferences for cold smoked salmon attributes using conjoint based choice experiment. Three attributes of cold smoked salmon: production method, product origin and price, were used to create twenty-four smoked salmon alternatives. Analysis of consumers' shopping behavior for cold smoked salmon reveals that consumers' preferences are positively affected if the origin of product is identified with Alaska but negatively affected if the origin of product is USA. In addition, the results suggest that consumers prefer cold wild smoked salmon over cold farmed smoked salmon. Computations of the trade-offs between attribute levels indicate consumers' willingness to pay premium if product is wild smoked and caught in Alaska but want discount for product identified with British Columbia. The results provide a number of interesting implications for fishery industry such as (a) to promote cold smoked salmon products with region of origin such as Alaska and British Columbia, and (b) to use wild caught salmon in making cold smoked salmon product.

Three studies in dissertation contribute to a growing literature on consumers' preferences for differentiated products and perception of food safety and quality, providing insights into market segmentation and competition of differentiated products. Theoretical and empirical evidence from three manuscripts suggest that a long-term research plan is needed to investigate factors affecting consumers' preferences for different product attributes.

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## CHAPTER TWO

# ASSYMETRYC QUALITY PERCEPTION ARISING FROM EXOGENOUS TECHNOLOGY PREFERENCES IN VERTICALLY DIFFERENTIATED MARKETS


### Summary

The study analyses effects of differences in quality perception arising from exogenous technology preferences on firm's profits in domestic and foreign markets using one-shot three stage game theoretic approach. In addition to entering domestic market, domestic firm also decides to export their products to foreign market. Two-country game theoretic model allows only one domestic and foreign firm to exist in both markets. Due to *exogenous preferences for technologies* used by domestic firms in respective markets, consumers perceive foreign firm's products relatively lower than domestic firm's products. To overcome pre-emptying market problem, foreign firm sets its price lower than price of domestic firm's products upon export. Differences in quality perception of physically same product across two markets encourage domestic firms to produce relatively low quality for foreign markets.

Results also suggest that if the technology used by foreign firm is symmetrically promoted in both of export markets before the entry, products of foreign firm could face symmetric quality perception in domestic and foreign markets.



**Key words:** Vertical quality differentiation, Stackelberg game, Bertrand-Nash equilibrium,

## Introduction

A significant body of literature investigates the issues related to vertical product differentiation, and therefore, the focus of those studies is centered on studying the conditions under which firms select product varieties or variants and compete with one another through their strategic actions e.g. pricing and quality choices.

The previous literature defines vertical product differentiation as a phenomenon that allows all consumers to rank the variants of a product. If product variants differ in quality, everyone agree that higher quality is preferable (Tirole 1988). If product variants are assumed to be 'vertically' differentiated, and the products are offered at the same price, and all consumers choose to purchase the same product, which is of highest quality (Shaked and Sutton, 1982, 1983).

The main assumptions in models of vertical product differentiation are that (a) consumers differ in their incomes or willingness to pay (or reservation prices) for quality improvement, and (b) products will sell at different prices with the higher quality products being sold at a premium over the price of rival, lower quality products (Gabszewics and Thisse, 1979; Boom 1995).

Gabszewicz and Thisse (1979) analyze the vertical product differentiation model in the oligopoly framework demonstrating the competition of two firms with different quality levels on the supply side. On the demand side, Gabszewicz and Thisse (1979) show that there exists a group of consumers who (a) are willing to purchase only high quality at high price or only low quality at low price, (b) are indifferent between purchasing high quality at high price and low quality at low price, (c) are not able to purchase either of qualities by suggesting assuming that consumers are heterogeneous only in their income levels.

In addition to the previous work of Gabszewicz and Thisse (1979), who define price endogenously in the second stage of the game by assuming exogenous quality choices in the first stage of the game, Sutton and Shaked (1982) develop one shot three stage game theoretic approach in which a number of firms choose firstly, whether to entry an industry or a market, secondly, the endogenous quality level of their respective products, and thirdly, endogenously their prices. They define a duopoly market by deriving from the income dispersion of consumers, an upper bound to the number (only two) of firms that enjoy positive market shares with the choice of distinct quality levels, at positive prices (production costs being assumed zero). Their intuition behind the latter result is that as the quality choices become close, the price competition between the increasingly similar products reduces the profit of both firms. Additionally, they show if three or more firms are present in the market, it is possible that the competition in choice of quality drives all firms to set the same 'top' level of quality, while prices and profits become zero. The latter condition depends on the fact that none of those three firms will now prefer to set its quality lower than that of its two rivals since the reduction of quality level certainly earns zero revenue at equilibrium. Finally, they conclude that the competition between the surviving 'high quality' products drives respective prices down to such a point at which even poorest refrain themselves from purchasing low quality products at zero prices.

The unique nature of the quality and price competition in vertical product differentiation model does not allow a large number of firms in the market or industry to increase indefinitely as the fixed costs associated with entry decline or even the size of the economy expands. Chamberlinian approach to monopolistically competitive market supports the existence of an arbitrarily large number of firms with a positive market share and a price sufficiently greater than the unit variable cost of a respective product, firms' quality choices

are more closely spaced, which derives price to approach an equality level with unit variable costs (Chamberlin, 1950). Shaked and Sutton (1983) derive necessary and sufficient conditions for 'finiteness property' or a finite number of firms to exit in the industry where the quality improvement takes the form of R & D or other forms of fixed costs. On the other hand, the unit variable costs may increase slowly with an increase in quality or may slowly fall through an innovation process. The finiteness property leads to the formation of a 'natural oligopoly' in the vertical product differentiation framework. Even though Shaked and Sutton (1983) suggest that the industry still might allow an arbitrarily large number of firms that sell an identical product at a price level equal to unit variable cost. Their main conclusion is that there exists a bound on the number of firms offering a range of higher and distinct qualities of products at price levels greater than unit variable cost. Note that small but still strictly positive fixed costs upon entering the industry excludes firms pricing their products equal to unit variable costs from the market.

Shaked and Sutton (1987) brings another significant contribution to the literature of vertical product differentiation focusing on the issues of effects of fixed costs with regard to their size and substitution for unit variable costs to improve quality of products. They successfully demonstrate that the influence of any fixed costs in the vertical product differentiation framework is not associated with the size of the fixed costs but with the extent to which these fixed costs substitute for higher variable cost in the quality improvement (whether real or perceived) of the product. They derive conditions showing that interplay between the technology used to produce certain quality levels and consumers' tastes simultaneously determine the level of fixed costs undertaken by the firm and the degree of industry concentration.

The influence of fixed versus variable costs have been addressed by other authors from the different angle in the vertical product differentiation framework where Lehmann-Grube (1997) suggests that the advantage of quality leadership may be a stable result if the firms do not change their quality during the price stage of the game. He brings an interesting perspective to the vertical differentiation literature by showing that it is difficult for firms to commit themselves to a certain quality level if the costs of quality are variable. Lehmann-Grube (1997) shows that the most natural commitment to a certain quality level is a sunk cost associated with quality choice at the early stages of the game. But Gal-Or (1987) introduces conditions when the choice of quality is an irreversible decision, firms usually tend to produce more similar products than when the choice is not irreversible. He suggests that the decreased differentiation will lead to the reduction of the quality range available to the consumers that reduces social welfare.

In addition to the quality and price competition in the vertical product differentiation framework, Gal-Or (1983) introduces an oligopoly model where both the quantity and the quality of products are endogenously determined by each firm. He also demonstrates that if consumers are uniformly distributed, the additional entry of firms reduces an average quality and may reduce welfare. In addition, he shows that the entry of many firms in the market leads to the failure of the symmetric equilibria. Motta (1993) introduces the conditions under which the product differentiation always arises at equilibrium when firms differentiate their products more under price rather than under quantity competition. He also suggests that firms face fierce price competition at the last stage of the game, which forces firms to choose more differentiated products under Bertrand than Cournot competition. His findings are consistent with Bertrand's (1883) objections on the theoretical framework of Cournot (1838)

by mostly arguing that firms are competing in strategic variables such as price not in quantities.

The literature suggesting the endogenous choice of quality levels (Shaked and Sutton, 1982) introduces bounded quality space with lower and upper limits. Ronnen (1991) demonstrates that if the minimum quality standard is chosen appropriately, none of the consumers will drop out of the market, and some of non consumers will join the market. In a real market situation, consumers will raise their quality selection, even though their selection of the quality exceeds the quality standard in the absence of regulation. The consumer' choice of a higher quality urges low quality firms to set their quality greater than minimum quality standards mandated by the government. In 1991, Ronnen proposed that high-quality sellers raise their quality level in reply to the low-quality sellers that raised their quality to the mandated minimum quality level. Note that the nature of minimum quality standards limits the quality range in which producers can differentiate qualities.

Boom (1995) measures the effects of differing national minimum quality standards on the price equilibria and the quality choices of a vertically differentiated duopoly. She proposes that if one of the two countries demand a marginally higher minimum quality standard and both firms still decide on entering two country markets, the qualities of both firms will be higher, their prices will be lower, and their market shares will be the same as in the case of an identical and lower minimum quality standard in the two countries. Finally, she shows that each consumer in both country markets gains from a higher minimum quality standard in at least one country if both firms still decide to enter the markets.

By expanding on the previous literature, Xavier (1996) introduces the quality game by allowing for either covered or uncovered market outcomes where he shows the endogenous market outcomes of equilibrium quality choice at the price stage. In his

theoretical framework, the equilibrium in the quality game yields a corner solution in the price game. Additionally, he drives the conditions how to maintain the principle of maximal differentiation by demonstrating the quality choice dominated solutions that generate a corner solution in the price game. Finally, he suggests that the distribution of consumers' tastes is the crucial factor in the markets, and difference of quality levels do not depend on the population characteristics. His intuition is that the differences of quality levels will be negatively related to the population dispersion. Note that the degree of heterogeneity in the population places an upper bound to the extent of product differentiation.

One of the interesting perspectives offered to the previous literature on the minimum quality standard in the vertical product differentiation belongs to Lutz *et al.* (2000) who present a model in which firms make quality improvements to reduce the impacts of forthcoming regulatory standards. Authors suggest that those quality improvements increase profits but reduce total social welfare, and this finding is strictly dependent on the assumptions of the model such as upward-sloping reaction functions and an influential quality leader. Note that the latter two assumptions are very consistent with the assumptions made by Boom (1995) but the actual finding is not consistent with the work of Ecchia and Lambertini (1997) who present a model of duopoly where firms with incentives for quality improvements produce only one variety and production involves variable costs convex in quality and an exogenous fixed cost. In their approach, they set the endogenous minimum quality standard aiming at maximizing social welfare. However, *Lutz et al.* (2000) propose that the minimum quality standard decreases the degree of product differentiation in the market, reduces the market share of the high quality firm to the advantage of the low quality firm, and increases social welfare in such a way that the gains for the low quality firm and low income consumers are greater than the losses suffered by the high quality firm and high

income consumers. This finding is very consistent with the findings of Ronnen (1991) and Crampes and Hollander (1995) who also proposed that minimum quality requirements in a duopoly market where firms' unit costs are increasing in quality results in increasing the profits of the lower quality firm. Crampes and Hollander (1995) also show that high-quality producer will not raise the quality as the result of mandated quality imposition since the cost of quality contains a large component, which is sunk implying that the marginal cost of the quality at the level chosen by the firm exceeds the marginal cost at the same quality level for a new firm.

One of the new research streams emerging in the literature of the vertical product differentiation is the vertical difference in the consumer perception of product quality. Tremblay and Polasky (2002) demonstrate that consumer may perceive the quality of products vertically different even when the physical qualities of product are identical due to the influence of the advertising. They assume the product brand as the quality indicator under the advertising, and if the product brand is more advertised than the other brand, over advertised brand may be perceived vertically high quality than under-advertised. Their approach suggests that advertising generates subjective vertical perception of quality in the market.

Our current research expands the theoretical framework developed by Tremblay and Polasky (2002) with regard to the subjective quality perception of competing brands into two-country model by suggesting that exogenous technology preferences generate subjective perception of product quality, which differs across two markets. We assume that consumers in this model differ in willingness to pay for perceived quality of product but the size of consumer population is symmetric across two markets. Note that the product is the same (consumers of both market have demand for i.e., meat product) except its quality is vertically

perceived different due to the fixed technology preferences in both markets. We also assume that exogenous preferences for technologies used to produce the same product generates subjective perception of the product quality, meaning that consumers residing in one country prefer to one technology and perceive the quality of that technology output higher than the quality of the other technology output imported from another country. The reverse of this effect holds in another country context. In other words, the domestic firm's product quality is perceived higher in its home market but lower in the foreign market due to the exogenous technology preferences. We show that, due to the subjective perception of physically identical product quality resulting from exogenous preferences for technologies used to produce the product, both firms face with demand for the low perceived quality in the foreign market, which negatively affect surplus of the domestic firm leading to reduction of the profits.

## THEORETICAL MODEL

Our model considers two countries; A and B where (a) the consumers residing in the country A prefer the traceable technology, and therefore, they perceive the quality of the product produced with traceability technology to be of higher quality compared to the quality of the product produced with environmentally sustainable technology, and (b) the consumers residing in the country B prefer to the environmental sustainable technology, and therefore, they perceive the quality of the products produced with environmentally sustainable technology higher quality compared to the quality of the product produced with traceable technology. Note that the quality perception of the physically identical product produced by the same firm is different across two markets due to those exogenous technology preferences. However, our model assumes that all consumers of both markets agree in preferring high quality (or perceived quality).

We assume that for both countries, there is a continuum of potential consumers of mass $N$, and each consumer purchases a single unit of a good and consumers' willingness to pay is described by the parameter $v$, which has a triangular distribution[1] over the range of $[\underline{v},\overline{v}]$ with, $\overline{v} > \underline{v} > 0$. The given parameter has the cumulative density of $F(v)$, and the probability density function $f(v)$. It is also assumed that $f(v)$ is continuous, differentiable, and positive everywhere in $v \sim T[\underline{v},\overline{v}]$.

Consumers have the same indirect utility function, which is described as follows:

$$\textbf{(1)}\quad U_{ij} = \begin{cases} v\lambda_j^z \tau_{ij}^z - p_{ij}^z + \phi & \text{if a consumer in } j \in (A,B) \text{ purchases firm } i's \text{ product} \\ 0 & \text{otherwise} \end{cases}$$

We assume that $\lambda_j^z$ denotes the exogenous preferences for technologies[2], where $\lambda_j^z = \lambda_j^s + \lambda_j^t$ [3] holds in both markets, $p_{ij}^z$ denotes the price of the product, $\tau_{ij}^z$ represents the perceived quality of product, where $\tau_{lA}^s < \tau_{hA}^t$ in A market[4] or $\tau_{lB}^t < \tau_{hB}^s$ [5]in B. For the $\phi$ represents the intrinsic utility that consumers receive from the food product in terms of its other benefits[6], which is assumed to be constant across both levels of quality and country

[1] The purpose of using a triangular distribution is related to the characteristic of the vertical product differentiation model, which assumes that consumers are heterogeneous in their willingness to pay for the perceived quality of the product.

[2] We introduce $\lambda_j^z$ to denote exogenous technology preferences e.g., environmentally sustainable or traceability technology, which is equivalent to the increase of the consumer valuation for perceived quality.

[3] We assume that exogenous preference is defined by $\lambda_j^z = \lambda_j^s + \lambda_j^t$ in A market, where, $\lambda_A^t = 1$, then, $\lambda_A^s = 0$ or in the country B, $\lambda_B^s = 1$, then, $\lambda_B^t = 0$.

[4] It is assumed that consumers residing in A market perceive the quality of product produced with traceability technology higher than the quality of the product produced with environmentally sustainable technology. Under this assumption, $\tau_{lA}^s < \tau_{hA}^t$ holds for the market A.

[5] The assumption is made under 4 applies to the market B but consumer perceives the quality of product produced with environmentally sustainable technology higher than the quality of the product produced with traceability technology. Under this assumption, $\tau_{lB}^t < \tau_{hB}^s$ holds for the market B.

[6] The intrinsic utility of consumers is defined in terms of the safety and other quality attributes of food product that are not included in $\tau_{ij}$. Although those attributes may differ across products in actual examples, for the sake of the simplicity, we assume that those intrinsic attributes of the food are constant across types.

markets. Note that $z$ stands for either of two technologies, where $z \in \{s,t\}$, and those technologies are an environmentally sustainable defined by $s$ and traceability defined by $t$. For the sake of the simplicity, we assume that the size of economies, consumer population, the distribution of product quality valuation (perceived quality) are symmetric across both countries, and there exists no arbitrage between two markets.

We assume that the consumers receive information about the technology used to produce the product from the label. In our model, the firms introduce two different labels. The domestic firm in the country A introduces the label with cue representing information about the traceability technology, and the domestic firm in the country B introduces the label with cue representing information about the environmentally sustainable technology.

Following the assumptions regarding perception of quality by consumers and labeling by domestic firms in A and B countries, we assume that the perceived quality level is defined by $\tau_{ij} = t_j + s_j$, which presents technologies used to produce the food product where $t_j$, level of traceability and $s_j$, an environmentally sustainable in either of markets. Below we introduce the possible combinations of perceived quality[7]- technology in the country A and B markets:

**Perceived Quality-Technology Combinations in Country A**

$$\textbf{(2)} \quad \begin{cases} if \quad L_A^t, \quad \tau_{hA}^t = t_A, \quad t_A = 1 \quad s_A = 0 \\ if \quad L_{A,}^s \quad \tau_{lA}^s = s_A, \quad 0 < s_A \le 1 \quad t_A = 0 \end{cases}$$

**Perceived Quality-Technology Combinations in Country B**

$$\textbf{(3)} \quad \begin{cases} if \quad L_B^s, \quad \tau_{hB}^s = s_B, \quad s_B = 1 \quad t_B = 0 \\ if \quad L_B^t, \quad \tau_{lB}^t = t_A, \quad 0 < t_B \le 1 \quad s_B = 0 \end{cases}$$

[7] Note that the actual quality is the same but perception of the quality is different.

where $L_j^s$ stands for the label of the food product produced with different technologies. In the country A, $\tau_{lA}^t = t_A + s_A$, the level of perceived quality is defined by low or high, $i \in (l,h)$. If the domestic firm produces product using the traceability technology and showing that on the label, the perceived quality is high and defined by $\tau_{hA}^t = t_A$ where $t_A = 1$ and $s_A = 0$. If the firm produces a food product using the environmentally sustainable technology and showing that on the label having logo of MSC[8], then, the perceived quality is low but defined by $\tau_{lA}^s = s_A$, where $0 < s_A \leq 1$ and $t_A = 0$.

Those assumptions change as we move from the country A to B being consistent with the condition (3).

## GAME STRUCTURE

The present research involves two firms, each of which is an incumbent in its home country but these incumbent firms also want to export to new markets as the potential entrants (or exporter). Therefore, firms maximize their profits following a one-shot three-stage game. The model assumes that the firms decide to enter or not domestic market at $t = 1$ (or stage 1) by incurring (a) sunk $\frac{\left(\tau_j^z\right)^2}{2}$ entry cost (quadratic cost) upon entry, which is the cost of the technology used to produce the product, and note that the cost is symmetric across two technologies and perceived qualities, (b) the fixed cost of labeling the food that represents both of technologies used. After each firm enters its domestic market, they decide to enter the foreign market. Observing each other's entry, at stage two, $t = 2$, the firms that have entered simultaneously choose the quality level. At stage three, $t = 3$, the firms that have entered and chosen their respective quality levels in those markets (or domestic and foreign

[8] Marine Stewardship Council

markets) simultaneously choose their prices. We use backward induction method to derive equilibrium through decision stages.

Note that firms have ex-ante information that they product is perceived as low quality relative to the product of the domestic firm. However, we provide the condition under which the firms keep entering the foreign market if they receive positive profit. The production technology of the firm in market A using traceability technology as follows:

**(4)** $C_A^t = c_A^t q_{hA} + L_A^t + \frac{\left(\tau_A^t\right)^2}{2}$, where, $L_A^t > 0$, and $\frac{\left(\tau_A^t\right)^2}{2} > 0$

where $C_A^t$ represents the total cost, $c_j$ represents the constant marginal cost associated producing the food product in two different markets, which is also linear in quantity. According to the production technology, $L_A^t$ is the fixed cost of labeling, which differs across the firms and the same across both domestic and foreign markets. Finally, we assume that $\frac{\left(\tau_A^t\right)^2}{2} > 0$, is strictly positive and satisfies the convexity conditions[9], but the fixed cost is the same across both country markets. Note that the same production technology holds for the domestic firm in market B as follows:

**(5)** $C_B^s = c_B^s q_{hB} + L_B^s + \frac{\left(\tau_B^s\right)^2}{2}$

As it was discussed before, our model suggests that consumers differ in their willingness to pay parameter, $v$, which is assumed to have a triangular distribution over the range of $[\underline{v}, \overline{v}]$. The main purpose in using an asymmetric triangular distribution is that it is close to the distributions of the willingness to pay of consumers in real situations, and

[9] If $F = \frac{\left(\tau_A^t\right)^2}{2}$, $F' > 0$, and $F'' > 0$

additionally, it is also continuous distribution. According to the triangular distribution, the parameters $\underline{v}$ and $\overline{v}$ stands for min and max points, and consumers including and between those points are heterogeneous with respect to willingness to pay for the offered quality levels with the given attributes. The consumers with $\overline{v}$ valuation (or willingness to pay) are indifferent between purchasing the high quality product with either of two technologies in either of those markets at high price denoted by $p_{hA}^{t}$ or $p_{hB}^{s}$ or not purchasing at all. Opposed to the previous condition, the consumers with $\underline{v}$ willingness to pay are indifferent between purchasing the low perceived quality food product with either of two technologies in either of those markets at low price denoted by $p_{lA}^{s}$ or $p_{lB}^{t}$ or not purchasing at all. The marginal consumer located at the mode of the triangular distribution, which is denoted, $\hat{v}$ is indifferent between purchasing high quality food product at high price and low perceived quality food product at low price. After assuming that $\underline{v} > p_{lA}^{s}$ or $\underline{v} > p_{lB}^{t}$ is high enough to satisfy the covered market and using condition (1) we solve for $\hat{v}$, which is defined as $\hat{v} = \frac{\left(p_{hA}^{t} - p_{lA}^{s}\right)}{\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)}$ in market A or $\hat{v} = \frac{\left(p_{hB}^{s} - p_{lB}^{t}\right)}{\lambda_{B}^{t}\left(\tau_{hB}^{s} - \tau_{lB}^{t}\right)}$ in market B. Note that unlike previous literature that relies heavily on uniform distribution by suggesting $\hat{v}$ to be a point to split the entire market evenly in equilibrium, we assume that $\hat{v}$ is located at the mode point, which might closer to $\underline{v}$ than to $\overline{v}$ in terms of interval[10].

[10] Actually, we consider this assumption to be very important as the other distributions such as lognormal and gamma has a thicker kurtosis on the right side (or tail). This assumption allows us to state that our triangular distribution has an asymmetric shape with a thicker left tail and more skewed to the right.

Following our discussion on the demand of low and high perceived quality products, the present theoretic approach assumes that the inferences of cues[11] from labels representing different technologies lead to heterogeneous perception of food quality in domestic and foreign markets.

## BERTRAND NASH EQUILIBRIUM IN PRICES

***Proposition 1***. *For a Natural Equilibrium in the price game (or Bertrand Equilibrium) involving a natural duopoly[12] in vertical product differentiation:*

(*i*.) *There exists two distinct levels of perceived quality such as low and high, the consumers with levels of willingness to pay within the range of* $\left[\underline{v},\hat{v}\right]$ *constitute the quantity demand for low perceived quality, and the consumers with level of willingness to pay within the range of* $\left[\hat{v},\overline{v}\right]$ *constitute the quantity demand for high perceived quality in both of markets:*

*Demand in the market A:*

$$\textbf{(6)} \qquad q_{hA} = \int_{\hat{v}}^{\overline{v}} f(v)dv = \frac{\left(\overline{v}\lambda_A^t\left(\tau_{hA}^t - \tau_{lA}^s\right) - \left(p_{hA}^t - p_{lA}^s\right)\right)}{\left(\overline{v} - \underline{v}\right)\lambda_A^t\left(\tau_{hA}^t - \tau_{lA}^s\right)}$$

$$\textbf{(7)} \qquad q_{lA} = \int_{\underline{v}}^{\hat{v}} f(v)dv = \frac{\left(\left(p_{hA}^t - p_{lA}^s\right) - \underline{v}\lambda_A^t\left(\tau_{hA}^t - \tau_{lA}^s\right)\right)}{\left(\overline{v} - \underline{v}\right)\lambda\left(\tau_{hA}^t - \tau_{lA}^s\right)}$$

*Demands in the market B:*

$$\textbf{(8)} \qquad q_{hB} = \int_{\hat{v}}^{\overline{v}} f(v)dv = \frac{\left(\overline{v}\lambda_B^s\left(\tau_{hB}^s - \tau_{lB}^t\right) - \left(p_{hB}^s - p_{lB}^t\right)\right)}{\left(\overline{v} - \underline{v}\right)\lambda_B^s\left(\tau_{hB}^t - \tau_{lB}^s\right)}$$

$$\textbf{(9)} \qquad q_{lB} = \int_{\underline{v}}^{\hat{v}} f(v)dv = \frac{\left(\left(p_{hB}^s - p_{lB}^t\right) - \underline{v}\lambda_B^s\left(\tau_{hB}^s - \tau_{lB}^t\right)\right)}{\left(\overline{v} - \underline{v}\right)\lambda\left(\tau_{hB}^s - \tau_{lB}^t\right)}$$

[11] Cox (1962) defines cue as information about the product.
[12] Shaked and Sutton (1982), and Boom (1995) have already proven the existence of a natural duopoly.

(*ii*.) *In a covered market condition, the equilibrium in prices for both domestic and foreign markets is described by:*

*Price equilibrium in market A:*

**(10)** $$p_{hA}^{t*} = \frac{1}{3}\left(\left(2\overline{v} - \underline{v}\right)\lambda_A^t\left(\tau_{hA}^t - \tau_{lA}^s\right) + 3c_A^t\right)$$

**(11)** $$p_{lA}^{s*} = \frac{1}{3}\left(\left(\overline{v} - 2\underline{v}\right)\lambda_A^t\left(\tau_{hA}^t - \tau_{lA}^s\right) + 3c_A^s\right)$$

*Price equilibrium in market B:*

**(12)** $$p_{hB}^{s*} = \frac{1}{3}\left(\left(2\overline{v} - \underline{v}\right)\lambda_B^s\left(\tau_{hB}^s - \tau_{lB}^t\right) + 3c_B^s\right)$$

**(13)** $$p_{lB}^{t*} = \frac{1}{3}\left(\left(\overline{v} - 2\underline{v}\right)\lambda_B^s\left(\tau_{hB}^s - \tau_{lB}^t\right) + 3c_B^t\right)$$

***Proof:***

(*i*.) We assume that there exists two distinct levels of perceived quality such as low and high, where the both of domestic firms are faced with the demand for high perceived food quality and both of exporters or potential entrants are faced with the demand for low perceived food quality. In the previous sections, we have already defined the food product with the high perception of quality and food product with low perception of quality. Those assumptions allow us to successfully build our further discussions on types of consumer demand, which are high and low. In addition, we also know that consumers perception of quality whether it is high or low is positively correlated with the level of willingness to pay. It means that if the perception of quality is high, the consumer's willingness to pay is also high, and if the perception of quality is low, the consumer's willingness to pay is also low. Following our previous assumption that $\underline{v}$ and $\overline{v}$ stand for the min and max points in the

triangular distribution[13] and $\hat{v}$ represents the mode point, and adding $\hat{v}$ into the following demand equations, we solve for our demands, which are given as (6), (7) for the market A, and (8) and (9) for the market B:

$$q_{lA} = \int_{\underline{v}}^{\hat{v}} f(v)dv = \frac{2(v-\underline{v})}{(\overline{v}-\underline{v})(\hat{v}-\underline{v})}dv = \frac{\hat{v}-\underline{v}}{\overline{v}-\underline{v}} = \frac{\left(\left(p_{hA}^{t}-p_{lA}^{s}\right)-\underline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lB}^{s}\right)\right)}{(\overline{v}-\underline{v})\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lB}^{s}\right)}$$

$$q_{hA} = \int_{\hat{v}}^{\overline{v}} f(v)dv = \frac{2(\overline{v}-v)}{(\overline{v}-\underline{v})(\overline{v}-\hat{v})}dv = \frac{\overline{v}-\hat{v}}{\overline{v}-\underline{v}} = \frac{\left(\overline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)-\left(p_{hA}^{t}-p_{lA}^{s}\right)\right)}{(\overline{v}-\underline{v})\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}$$

by symmetry the same method of solution could be applied to get the demand for the market B.

$(ii.)$ After finding the demand for low perceived quality and high perceived quality in both markets, we set the profit functions for high and low perceived quality firm using (4), (6), (7), and (5), (8) and (9) to solve for response functions in terms of high and low prices as follows:

*Profit functions in the market A:*

**(14)** $$\pi_{lA}^{s} = \left(p_{lA}^{s}-c_{A}^{s}\right)\left(\frac{\left(p_{hA}^{t}-p_{lA}^{s}\right)-\underline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}{(\overline{v}-\underline{v})\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}\right)-L_{A}^{s}-\frac{\left(\tau_{A}^{s}\right)^{2}}{2}$$

**(15)** $$\pi_{hA}^{t} = \left(p_{hA}^{t}-c_{A}^{t}\right)\left(\frac{\overline{v}\lambda\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)-\left(p_{hA}^{t}-p_{lA}^{s}\right)}{(\overline{v}-\underline{v})\lambda\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}\right)-L_{A}^{t}-\frac{\left(\tau_{A}^{t}\right)^{2}}{2}$$

[13] We know that the triangular distribution is a continuous probability distribution with lower limit e.g. $\underline{v}$, mode $\hat{v}$ and upper limit $\overline{v}$, where its pdf is $\begin{cases} \frac{2(v-\underline{v})}{(\overline{v}-\underline{v})(\hat{v}-\underline{v})} & for \quad \underline{v} \le v \le \hat{v} \\ \frac{2(\overline{v}-v)}{(\overline{v}-\underline{v})(\overline{v}-\hat{v})} & for \quad \hat{v} \le v \le \overline{v} \\ 0 \quad for \quad any \quad other \quad case \end{cases}$

Note that in market A, the profit function for low perceived quality belongs to the firm using the environmentally sustainable technology and the profit function for high perceived quality belongs to the firm using the traceability technology.

*Profit functions in the market B:*

**(16)** $$\pi_{lB}^{t}=\left(p_{lB}^{t}-c_{B}^{t}\right)\left(\frac{\left(p_{hB}^{s}-p_{lB}^{t}\right)-\underline{v}\lambda_{B}^{s}\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)}{\left(\overline{v}-\underline{v}\right)\lambda_{B}^{s}\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)}\right)-L_{B}^{t}-\frac{\left(\tau_{B}^{t}\right)^{2}}{2}$$

**(17)** $$\pi_{hB}^{s}=\left(p_{hB}^{s}-c_{B}^{s}\right)\left(\frac{\overline{v}\lambda\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)-\left(p_{hB}^{s}-p_{lB}^{t}\right)}{\left(\overline{v}-\underline{v}\right)\lambda\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)}\right)-L_{B}^{s}-\frac{\left(\tau_{B}^{s}\right)^{2}}{2}$$

Note that in the market B, the profit function for low perceived quality belongs to the firm using the traceability and the profit function for high perceived quality belongs to the firm using the traceability technology.

By taking derivatives of (14), (15), and (16), (17) we derive the FOCs, which can be solved as the response functions in terms of low and high prices for both of the markets as follows:

Response functions for the market A:

**(18)** $$p_{lA}^{s}\left(p_{hA}^{t}\right)=\frac{1}{2}\left(c_{A}^{s}-\underline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+p_{hA}^{t}\right)$$

**(19)** $$p_{hA}^{t}\left(p_{lA}^{s}\right)=\frac{1}{2}\left(c_{A}^{s}+\overline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+p_{lA}^{s}\right)$$

Response functions for the market B:

**(20)** $$p_{lB}^{t}\left(p_{hB}^{s}\right)=\frac{1}{2}\left(c_{B}^{t}-\underline{v}\lambda_{B}^{s}\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)+p_{hB}^{s}\right)$$

**(21)** $$p_{hB}^{s}\left(p_{lB}^{t}\right)=\frac{1}{2}\left(c_{B}^{s}+\overline{v}\lambda_{B}^{t}\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)+p_{lB}^{t}\right)$$

Now, we use the response functions of low and high perceived quality firms in terms of prices (18)-(21) in order to solve for the Nash-Bertrand Prices in both of the markets by assuming that there are symmetric for both markets in terms of perceived quality levels as shown in (10) - (13) condition above.

Note that it is important to show that (10) - (13) hold if we have a covered market condition, which is denoted by $p_{lA}^{s*} < \underline{v}$ or $p_{lB}^{t*} < \underline{v}$ [14].

Q.E.D.

***Proposition 2.*** *The firms' prices* $p_{lA}^{s}, p_{hA}^{t}$ *or* $p_{lB}^{t}, p_{hB}^{s}$ *are the strategic complements if the following conditions hold:*

(*i.*) *Profit functions of both firms,* $\pi_{lA}^{s}, \pi_{hA}^{t}$ *or* $\pi_{lB}^{t}, \pi_{hB}^{s}$ *are strictly concave in prices* $p_{lA}^{s}, p_{hA}^{t}$ *or* $p_{lB}^{t}, p_{hB}^{s}$ *where SOCs are satisfied;*
(*ii.*) *Both firms have reactions functions for prices have upward slope where* $\frac{\partial^2 \pi_{lA}^{s}}{\partial p_{lA}^{s} p_{hA}^{t}} > 0; \frac{\partial^2 \pi_{hA}^{t}}{\partial p_{hA}^{t} p_{lA}^{s}} > 0$ *or* $\frac{\partial^2 \pi_{lB}^{t}}{\partial p_{lB}^{t} p_{hB}^{s}} > 0; \frac{\partial^2 \pi_{hB}^{s}}{\partial p_{hB}^{s} p_{lB}^{t}} > 0$ *conditions are satisfied;*

***Proof:***

Note that two important assumptions need to hold for the prices to be the strategic complements - (a) the concavity of the profit functions in prices, and (b) upward sloping reaction price functions (Tirole, 1988). Those assumptions suggest that prices are usually strategic complements, and their existence is guaranteed by quasi-concave profit function (Boom, 1995).

(*i.*) The previous literature (Shaked and Sutton, 1982, Boom, 1995) focusing on the vertical product differentiation assumed the concavity and quasi-concavity of profit functions. We derive necessary first order and sufficient second order conditions to test the

[14] We will put a special restriction by assuming that $p_{lA}^{s*} < \underline{v}$ or $p_{lB}^{t*} < \underline{v}$ is necessary condition for the covered market without incorporating $\phi$.

strictly-concavity of $\pi_{lA}^{s}, \pi_{hA}^{t}$ or $\pi_{lB}^{t}, \pi_{hB}^{s}$ in prices as follows. Note that if the strict concavity of the functions holds, the concavity with semi-definiteness and quasi-concavity also hold, but it does not work the other way around. Initially, we derive the FOCs respect to own prices, $\pi_{lA}^{s}, \pi_{hA}^{t}$:

**(22)** $$\frac{\partial \pi_{lA}^{s}}{\partial p_{lA}^{s}} = \frac{\left(p_{hA}^{t} - p_{lA}^{s}\right) - \underline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right) - \left(p_{lA}^{s} - c_{A}^{s}\right)}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} = 0$$

**(23)** $$\frac{\partial \pi_{hA}}{\partial p_{hA}^{t}} = \frac{\overline{v}\lambda_{j}^{z}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right) - \left(p_{hA}^{t} - p_{lA}^{s}\right) - \left(p_{hA}^{t} - c_{A}^{t}\right)}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} = 0$$

Note that the same solutions apply to the market B case. Once we derived the FOCs as (22) and (23), the second order conditions can be obtained with respect to their own and rivalry's prices as follows:

**(24)** $$\begin{cases} \dfrac{\partial^{2}\pi_{lA}^{s}}{\partial p_{lA}^{s2}} = -\dfrac{2}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} < 0 \\ \dfrac{\partial^{2}\pi_{lA}^{s}}{\partial p_{lA}^{s}\partial p_{hA}^{t}} = \dfrac{1}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} > 0 \end{cases}$$

**(25)** $$\begin{cases} \dfrac{\partial^{2}\pi_{hA}^{s}}{\partial p_{hA}^{s2}} = -\dfrac{2}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} < 0 \\ \dfrac{\partial^{2}\pi_{hA}^{s}}{\partial p_{hA}^{s}\partial p_{lA}^{s}} = \dfrac{1}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} > 0 \end{cases}$$

Those partial derivatives allow us to construct the Hessian matrix to check for concavity. Using (24)-(25) we set up the Hessian as follows:

**(26)** $$\left|H_{2}\right| = \begin{bmatrix} \dfrac{\partial^{2}\pi_{lA}^{s}}{\partial p_{lA}^{z2}} & \dfrac{\partial^{2}\pi_{lA}^{t}}{\partial p_{lA}^{s}\partial p_{hA}^{t}} \\ \dfrac{\partial^{2}\pi_{hA}^{t}}{\partial p_{hA}^{t}\partial p_{lA}^{s}} & \dfrac{\partial^{2}\pi_{hA}^{t}}{\partial p_{hA}^{t2}} \end{bmatrix} = \begin{bmatrix} -\dfrac{2}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} & \dfrac{1}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} \\ \dfrac{1}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} & -\dfrac{2}{\left(\overline{v} - \underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)} \end{bmatrix}$$

A small algebraic manipulation such as dividing all partial derivatives by $\frac{1}{(\overline{v}-\underline{v})\lambda_A^t\left(\tau_{hA}^t-\tau_{lA}^s\right)}$ will simplify the computation of Hessian matrix and enable us to easily check for concavity:

**(27)** $$\frac{\partial^2\pi_{lA}^s}{\partial p_{lA}^{s2}}=-2<0\text{, and }\left|H_2\right|=\begin{bmatrix}-2 & 1\\ 1 & -2\end{bmatrix}=3>0$$

Note that we can obtain exactly the same results for the market B under the assumption of symmetry. So, our computations in (26) condition show that the profit functions of firms are strictly concave in $p_{lA}^s, p_{hA}^t$ with definite negative conditions, and this result is not supported by the some of the previous literature focusing on the vertical differentiation models (Tirole 1988). Note that we already know from Mas Golell (1995) that if the function is strictly concave, then it is also concave and quasi-concave (Boom, 1995) where the strict concavity is very restrictive condition than the quasi-concavity.

(*ii.*) Once it is proved that the profit functions are strictly concave in prices, we need to compute the slopes of reaction functions for prices. Tirole (1988) suggests $signR_{lA}^{'s}\left(p_{hA}^t\right)=sign\left(\frac{\partial^2\pi_{lA}^s}{\partial p_{lA}^s\partial p_{hA}^t}\right)$ formula to calculate the slope of the price reaction curves. Using this formula, we can derive the following conditions:

**(28)** $$\frac{\partial\pi_{hA}}{\partial p_{hA}^s}=\frac{\overline{v}\lambda_A^t\left(\tau_{hA}^t-\tau_{lA}^s\right)+p_{lA}^s+c_A^t-2p_{hA}^t}{(\overline{v}-\underline{v})\lambda_A^t\left(\tau_{hA}^t-\tau_{lA}^s\right)}>0\text{, iff }\overline{v}\lambda_A^t\left(\tau_{hA}^t-\tau_{lA}^s\right)+p_{lA}^s+c_A^t>2p_{hA}^t$$

**(29)** $$\frac{\partial\pi_{lj}^z}{\partial p_{lj}^z}=\frac{p_{hj}^z+c_j^z-2p_{lj}^z-\underline{v}\lambda_j^z\left(\tau_{hj}^z-\tau_{lj}^z\right)}{(\overline{v}-\underline{v})\lambda_j^z\left(\tau_{hj}^z-\tau_{lj}^z\right)}>0\text{, iff }p_{hA}^t+c_A^t>2p_{lA}^s-\underline{v}\lambda_A^t\left(\tau_{hA}^t-\tau_{lA}^s\right)$$

Relying on the results obtained from (28) and (29), we can conclude that both of the price reaction curves are upward sloped. Finally, our findings are consistent with the findings of Tirole (1988) who suggests that prices are usually strategic complements.

***Q.E.D.***

***Lemma 1****.The increase in the dispersion of willingness to pay* $(\overline{v}-\underline{v})$ *and perceived quality dispersion* $\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)$ *leads to increase in the prices of low perceived and high perceived food product in both of the markets such that* $\frac{\partial p_{lA}^{s}}{\partial \overline{v}}>0;\frac{\partial p_{hA}^{t}}{\partial \overline{v}}>0$ *and* $\frac{\partial p_{lA}^{s}}{\partial \tau_{hA}^{t}}>0;\frac{\partial p_{hA}^{t}}{\partial \tau_{hA}^{t}}>0$ *conditions hold:*

***Proof:***

Holding the lowest point of the willingness to pay constant, which is denoted by $\underline{v}$ and taking derivatives of both of the prices for low perceived and high perceived quality food product with respect to the maximum level of willingness to pay, we derive the conditions supporting the increase of both prices as result of increasing the maximum level of the willingness to pay, which is denoted by $\overline{v}$ . So, those conditions are given as follows:

**(30)** $$\frac{\partial p_{lA}^{s}}{\partial \overline{v}}=\frac{1}{3}\left(\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)\right)>0$$

**(31)** $$\frac{\partial p_{hA}^{t}}{\partial \overline{v}}=\frac{1}{3}\left(2\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)\right)>0$$

The purpose of the proposition 1 is to show that our model set up is consistent with all previous seminal literature on the vertical product differentiation. We suggest that the increase of income dispersion (which is here denoted as willingness to pay in our model) and quality dispersion $\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)$ should increase the both of the prices. Relying on the findings of the present research, we can also conclude that decrease of dispersion level of willingness

to pay will lead to the decrease in both of prices such as $\frac{\partial p_{lA}^{s}}{\partial \underline{v}} < 0; \frac{\partial p_{hA}^{t}}{\partial \underline{v}} < 0$. We obtained these results by holding $\overline{v}$ constant and taking the derivative of both of prices with respect to $\underline{v}$.

With regard to the quality dispersion, which will be discussed more in the later section, we take the derivates of both prices with the respect to the high perceived quality to satisfy the conditions supporting the increase of prices as the result of the increase in quality dispersion $\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)$. So, when the high quality level increases, the qualities are more distinct and both firms charge higher prices.

**(32)** $$\frac{\partial p_{lA}^{s}}{\partial \tau_{hA}^{t}} = \frac{1}{3}\left(\lambda_{A}^{t}\left(\overline{v} - 2\underline{v}\right)\right) > 0$$

**(33)** $$\frac{\partial p_{hA}^{t}}{\partial \tau_{hA}^{s}} = \frac{1}{3}\left(\lambda_{A}^{t}\left(2\overline{v} - \underline{v}\right)\right) > 0$$

Finally, the economic intuition for these results suggests that the higher the willingness to pay dispersion and higher the quality dispersion are, the higher firm sets its mark-up to capture the consumer surplus in a duopolistic market.

***Q.E.D***

## CHOICE OF QUALITY LEVELS AND QUALITY EQUILIBRIUM

Following our previous assumptions in terms of perceived quality levels, we suggest that the perceived quality levels affect the consumers in one way such as if the quality of the food product is perceived high, then the firm makes higher profit relative to the one whose product is perceived low. Note that though the perception of quality attributes vary from one to another country, we can still solve firm's profit functions in terms of perceived quality

levels and derive the response functions for perceived quality levels by proposing the following.

***Proposition 3***. *In a covered market, the following conditions are satisfied for the duopoly to choose the quality level at the second stage (or* $t=2$*) in vertical production differentiation game*:

(*i*.) *Profit functions for the domestic and foreign firms are derived in terms of quality levels - low and high perceived qualities in market A as follows:*

**(34)** $$\pi_{lA}^{s}=\left(\frac{\left(\overline{v}-2\underline{v}\right)^{2}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}{9\left(\overline{v}-\underline{v}\right)}\right)-L_{A}^{t}-\frac{\left(\tau_{A}^{s}\right)^{2}}{2}\quad\text{where }\overline{v}>2\underline{v}\text{ or }\frac{\overline{v}}{2}>\underline{v}$$ [15]

**(35)** $$\pi_{hA}^{t}=\left(\frac{\left(2\overline{v}-\underline{v}\right)^{2}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}{9\left(\overline{v}-\underline{v}\right)}\right)-L_{A}^{t}-\frac{\left(\tau_{A}^{t}\right)^{2}}{2}$$

(*ii*.) *The Nash equilibrium in low and high perceived quality levels for a duopoly game are described by:*

**(36)** $$\tau_{lA}^{s*}=\underline{\tau}$$ [16]

**(37)** $$\tau_{hA}^{s*}=\left\{\tau_{hA}^{s}\middle|\frac{\underline{\tau}\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}-3c_{A}^{t}+3\underline{v}}{\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}}\right\}$$

(*iii*.) *The reaction functions for low and high perceived quality levels are described by:*

**(38)** $$\tau_{hA}^{t}\left(\tau_{lA}^{s}\right)=\frac{\lambda_{A}^{t}\tau_{lA}^{s}\left(\overline{v}-2\underline{v}\right)-3c_{A}^{t}+3\underline{v}}{\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}}$$

**(39)** $$\tau_{lA}^{s}\left(\tau_{hA}^{t}\right)=\frac{\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}\tau_{hA}^{t}+3c_{A}^{t}-3\underline{v}}{\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}}$$

---

[15] Note that Shaked and Sutton (1982) have already derived the same condition for two firms to exist with positive profit in the market by suggesting that $4a>b>2a$ or just $\frac{b}{2}>a$ where $b$, max and $a$, min levels of incomes are equivalent to the $\overline{v}$, max and $\underline{v}$ min levels of willingness to pay in our model.

[16] Note that $\underline{\tau}$ denotes the lower bound for the quality level in this model.

(*iv.*) *As the perceived quality dispersion* $\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)$ *increases, both of profit functions for firms increase under the* $\frac{\partial \pi_{lA}^{s}}{\partial \tau_{hA}^{t}}>0$ *and* $\frac{\partial \pi_{hA}^{t}}{\partial \tau_{hA}^{t}}>0$ *conditions.*

***Proof:***

Suppose that the actual quality of the product is also defined by $i$, where $i \in \left[\underline{\tau}, \overline{\tau}\right]$ where $\underline{\tau}$ and $\overline{\tau}$ denote the lower and upper bounds of the actual quality. The latter expression is equivalent to the following expression[17]:

**(40)** $$\frac{\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}\tau_{hA}^{t}+3c_{A}^{s}-3\underline{v}}{\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}}<\tau_{lA}^{s}, \text{ iff } \overline{v}\lambda_{A}^{t}\tau_{hA}^{t}+3c_{A}^{s}>2\underline{v}\lambda_{A}^{t}\tau_{hA}^{t}+3\underline{v}$$

from (40) we can conclude that (41) holds for the high quality response function:

**(41)** $$\frac{\tau_{lA}^{s}\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}-3c_{A}^{t}+3\underline{v}}{\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}}<\tau_{hA}^{t}, \text{ iff } \overline{v}\lambda_{A}^{t}\tau_{hA}^{t}+3\underline{v}>2\underline{v}\lambda_{A}^{t}\tau_{hA}^{t}+3c_{A}^{s}$$ **[18]**

(*i.*) In order to derive the profit functions in terms of perceived quality levels, we use (10) and (11) in (14) and (15) to derive the profit functions for both of the firms in terms of perceived quality levels in the market A as follows:

$$\pi_{lA}^{s}=\left(\frac{1}{3}\left(\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+3c_{A}^{t}\right)-c_{A}^{s}\right)\left(\frac{\left(\frac{1}{3}\left(\left(2\overline{v}-\underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+3c_{A}^{s}\right)-\frac{1}{3}\left(\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+3c_{A}^{t}\right)\right)-\underline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}{\left(\overline{v}-\underline{v}\right)\lambda_{A}^{s}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}\right)-L_{A}^{s}-\frac{\left(\tau_{A}^{s}\right)^{2}}{2}$$

$$\pi_{hA}^{t}=\left(\frac{1}{3}\left(\left(2\overline{v}-\underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+3c_{A}^{t}\right)-c_{A}^{t}\right)\left(\frac{\overline{v}\lambda\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)-\left(\frac{1}{3}\left(\left(2\overline{v}-\underline{v}\right)\lambda\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+3c_{A}^{s}\right)-\frac{1}{3}\left(\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+3c_{A}^{t}\right)\right)}{\left(\overline{v}-\underline{v}\right)\lambda_{j}^{z}\left(\tau_{hj}^{z}-\tau_{lj}^{z}\right)}\right)-L_{A}^{t}-\frac{\left(\tau_{A}^{t}\right)^{2}}{2}$$

[17] We assume that (40) and (41) are reaction functions for perceived quality levels.

[18] Note that proof of Shaked and Sutton (1982) supporting the existence of $\frac{b}{2}>a$ where $b$, max and $a$, min levels of incomes are equivalent to the $\overline{v}$, max and $\underline{v}$ min levels of willingness to pay in our model. Therefore, our models also assume that $\frac{\overline{v}}{2}>\underline{v}$. In later section, we will refer to this condition.

By using some algebraic manipulations and simplifying these profit functions, we arrive at the conditions as (34) and (35) above.

(*ii*.) The proof of this part of proposition is very straightforward as the previous part where the derivative of own quality levels are taken with respect to the profit functions and following results are obtained:

**(42)** $$\frac{\partial \pi_{lA}^{s}}{\partial \tau_{lA}^{s}} = -\frac{\lambda_{A}^{t}\left(\overline{v} - 2\underline{v}\right)^{2}}{9\left(\overline{v} - \underline{v}\right)} < 0$$

**(43)** $$\frac{\partial \pi_{hA}^{t}}{\partial \tau_{hA}^{t}} = \frac{\lambda_{A}^{t}\left(2\overline{v} - \underline{v}\right)^{2}}{9\left(\overline{v} - \underline{v}\right)} > 0$$

The equations shown in (42) and (43) are consistent with the results of Boom (1995, p.108), and our results intuitively means that (a) the profit of the low perceived quality firm decreases in $\tau_{lA}^{s}$, and (b) the profit of high perceived quality firm increases in $\tau_{hA}^{t}$ for the market A. We know that these results are obtained in the covered market condition, and therefore, findings for low perceived quality firm suggest that he can never gain former non-consumers by increasing its quality. Boom (1995) suggests that as the products are close substitutes, the low perceived quality firm has to face an intensified competition with the high perceived quality firm. So, the profit maximizing response of the low perceived quality firm is to always to choose the lowest quality, which satisfies $\tau_{lA}^{s*} = \underline{\tau}$ optimal condition. Therefore, the exporting firm should choose the quality level, which is below the quality level of the product produced for the domestic market or must be equal to the minimum quality level in the regulated market. In other terms, the either of firms should set up two production lines; low and high quality producing facilities in the plant (a) high quality product produced with locally preferred technology for the domestic market, and (b) low

quality product produced with the same technology for the foreign market. If the either of firms still wants to export high quality food products to the foreign markets by hoping to obtain the market share in high quality market, then, the either of the firms should wait for the adoption of the bilateral trade agreement between two countries that will enable the recognition of technologies in both countries. In the next sections, we will discuss these issues more in detail.

For the high perceived quality firm, a rise in its own quality always causes a rise in the profit of the high perceived quality firm. In addition, the condition (43) means that the marginal profit of the high quality firm at any chose quality level is higher if the market is covered. Finally, given that the best response of the low perceived firm is $\tau_{lA}^{s*} = \underline{\tau}$, the best response of high perceived quality firm is $\tau_{hA}^{t*} = \overline{\tau}$ or $\tau_{hA}^{t}\left(\tau_{lA}^{t}\right) = \dfrac{\tau_{lA}^{s}\left(\overline{v} - 2\underline{v}\right)\lambda_{A}^{t} - 3c_{A}^{t} + 3\underline{v}}{\left(\overline{v} - 2\underline{v}\right)\lambda_{A}^{t}}$ from the condition (41).

Therefore, the chance and incentive of low perceived quality to leapfrog the high perceived quality firm is ruled out in this model for two reasons; (a) the fixed cost is the sunk cost, and (b) the concavity of the profit functions in respective prices are satisfied in both market, and therefore, Nash equilibrium conditions are provided by:

$$\tau_{lA}^{s*} = \underline{\tau}$$

$$\tau_{hA}^{t*} = \left\{ \tau_{hA}^{t} \middle| \frac{\underline{\tau}\left(\overline{v} - 2\underline{v}\right)\lambda_{A}^{t} - 3c_{A}^{t} + 3\underline{v}}{\left(\overline{v} - 2\underline{v}\right)\lambda_{A}^{t}} \right\}$$ [19]

(*iii*.) Response functions for the quality are based on the conditions (40) and (41) that have been derived from (38) and (39), which denote the level of quality choices in the covered market. One may find that (38) and (39) conditions are derived in terms of rival's

[19] The low perceived quality level is replaced with its optimal quality level in the equilibrium for the high perceived quality level.

quality level, which is one of the defining characteristics of reaction functions for perceived quality variable. The conditions (38) and (39) are derived based on the explanation provided in the proof of the proposition 1, which characterizes the necessary conditions for the existence of the covered market.

(*iv.*) Relying on the techniques used to prove the proposition 2, we will take the derivatives of (a) the profit function for low perceived quality firm with and (b) the profit function for high perceived quality firm respect to the high perceived quality and obtain the following results:

**(44)** $$\frac{\partial \pi_{lA}^{s}}{\partial \tau_{hA}^{s}} = \frac{\lambda_{A}^{t}\left(\overline{v} - 2\underline{v}\right)^{2}}{9\left(\overline{v} - \underline{v}\right)} > 0 \text{ iff } \overline{v} > 2\underline{v}$$

**(45)** $$\frac{\partial \pi_{hA}^{t}}{\partial \tau_{hA}^{t}} = \frac{\left(2\overline{v} - \underline{v}\right)^{2} \lambda_{A}^{t}}{9\left(\overline{v} - \underline{v}\right)} > 0$$

These results are consistent with what has been proved in the proposition 2 where as the perceived quality dispersion $\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)$ increases, the prices of both firms increase. Now, we demonstrate that as the perceived quality dispersion $\left(\tau_{hA}^{t} - \tau_{lA}^{s}\right)$ increases, the profit functions of both firms increase as well.

***Q.E.D.***

## ENTRY

***Remark 1.*** *If* $\pi_{hA}^{t} > \pi_{hB}^{t} > 0$ and $\pi_{hB}^{s} > \pi_{lA}^{s} > 0$, then both domestic firms desire to enter the foreign market, if $\pi_{hA}^{t} > \pi_{lB}^{t} = 0$ and $\pi_{hB}^{s} > \pi_{lA}^{S} = 0$, then, both domestic firms are indifferent between to enter and not to enter the foreign market, and if $\pi_{hA}^{t} > 0$ $\pi_{lB}^{t} < 0$ and $\pi_{hB}^{s} > 0$ and $\pi_{lA}^{s} < 0$, then, both firms decide only to supply their domestic markets.

***Lemma 2.*** *If* $\tau_{hA}^{t} > \tau_{lB}^{t}$, $\tau_{hA}^{s} > \tau_{lB}^{s}$ *and* $\tau_{hA}^{t} = \tau_{hB}^{s}$, *then* $U_{hA}^{t} > U_{lB}^{t}$, $U_{hB}^{s} > U_{lA}^{s}$ and $U_{hA}^{t} = U_{hB}^{s}$.

***Proof:***

The proof of this lemma is straightforward since we already know that due to the preference for technology the perception of food quality is different across the both domestic and foreign markets. Consumers receive information about the technology from the label, but those labels represent cues and tags about the technology used to produce the food product. But consumers are not familiar with those cues or the way that the information is represented. Following these assumptions, we assume that $\tau^t_{hA} > \tau^t_{lB}$ hold for the products produced with traceable technology and $\tau^s_{hA} > \tau^s_{lB}$ holds for the products produced with environmentally sustainable technology. Once we have the conditions supporting the variation of quality across markets, we can easily conclude that the utilities of consumers are represented as follows:

**(46)** $U^t_{hA} > U^t_{lB}$ and $U^s_{hB} > U^s_{lA}$.

***Q.E.D.***

***Proposition 4.****Upon the entry, the exporting firm e.g. using traceability technology or environmentally sustainable technology receives ex-ante information about the perception of quality of his products in the foreign market and decides to produce food products with two levels of quality; high quality for the domestic market and low quality for the foreign markets. This holds under the following conditions such that:*

$(i.)$ $\tau^t_{hA} = \overline{c}^t_A > \tau^t_{lB}$

$(ii.)$ $\dfrac{\left(\tau^t_{hA}\right)^2}{2} = \dfrac{\left(\overline{\tau}^t_A\right)^2}{2} > \dfrac{\left(\tau^t_{lB}\right)^2}{2}$

$(iii.)$ $p^t_{hA} > \overline{p}^t_{lB} = p^t_{lB}$

$(iv.)$ $\pi^z_{hj} > \pi^z_{lj} > \overline{\pi}^t_{lA}$ *only if* $(i.)$ *holds*

$(v.)$ $L^t_{hA} = \overline{L}^t_A > L^t_{lB}$

Note that we denote the marginal cost, price, fixed cost of quality, profit and labeling cost with cap belongs to the firm with traceable technology or environmentally sustainable technology producing a single quality, and all of the rest belongs to the firm with traceable technology or environmentally sustainable technology producing two quality levels. It is also true that the fixed cost associated with quality and labeling gets smaller as the quantity goes up, and therefore, we assume that it does not affect the profit in long run and $(iv.)$ condition is satisfied only if $(i.)$ holds.

***Proof:***

In order to proof the proposition 4 we use (6), (7) and (11) and derive the following response functions for prices and quality, profits in terms of prices and quality, and equilibrium in prices and quality by using respective terms in $(i.)-(v.)$.

*(a.1) Profit Functions in terms of prices for the firm with traceability technology in markets, B and A:*

**(47)** $$\pi_{lB}^{t}=\left(p_{lB}^{t}-\tau_{lB}^{t}\right)\left(\frac{\left(p_{hB}^{t}-p_{lB}^{s}\right)-\underline{v}\lambda_{B}^{s}\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)}{\left(\overline{v}-\underline{v}\right)\lambda_{B}^{s}\left(\tau_{hB}^{t}-\tau_{lB}^{t}\right)}\right)-L_{lB}^{t}-\frac{\left(\tau_{lB}^{t}\right)^{2}}{2}$$

**(48)** $$\pi_{hA}^{t}=\left(p_{hA}^{t}-\tau_{hA}^{t}\right)\left(\frac{\overline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)-\left(p_{hA}^{t}-p_{lA}^{s}\right)}{\left(\overline{v}-\underline{v}\right)\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)}\right)-L_{hA}^{t}-\frac{\left(\tau_{hA}^{t}\right)^{2}}{2}$$

*(a.2) Response Functions for prices for the firm with traceability technology in markets, B and A:*

**(49)** $$p_{lB}^{t}=\frac{1}{2}\left(p_{hB}^{s}-\underline{v}\lambda_{B}^{s}\left(\tau_{hB}^{s}-\tau_{lB}^{t}\right)+\tau_{lB}^{t}\right)$$

**(50)** $$p_{hA}^{t}=\frac{1}{2}\left(p_{hA}^{t}+\overline{v}\lambda_{A}^{t}\left(\tau_{hA}^{t}-\tau_{lA}^{s}\right)+\tau_{hA}^{t}\right)$$

*(a.3) Nash-Bertrand Equilibrium in prices for the firm with traceability technology in markets, B and A:*

**(51)** $$p_{lB}^{t*} = \frac{1}{3}\left(\left(\overline{v} - 2\underline{v}\right)\lambda_B^s\left(\tau_{hB}^s - \tau_{lB}^t\right) + \tau_{hB}^s + 2\tau_{lB}^t\right)$$

**(52)** $$p_{hA}^{s*} = \frac{1}{3}\left(\left(2\overline{v} - 2\underline{v}\right)\lambda_A^t\left(\tau_{hA}^t - \tau_{lA}^t\right) + \tau_{hA}^t + 2\tau_{lA}^s\right)$$

*(b.1) Profit Functions in terms of quality levels for the firm with traceability technology in markets B and A:*

**(53)** $$\pi_{lB}^t = \left(\frac{\left(\left(\overline{v} - 2\underline{v}\right)\lambda_B^s\left(\tau_{hB}^s - \tau_{lA}^t\right) - \tau_{lB}^t + \tau_{hB}^s\right)^2}{9\left(\overline{v} - \underline{v}\right)\lambda_B^s\left(\tau_{hB}^s - \tau_{lB}^t\right)}\right) - L_{lB}^t - \frac{\left(\tau_{lB}^t\right)^2}{2}$$

**(54)** $$\pi_{hA}^t = \left(\frac{\left(\left(2\overline{v} - \underline{v}\right)\lambda_A^t\left(\tau_{hA}^z - \tau_{lA}^z\right) - \tau_{hA}^t + \tau_{lA}^z\right)^2}{9\left(\overline{v} - \underline{v}\right)\lambda_A^t\left(\tau_{hA}^t - \tau_{lA}^s\right)}\right) - L_{hA}^t - \frac{\left(\tau_{hA}^t\right)^2}{2}$$

*(b.2) Equilibrium in quality levels for the firm with traceability in the markets, B and A:*

**(55)** $$\tau_{lB}^t = \frac{\left(\left(\overline{v} - 2\underline{v}\right) + 1\right)^2}{9\left(\overline{v} - \underline{v}\right)\lambda_B^s}$$

**(56)** $$\tau_{hA}^t = \frac{\left(\left(2\overline{v} - \underline{v}\right) - 1\right)^2}{9\left(\overline{v} - \underline{v}\right)\lambda_A^t}$$

Note that the derivation of equilibrium in qualities show that either level of quality cancels out, or therefore, we cannot derive the response functions for quality levels. However, we can still derive response functions for quality levels similar to the conditions in (38) and (39):

**(57)** $$\tau_{lB}^t\left(\tau_{hB}^s\right) = \frac{\lambda_B^s\tau_{hB}^s\left(\overline{v} - 2\underline{v}\right) + \tau_{hA}^s - 3\underline{v}}{\left(\left(\overline{v} - 2\underline{v}\right)\lambda_B^s - 2\right)} > 0 \text{ , iff } \left(\overline{v} - 2\underline{v}\right)\lambda_B^s > 2$$

Note that $\left(\overline{v} - 2\underline{v}\right)\lambda_B^s > 2$ condition suggests that $\overline{v}$ is large enough to have a covered market condition.

**(58)** $$\tau_{hA}^{t}\left(\tau_{lA}^{s}\right)=\frac{\lambda_{A}^{t}\tau_{lA}^{s}\left(\overline{v}-2\underline{v}\right)-\tau_{hA}^{t}+3\underline{v}}{\left(\left(\overline{v}-2\underline{v}\right)\lambda_{A}^{t}+1\right)}>0$$

After all conditions are obtained, we can easily compare and show that producer with either of the technology is better of, if he or she produces two types of qualities versus a single type of quality for both domestic and foreign market.

## CONCLUSIONS

Our game theoretic approach shows that the incumbent uses the advantage of the consumers' exogenous preference for the technology that he or she uses. The advantage of the exogenous preference technology of the domestic firm lead consumers to perceive the food products of the entrant as low quality or with low quality specification compared to the domestic firms' products. The main focus in this article is the variation of quality perception is due to exogenous technology preferences across markets.

The findings of the paper suggests that the incumbent needs (a) to supply a high quality food products to the domestic market, but low quality food products to the foreign market by setting up two production lines in the plant, (b) to label the food product with appropriate label for each level of quality since consumers use the label to obtain information about the technology used to produce the product.

We also demonstrated that when firms choose quality levels simultaneously, the low perceived quality firm should choose the minimum quality level, and the high perceived quality firm should choose the maximum quality level existing in the regulated market. Additionally, the results showed that low perceived quality firm could not leapfrog the high-

perceived quality firm due to the concavity of the profit function in prices and the fixed cost (or sunk type) incurred in the first stage.

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# CHAPTER THREE

# CUE UTILIZATION IN EVALUATING SAFETY AND QUALITY OF FOOD PRODUCTS: EMPERICAL EVIDENCE


## Summary

Food safety perception is an important construct in consumer's food product evaluation. However, there is a limited research conducted to examine the role of food safety perception in addition to food quality perception in evaluating food products or making food choices. Understanding the importance of food safety perception construct in product evaluations, the present research studies the effects of country of origin and region of origin on consumers' perceptions of food quality and willingness to buy through food safety perceptions.

Findings show that consumers' food safety perceptions explain the relationship between country of origin and region of origin and food quality. But food quality perception does not explain the relationship between food safety perception and willingness to buy. The latter result suggests that consumers' food safety perceptions have a direct impact on their likelihood of purchasing food products.

Results demonstrate that product sampling and price levels have significant interaction effects with different levels of product origin. Finally, the study reports three way interaction effect of price, product sampling and product origin cues revealing a number of perspectives for further research.



**Key words:** mediation analysis, cue utilization, perceived food safety, product origin

## Introduction

Recent food outbreaks in the USA and elsewhere have elevated public attention on food safety issues and become a major focus of food production, marketing and consumption literature (Mead et al. 1999; Rasco and Bledsoe, 2005; Currie et al. 2007). Usually, food-borne illnesses occur when consumers are exposed to contaminated food products, which contain harmful microorganisms (*i.e*. bacteria or microbes).

The Economic Research Service estimated the cost of seven food-borne illnesses associated with pathogens such as *E.coli O157:H7* ranged from $6.6 billion to $37.1 billion in medical expenses and lost productivity in US (Buzby, 2003). Food safety experts identified that the most common food contaminations that exist might be due to obtaining food from unsafe sources, and inadequate food handling practices (Brayn, 1988). Most consumers believe that their illnesses were caused by contaminations through food producers and not at home (Williamson, 1992). Consumers are very concerned about the food they are exposed to on daily basis, because they cannot fully evaluate its safety based upon the information available to them (Shogren et al. 1999).

Consumer's ability to determine actual safety of food product is limited due to the fact that food safety is a credence attribute[20]. Lack of such ability usually leads to increased concern for food safety (Medeiros et al. 2004). In the process of evaluating the credence attributes of food products, consumers heavily rely upon available information cues (Darby and Karni, 1973). Consumer perceptions of different information cues are considered to be fundamental determinants of shopping behavior and product choice (Doyle, 1984; Jacoby

[20] Darby and Karni (1973) suggest that consumers cannot determine the quality of credence goods without an expert's evaluation. Based on that definition, we suggest that food safety is also the credence attribute of a food product.

and Olson, 1985, Dodds et al. 1991).[21] A large number of studies (Szybillo and Jacoby, 1974; Dodds and Monroe 1985; Woodside and Taylor, 1986; Tellis, 1987; Tellis and Fornell, 1988; Lichtenstein and Burton, 1989; Petroshius and Monroe, 1989, Sprott and Shimp, 2004) investigating effects of different information cues on product evaluation suggest that consumer heavily rely on certain cues in determining product quality. However, a very little formal conceptual effort (Bredahl et al. 1998; Van Ittersum et al. 2003; Krissoff et al. 2004) has been directed toward offering theoretical and empirical evidence for information cues influence on consumers' food safety perceptions.

Either theoretical or empirical evidence or even both might be very helpful to marketing managers in successfully promoting their products in the marketplace and researchers in studying determinants of consumers' food safety perceptions. Understanding the necessity for investigating consumers' food safety perceptions and quality, the present research is motivated to find the theoretical and empirical evidence on several key issues. The first issue is what information cues affect consumers' food safety perceptions. The second issue is the role of consumers' food safety perceptions in explaining the relationship between information cues and consumers' food quality perceptions and willingness to buy. The third issue is how product sampling improves food safety and quality perceptions.

To answer the questions above, the present research uses two extrinsic cues: (1) country of origin, and (2) region of origin. In addition, the present research relies on moderating power of price cue (Dodds et al. 1991) and product sampling process (Sprott and Shimp, 2004). By doing so, the present study identifies significant positive effects of country of origin, region of origin on food safety and quality perceptions, and mediation

[21] Cox (1962) defines cue as information about product.

effect of perceived safety to explain the relationship between food origin and food quality perception.

In the next section, the conceptual framework is introduced and includes potential linkages among information cues and perceived food safety, and how different cues such as price and product sampling moderate the functional relationship between product origin cues and perceived safety and quality. In the second section, the experiment and data analysis are described. In the final section, the findings and conclusion are provided.

## CONCEPTUAL FRAMEWORK

### *Cue Utilization Theory*

The literature suggests that consumers use intrinsic and extrinsic cues to infer the quality of products (Cox 1962; 1967; Szybillo and Jacoby 1974; Dodds and Monroe 1985; Woodside and Taylor 1986; Tellis 1987; Tellis and Fornell 1988; Lim and Olshavky, 1988; Lichtenstein and Burton 1989; Petroshius and Monroe 1989).

Cue utilization involves obtaining and processing cues from the external environment to produce a particular behavior e.g. a product evaluation or a choice. Cox (1962) originated the cue utilization theory and according to this theory, products consist of an array of cues that serve as surrogate indicator of product quality to consumer (Olson and Jacoby, 1972). Olson (1972) further refines this theory by defining intrinsic cues as attributes that cannot be changed without altering the nature of the product itself and are consumed as the product (*e.g.*. flavor, color and texture of a product), and extrinsic cues as attributes that are not part of the physical product itself (*e.g.* brand name, packaging, price and advertising).

The present research analyzes the effects of extrinsic cues on food safety and quality perceptions, which lead to determining willingness to buy. Studies have found that once

consumers perceive food to be safe (Burnkrant, 1978), they will perceive the quality (Medeiros et al. 2004) and will eventually be willing to buy the product (Dodds et al. 1991). Understanding the relationship between extrinsic cues and food quality perceptions, the present research extends traditional quality perception and product evaluation model adding construct of food safety perception. Addition of the construct of food safety perception enables to explain the effect of country of origin cues on food quality perception.

The present research explores two types of extrinsic cues with different levels - country of origin and region of origin, and price (high and low), and five intrinsic cues (color, taste, flavor, texture, and appearance) captured via a product sampling process.

*Intrinsic versus Extrinsic cues*

The literature investigating the main and interaction effects of information cues such as color (Peterson 1977), brand name (Allison and Uhl 1964, Keller 1993; Erdem and Swait 1998; Rao 1999; Roosen 2003; Hsiu-Yuan et al. 2006), advertising (Miller and Plott 1985; Bagwell and Riordan 1991; Lichtenstein et al. 1993; Laurent 1998; Mark 2000; Zhao 2000; Linnemer 2002; Fluet and Garella 2002), store name (Wheatley et al. 1977) and packaging (McDaniel and Baker 1977) suggests that consumers tend to use both intrinsic and extrinsic cues concurrently when evaluating product quality (Dodds et al. 1991).

For example, Richardson et al. (1994) demonstrated that the relative importance of extrinsic versus intrinsic cues in forming quality judgments is a function of the cue's predictive and confidence values. Richardson et al. (1994) defined the predictive value of a cue as the degree to which a consumer associates the cue with the product quality, and confidence value of a cue is the degree to which the consumer is confident in his or her ability to correctly use and judge that cue. Generally, extrinsic cues are considered likely to

be associated with high confidence, but low predictive values, whereas, intrinsic cues are likely to have low confidence but high predictive values. Intrinsic cues are not always available to consumers, and consumers have to rely on extrinsic cues.

*Perceived Food Safety*

The conceptual model proposes that perceived food safety acts as a mediator between informational cues and perceived quality. Previous research has analyzed the effects of intrinsic and extrinsic cues such as color (Peterson 1977), brand name (Allison and Uhl 1964, Keller 1993; Erdem and Swait 1998; Rao 1999; Roosen 2003; Hsiu-Yuan et al. 2006), advertising (Miller and Plott 1985; Bagwell and Riordan 1991; Lichtenstein et al. 1993; Laurent 1998; Mark 2000; Zhao 2000; Linnemer 2002; Fluet and Garella 2002), store name (Wheatley et al. 1977) and packaging (McDaniel and Baker 1977) on the consumer's evaluation of the product and has not explicitly addressed in their models. The literature on rational decision-making (Jacoby 1977; Sheluga et al. 1979; Bettman and Park 1980; Bettman 1986) suggests that - no consumer will choose to purchase a food product if they cannot infer the safety of the product from the available cues (Sparks and Shepherd 1994; Elbasha and Riggs 2003; Klaus 2005; James 2005; McCluskey et al. 2006).

Several studies (Kramer and Penner 1986; Brewer et al. 1994; Sparks 1994a; Medeiros et al. 2004; Klaus 2005; Rasco and Bledsoe 2005) define food safety perception to be a consumer's perception that food as whole (including its all ingredients and components) is free of hazards that would cause sickness and harm during the process of food preparation and consumption. Perceived food safety is (1) different from objective or actual safety of the food product (Medeiros et al. 2004; Klaus 2005; Rasco and Bledsoe 2005) and (2) represents a higher level of abstraction than a specific attribute (Rasco and Bledsoe 2005).

*Country of Origin*

For the past two decades, the effect of a product's country of origin on buyer perceptions and product evaluations has been one of the most widely studied phenomena in marketing and consumer behavior literatures (Reierson, 1966; Schooler and Sunno, 1969; Anderson and Cunningham, 1972; Gaedeke, 1973; Etzel and Walker, 1974; Lillis and Narayana, 1974; Nagashima, 1970, 1977; White and Cundiff, 1978; White, 1979; Han and Terpstra 1988; Ettenson et al. 1988; Hong and Wyer 1989; Hong 1989; Johansson 1989; Roth and Romeo 1992; Ahmed et al. 1995). A number of studies (Lusk and John, 2004; Brester et al., 2004; Loureiro, L. M. and Umberger, 2005; McCluskey et al. 2006; Colin et al. 2006) analyzed the effects of the country of origin on food products. Country of origin of a product is typically communicated to the consumers, as an extrinsic cue through the phrase of "product of" for certain food products such as fish products e.g. Rasco and Bledsoe (2005) and Ruben (2000) states that consumers use country of origin as an extrinsic cue to make inferences about the quality and safety of fresh meat products.

In the present research, it is proposed that consumers use country to infer the safety, which in its turn impacts perceived quality. Understanding the importance of country of origin as cue to consumers in product evaluation, the present research explores the effects of country of origin on consumers' food safety and quality perceptions.

**H1a:** Country of origin influences food safety perceptions of consumers.

**H1b:** Country of origin influences food quality perceptions of consumers.

*Region of origin*

While the influence of a product's country of origin has been the focus of prior research. The same influence is expected in other places of origin such as regions and provinces (Hauser, 1993; Balling, 1995) and trade zones and continents (Papadopoulos, 1993; Smith, 1993). Despite its potential to influence consumer perceptions, the use of the region of origin as a marketing tool has not received much attention in literature.

Region of origin (*e.g.* Alaskan fish) is defined as the region where a product is produced. Consumers' intention to choose a regional product is strongly influenced by consumers' attitude towards the regional image (Rasco and Bledsoe 2005; Ahmadov et al. 2006). Ahmadov (2006) suggests that consumers prefer the region cue to the country of origin cue, if the region cue helps them better assess product quality or if the product matches the image of region.

Using region of origin, marketers can exploit associations consumers have with a particular region. Since regions are more homogenous in terms of human and natural environmental factors compared countries, they may provide a more consistent image (Ittersum et al. 2003). Due to human and natural environmental factors, a region identity compared to country of origin may potentially provide consumers with a better opportunity for differentiating food products. For example, if consumers see the salmon product with a cue of "Product of USA" versus a cue of "Copper River salmon", they may prefer salmon from Copper River due to factors such as reputation for natural and environmental factors of ecologically cleanliness.

For example, Mus (2006) shows that consumers perceive the quality of meat from certain regions to be higher than that of other areas such that the region of origin serves as evidence that some meat has originated from regions free of animal diseases.

Understanding the importance of region of origin as cue to consumers in product evaluation, the present research explores the effects of region of origin on consumers food safety and quality perceptions.

**H2a:** Region of origin influences food safety perceptions of consumers.

**H2b:** Region of origin influences food quality perceptions of consumers.

*Mediating Effect of Food Safety Perception*

Zeithaml (1988) defines perceived food quality as the consumer's perception about the superiority or excellence of a product, which can be generalized to food products. Food quality perception is (1) different from objective or actual safety of the food product (Klaus 2005; Rasco and Bledsoe 2005) and (2) represents a higher level of abstraction than a specific attribute (Rasco and Bledsoe 2005). .

Although there is limited empirical support in the literature that focuses on the relationship between perceived food safety and perceived quality, the research does support this basic idea. Rasco and Bledsoe (2005) suggest that if a particular food or food substance is demonstrated to be unsafe, it might be assumed to be low quality. Spencer et al. (2006) consider that restaurants offering unsafe food products carry the reputation of a low quality food supplier. Therefore, consumers will infer that a food product is low quality if they have formed a belief that the food product is unsafe, for example potentially exposed to food borne pathogens. Understanding an important role of consumers' food safety perceptions in product evaluation, the present research explores the mediating effects of food safety perceptions between product of origin cues and food quality perceptions.

**H3a:** Perceived food safety mediates the relationship between product origin and perceived food quality.

*Mediating Effect of Food Quality Perception*

Willingness to buy is the likelihood of consumer's buying the product. The literature (Steenkamp 1990; Latvala and Kola 2000) suggests that consumers form individual beliefs about the quality of a food product and then determine their willingness to buy that food product based upon those beliefs. For example, Rasco and Bledsoe (2005) suggest that consumers will make the commitment of purchasing a product if they perceive that the product to be of good quality.

Based on the findings of the previous literature (Steenkamp 1990; Latvala and Kola 2000; Lusk and John, 2004; Brester et al., 2004; Loureiro and Umberger, 2005; McCluskey et al. 2006), perceived food quality is proposed to impact consumers' willingness to buy:

**H3b:** Perceived food quality mediates the relationship between perceived food safety and willingness to buy.

*The moderating Effects of Price and Product Sampling*

A large number of studies have exained the main and moderating effects of price on the product quality. One of the pioneering studies in the field was Scitovsky (1945) who argued that consumer's habit of judging product quality by price is rational, especially in the case of new brands. His argument is that a new commodity has no past reputation, and consumers reasonably infer its quality on the basis of its present price. Leavitt (1954) suggested that whether buyers perceive a positive price-quality relationship by observing that consumers often choose the higher price of two alternative brands when their only differential information is price. His findings are not consistent with the traditional demand theory that suggests demand curves to be invariably negatively sloped.

However, the literature (Akaah and Korgaonkar, 1988; Petroshius and Monroe, 1989; Mitchell and Greatorex 1989; Malone, 1990 and Asher 1992) demonstrates consumers use price to infer the quality of a product. Dodds et al. (1991) suggest that the subjective notion of price plays a dual role in product evaluation, and perception of value decline, as price increase beyond an acceptable range. In addition, the price is both an objective and subjective stimulus that affects buyers' product evaluations and attitudes. Rao and Monroe (1988) prove that consumers use price as extrinsic cue, when they are not familiar with the product or product's physical intrinsic cues.

In addition to the main effect of price, previous literature has examined the moderation effect of price. Jacoby et al. (1977) tested the effects of price in the presence and absence of brand name, and identify that when brand name as information is not available, consumers select the price from package panels as important information. Monroe (1976) studied specific price and cognitive effects on brand preferences, and analyzes the interactive effects of price differences and levels of brand familiarity on brand preferences. He concludes that changes in brand preferences due to a change in price from the comparison or reference price are asymmetric.

Wheatley and Chiu (1977) examined the effects of price as an indicator of quality together with other cues such as prestige store names, physical attributes of the product such as color, and income and education of consumers. They also find that the price is an indicator of quality but its effect is reduced or weakened in the presence of other cues.

All these arguments make us to believe that the price as extrinsic cues can affect the direction and strength of the relation between the cues such as country of origin and region of origin on the perception of safety. Since price and its different levels can cognized easily by consumers.

**H4a:** High (versus low) price will increase (or decrease) the effect of country origin on the perceived food safety.

**H4b:** High (versus low) price will increase (or decrease) the effect of region of origin on the perceived food safety.

Prior research (Jacoby, Olson, and Haddock 1971; Szybillo and Jacoby 1974; Valenzi and Andrews 1971) demonstrated that product sampling influences quality perceptions and improves it. Zeithaml (1998) proposed that intrinsic cues usually dominate extrinsic cues when the intrinsic attributes can be evaluated with high confidence at the time of purchase. Product sampling provides consumers with an opportunity to successfully evaluate the product increasing quality perceptions for certain cues (e.g., store brands, products from certain areas). Sprott and Shimp (2004) demonstrated that the improvement in quality perception of store brands of two distinct grocery products when consumers are provided opportunity to try these brands prior to judging quality. In addition, they revealed perceived quality differences among brands at each level of tasting experience (a low-quality versus a high quality version of the product) by enhancing the quality perceptions of a store brand only when the brand was of high (versus low) quality.

Based on the previous arguments, consumers rely more on intrinsic (or physically related product attributes) cues than on extrinsic cues if consumers can confidently make quality judgments.

**H5a:** Product sampling (versus non-sampling) will increase (or decrease) effect of product of origin on perceived food safety.

**H5b:** Product sampling (versus non-sampling) will increase (or decrease) effect of product origin on the perceived food safety when price is a moderator (three way interaction effect is expected).

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## REASEARCH METHODOLOGY

The present research used an experimental method and was implemented in three stages. In the first stage (pre-test I), an appropriate food product was selected for the experiment. In the second stage, appropriateness of food label, cues, price levels and items were examined. In the third stage, the actual experiment was conducted.

### *Pre-test I*

*Product selection* was determined by conducting a small pre-test (*N*=21) involving randomly selected students who ranked four products on a scale from 1 to 4, where 1 is most appropriate and 4 is least appropriate. Of 21 students, 11 chose the smoked salmon as most appropriate, 6 choose smoked beef, 3 chose smoked turkey and 1 choose smoked chicken. The focus on smoked meat products was due to (1) safe handling (if proper hygienic conditions are met) and no need for cooking, and (2) meat products are the most safety sensitive product as referred by some literature (Grunert et al. 2004; Nganje et al. 2005). Smoked salmon was selected as the product being the most appropriate for the experiment.

### *Pre-test II*

*Label appropriateness.* The present experiment uses a fictitious label, which has been developed by the researcher, and its appropriateness was assessed via a pre-test involving undergraduate students (*N*=32) from a food science class. The participants were asked three 7-point items: "This label is appropriate for a smoked salmon" anchored with Very Inappropriate and Very Appropriate; "When I see this label I think about smoked salmon" anchored with Strongly Disagree and Strongly Agree; "Based on the label, this

smoked salmon product is likely to be a quality product" anchored with Strongly Disagree and Strongly Agree. The results supported the appropriateness of the label for the experiment; Q1 ($M$ = 5.43, $SD$ = .80), Q2 ($M$ = 5.25, $SD$ = .91), and Q3 ($M$ = 5.15, $SD$ = .95).

*Price Level* was determined by asking undergraduate students from food science class ($N$=32) "to indicate the low or high price you are willing to buy for this product from the range given below – please, write down your price choices for high and low price anchored with two levels US $2.99 as the lowest and US $7.99 as the highest**".** The results show that lowest price choice was ($M$ = 3.10, $SD$ = .22) and the highest price choice was ($M$ = 5.95, $SD$ = 1.11). By using the information from pre-test and analyzing the actual price range of smoked salmon in the market, US $5.99 was used as the price and US $2.99 was used as low prcie.

*Brand familiarity* was measured to ensure that the fictitious brand on the label of the product ("Bear Crossing") does not necessarily impact perceived safety and quality. Note it is important to have a brand name on the label, since it more closely approximates the actual market situation. After being exposed to the brand name on the label, the participants were asked a single 7-point item ("this brand name is familiar to me") anchored with Very unfamiliar and Very familiar. The result shows that the brand was unfamiliar ($M$ = 1.84, $SD$ = .94) and therefore, the brand name is not expected to generate any safety nor quality perceptions.

## MAIN EXPERIMENT

*Participants and Design.* A total of 409 participants (53% female) were randomly assigned to the conditions of a **4** (origin: control or USA or British Columbia or Alaska) x **2**

(price: US $2.99 or US $5.99) x **2** (sample: Product Non-Sampling or Product Sampling) in the between participants design.

The experiment was conducted at a catering facility in a US University town in February month, 2008. The facility provided various food products to customers. In accordance with experimental protocols, the researcher invited everyone who entered into the facility to participate. The acceptance of the invitation (participation rate) was 92.62%. Participants immediately received a $3 discount coupon for any purchase at the facility following a ten-minute experiment session.

In accordance with experimental protocols, participants first provided consent by signing the standard consent forms. Next, they read the scenario and examined the label of the smoked salmon. Once finished, the product label was taken away together with the scenario, and participants were given a set of questions to answer with or without sample of the smoked salmon. The smoked salmon sample was served with two to three pieces of crackers and a glass of the water.

### *Measures*

*Independent Variables.* Perceived safety was measured with three 7-point items: "I think this smoked salmon is…"anchored with Not safe at All and Very Safe; "The risk of getting sick from this smoked salmon is low…" anchored with Strongly Disagree and Strongly Agree; "This smoked salmon is prepared so that it does not have any risk to my health…" anchored with Strongly Disagree and Strongly Agree. The measures for all conditions demonstrated high internal consistency ( $\alpha = .88$ ), which justifies to combining these items into a single measure.

Product Origin included four levels: Alaska, British Columbia, USA and control. Price was manipulated at high (US $5.99) and low (US $2.99) levels. Product sampling include 2 items , either consume have were or were not provided with a sample of the salmon.

*Dependent Variables.* Perceived quality dependent variable was measured with two 7-point items: "All things considered I would say this smoked salmon[22] has…" anchored with Poor Overall Quality and Excellent Overall Quality (Richardson et al. 1994); "This smoked salmon should be of ..." anchored with Very Poor Quality and Very Good Quality (Dodds et al. 1991). The measures demonstrated high internal consistency ( $\alpha = .90$ ), which is justified to combine the items into a single measure.

Willingness to buy was measured with three 7-point items: "The likelihood of purchasing this smoked salmon…" anchored with Very Low and Very High (Dodds et al. 1991); "My willingness to buy this smoked salmon is…" anchored with Very Low and Very High (Dodds et al. 1991); "The probability that I would consider buying this smoked salmon is…." anchored with Very Low and Very High (Dodds et al. 1991). The measures demonstrated high internal consistency ( $\alpha = .87$ ), which justified combinING the items into a single measure for the experiment.

***Estimations***

The present study estimates 21 models (see tables 1.2 and 1.3), which are specified from different combinations of available observations to estimate the hypothesized main and interaction effects. In addition, six of these models were used to test mediation effects. Both of tables (see tables 1.2 and 1.3) provide a detailed description of how those models

[22] The smoked salmon was added to items of scale to replace the term "this product".

constructed and specified. For example; the dependent variable of model 1 is perceived food safety and independent variables are both levels of price and all four product origin cues. The observations used for the model 1 are from non-sampling conditions with both levels of price and all four levels of product of origin.

## RESULTS

### *Manipulation check*

Participants indicated whether the cue on the label they had been exposed to included a country of origin cue or region of origin cue or nothing at all. For the country of origin cue (USA), region of origin cues (British Columbia and Alaska), 80% of participant correctly identified the cues.

Participants identified whether the sample of smoked salmon was real smoked salmon product, and 69% of participants identified that texture was real, flavor of participant identified that color was real, 75% of participants identified that taste was real, 63% of participants identified that appearance was real and 75% of participants identified that texture was real.

### *Mediation Analysis*

Following the methods proposed by Baron and Kenny (1986), I conduct the mediation analysis were conducted using two different estimation techniques: Two Way ANOVA for the categorical variables such as levels of price and cues, and Ordinary Least Squares (OLS) for the continuous variables such as perceived food safety, perceived food quality and willingness to buy. Mediations analyses involve the estimations of model 1 – 6.

*Mediation Analysis I.* In this section, the main objective is to measure mediating role of food safety in explaining the relationship between origin cues and perceived food quality.

Therefore, the following two Way ANOVA model is used to demonstrate the relationship between response variable and independent variables such as treatments.

(1) $$PQ_{ijt} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijt} \qquad \varepsilon_{ijt} \sim N(0, \sigma^2)$$

where $t = 1, ..., 25$; $i = 1, 2, 3, 4$; $j = 1, 2$,

In the equation 1, $t$ is the number of observation per $ij$ treatment where $i$ is assumed to be the levels of product origin cue such as control, USA, British Columbia and Alaska, and $j$ is the level of the price such as high and low (US $5.99 or US $2.99). We also define $\alpha_i$ as the effect (positive or negative) on the response due to the fact that the $i$ th level of product origin cue is observed, and $\beta_j$ is the effect (positive or negative) on the response due to the fact that $j$ th level of price is observed, and finally, $(\alpha\beta)_{ij}$ is the extra effect (positive or negative) on the response of observing levels $i$ and $j$ of product origin cues and prices together. Note that such specification of the model allows two primary sources of variation, namely, the two treatment factors (product origin cue and price).

(2) $$PQ_{ijt} = \mu + \alpha_i^1 + \beta_j^1 + (\alpha\beta)_{ij}^1 + \varepsilon_{ijt}$$

(3) $$PS_{ijt} = \mu + \alpha_i^2 + \beta_j^2 + (\alpha\beta)_{ij}^2 + \varepsilon_{ijt}$$

(4) $$PQ_{ijt} = \mu + \alpha_i^3 + \beta_j^3 + (\alpha\beta)_{ij}^3 + PS_{ijt} + \varepsilon_{ijt}$$

where $PQ_{ijt}$ is the response variable for observation $t$ of the treatment at level $i$ of cues and level $t$ of price, and is the measure of perceived food quality. $PS_{ijt}$ is perceived food safety, which enters into equation 3 as response variable, and independent variable into the equation 4. In addition, we also define the effects generated from the origin cue with different upper subscripts to be able to differentiate them across equations (2) – (4). Note

that all variables except perceived food safety and perceived food quality are categorical. We also know that the following four conditions must be met to establish the mediation effect as proposed by Baron and Kenny (2006):

In equation 2, there must be an overall effect of cues, $\alpha_i^1$ and prices, $\beta_i^1$ and interaction of prices and cues, $(\alpha\beta)_{ij}^1$ on perceived food quality, $PQ_{ijt}$. In equation 3, there must be an effect of cues, $\alpha_i^2$ and prices, $\beta_j^2$ and interaction of prices and cues $(\alpha\beta)_{ij}^2$ on perceived food safety, $PS_{ijt}$. In equation 4, there must be an effect of the perceived food safety on the outcome controlling for the effect of cues, $\alpha_i^3$ and prices, $\beta_j^3$ and interaction of prices and cues, $(\alpha\beta)_{ij}$. In equation 3, the effect of the cues, $\alpha_i^3$ and prices, $\beta_j^3$ and interaction of prices and cues, $(\alpha\beta)_{ij}$ are insignificant. Note that these equations are specified based on the models 1 – 3 in table 1.2.

*Mediation Analysis II.* Based on discussion in previous section, I use OLS estimation techniques to test the hypothesized mediating role of perceived food quality between perceived food safety and willingness to buy. The advantage of OLS estimation over two-way ANOVA is related to the efficiency of the test with regard to the continuous variables, and I define OLS equations as follows:

(5) $WTB = \beta_{10} + \beta_{11}PS + e_1$

(6) $PQ = \beta_{20} + \beta_{21}PS + e_2$

(7) $WTB = \beta_{30} + \beta_{31}PQ + \beta_{32}PS + e_3$

The same conditions as described before must be met to satisfy the mediation effect of the perceived food quality. Note that these equations are specified in models 4-6 from the table 1.2.

## RESULTS FOR MEDIATION ANALYSIS

*Results for Mediation Analysis I*

Mediation effect hypothesized in H3.a is estimated, which proposes that perceived food safety fully explains the relationship between product origin and perceived food quality. The results for the equation 2 are provided in the table 1.4, indicating that all effects are significant, which involves the main and interaction effects. Estimated results of model I (see table 2.3) show that the main effects of product origin $\left(F_{4.524}, p < 0.004\right)$, price $\left(F_{31.240}, p < 0.000\right)$ and interaction effect of price with product origin $\left(F_{2.834}, p < 0.039\right)$ on perceived food quality are significant. Estimated results of model II suggests that the main effects of product origin $\left(F_{4.298}, p < 0.006\right)$, price $\left(F_{50.811}, p < 0.000\right)$ and interaction effect of price with product origin $\left(F_{4.123}, p < 0.007\right)$ on perceived food safety are significant. Estimated results of model III suggest that the main effects of product origin $\left(F_{1.012}, p > 0.389\right)$, price $\left(F_{1.213}, p > 0.272\right)$ and interaction effect of price with product origin $\left(F_{1.134}, p > 0.337\right)$ on perceived food quality are insignificant but the main effect of perceived food safety $\left(F_{144.455}, p < 0.000\right)$ on perceived food quality is significant. All of those results prove existence of full mediation evidence in hypothesis 3.a.

Equations (5) - (6) were estimated to satisfy the mediation effect of perceived food quality between perceived food safety and willingness to buy. Estimated results for the equation 5 (see table 1.4) show that main effect of perceived food quality on willingness to

buy is significant $(p < 0.0001)$ , and the normality assumption is ( $p > .5450$ ) satisfied, and equality of variances is satisfied by $p < .6053$ .[23] Estimated results for equation 6 (see table 1.5) suggests that main effect of perceived food safety effect is significant $(p < 0.0001)$, and the normality assumption is weakly ( $p > .043$ ) satisfied, and equality of variances is satisfied by $p < .069$ . Finally, the results for the equation 7 (see table 1.5) show that main effects of both perceived food safety $(p < .0057)$ and perceived food quality $(p < .0001)$ are significant, and normality assumption is ( $p > .1575$ ) satisfied, and equality of variances is satisfied by $p < .5836$ for perceived food safety and $p > .7856$ for perceived food quality. However, the results obtained from the equation (7) show that the effect of perceived food safety from equation (5) to (7) is weakened from $(p < .0001)$ to $(p < .0057)$. These results indicate that there exists no full mediation but possibly partial mediation. Sobel test was conducted to test possible partial mediation effect, following recommendations by Baron and Kenny (1986). The result from Sobel test is $(p = 1e-8)$, which is a small effect to claim as partial mediation in hypothesis 3.b.

Two main conclusions were reached; (a) the perceived food safety is a mediator and explains fully relationship between cues about the origin of the product and prices and perceived food quality, and (b) the perceived food quality is not a mediator and does not explain the relationship between perceived food safety and willingness to buy. In other terms, results support hypothesis 3a but fail to support hypothesis 3b.

[23] Levenes Test for Equality of Variances

## HYPOTHESIS TESTING

### *Main and Interaction Effects on Perceived Food Safety*

*Country of Origin Effect* is estimated using model 8. Estimated results for Model 8 (see table 1.6) show that the main effects of country of origin $(F_{10.114}, p < 0.002)$ on perceived food safety is significant supporting H1.a, price $(F_{7.330}, p < 0.008)$ on perceived food safety are significant but interaction effect of price with country of origin $(F_{0.006}, p > 0.939)$ on perceived food safety is insignificant failing to support H4.a. Graphical representation of model 11 on figure 1.3 suggests that perceived food safety for both low priced and high priced products increases from control to country of origin.

*Region of Origin Effects* are estimated using models 7, 9. Estimated results for Model 7 (see table 1.6) show that the main effects of region of origin - Alaska $(F_{7.021}, p < 0.009)$ on perceived food safety is significant supporting H2.a, price $(F_{20.588}, p < 0.000)$ and interaction effect of price with region of origin $(F_{5.182}, p < 0.025)$ on perceived food safety are significant supporting H4.b. Graphical representation of model 7 on figure 1.2 suggests that perceived food safety for high priced product significantly increases from control to Alaska but a little increase observed for low priced product.

Estimated results for Model 9 (see table 1.6) show that main effect of region of origin – British Columbia $(F_{1.127}, p > 0.291)$ on perceived food safety is insignificant failing to support H2.a, but main effect of price $(F_{23.436}, p < 0.000)$ and interaction effect of price with foreign region of origin $(F_{6.007}, p < 0.016)$ on perceived food are significant supporting H4.b. Graphical representation of model 9 shown on figure 1.4 suggests that perceived food

safety for high priced product significantly increases from control to British Columbia but sufficient decrease observed for low priced products.

### *Main Effects on Perceived Food Quality*

*Country of Origin Effect* is estimated using model 11. Estimated results for Model 10 (see table 1.7) show that the main effects of country of origin – USA on perceived food quality $\left(F_{9.719}, p < 0.002\right)$ is significant supporting H2.a.

*Region of Origin Effects* are estimated using models 10, 12. Estimated results for Model 10 (see table 1.7) show that the main effects of region of origin - Alaska on perceived food quality $\left(F_{7.957}, p < 0.006\right)$ is significant on supporting H2.b.

Estimated results for Model 12 (see table 1.7) show that main effect of region of origin – British Columbia $\left(F_{1.719}, p > 0.193\right)$ on perceived food quality is insignificant failing to support H2.b.

### *Main and Interaction Effects on Perceived Food Safety*

*Country of Origin Effect* is estimated using model 14. Estimated results for Model 14 (see table 1.8) show that the main effects of country of origin $\left(F_{10.998}, p < 0.001\right)$ on perceived food safety is significant supporting H5.a, sampling $\left(F_{0.00}, p > 0.993\right)$ on perceived food safety and interaction effect of sampling with country of origin $\left(F_{0.028}, p > 0.868\right)$ on perceived food safety are insignificant failing to support H5.a.

*Region of Origin Effects* are estimated using models 13, 15. Estimated results for Model 13 (see table 1.8) show that the main effects of region of origin - Alaska $\left(F_{6.096}, p < 0.001\right)$ on perceived food safety is significant supporting H2.a, sampling

$(F_{17.618}, p < 0.000)$ and interaction effect of price with region of origin $(F_{6.080}, p < 0.001)$ on perceived food safety are significant supporting H5.a.

Estimated results for Model 15 (see table 1.8) show that main effect of region of origin – British Columbia $(F_{1.127}, p > 0.291)$ on perceived food safety is insignificant failing to support H5.a, but main effect of sampling $(F_{6.324}, p < 0.014)$ and interaction effect of price with region of origin $(F_{7.081}, p < 0.009)$ on perceived food are significant supporting H5.a.

*Three Way Interaction Effects* were estimated through model 13 – 15 using three-Way ANOVA technique, which is specified as follows:

$$(8) \qquad PS_{ijkt} = \mu + \alpha_i + \beta_j + \gamma_k + (\alpha\beta)_{ij} + (\alpha\gamma)_{ik} + (\beta\gamma)_{jk} + (\alpha\beta\gamma)_{ijk} + \varepsilon_{ijkt}$$

where only $\gamma_k$ is added as the factor with $k$ levels, which is denoted sampling with two level such as sampling versus non-sampling. The response variable in LHS is perceived food safety and independent variables are price, sampling, cues, interaction of price with product origin, interaction of price with sampling, interaction of product origin with sampling, and interaction of price with product origin and sampling. The results shown on table 1.9 indicate that main effects of product origin $(F_{12.013}, p < 0.000)$, price $(F_{79.611}, p < 0.000)$, sampling $(F_{22.051}, p < 0.000)$ on perceived food safety are significant. Interaction effects of product origin with sampling $(F_{2.976}, p < 0.032)$, sampling with price and product origin $(F_{2.864}, p < 0.091)$, price with sampling $(F_{5.108}, p < 0.002)$ are also significant supporting H5b. But interaction effect of product origin and price $(F_{1.637}, p < 0.180)$ is insignificant. Graphically, results of model 13 (see figure 1.5 and 1.6)

show that perceived food safety for high priced product increases from one level to another level of product origin, but decreases for low priced product. Note that results for a low priced product are different across sampling versus non-sampling plot spaces.

## DISCUSSION AND CONCLUSIONS

The results from present study must be examined in light of a number of limitations. The data were collected through a questionnaire rather than through observations of a real-life purchase situation. A single food product was used in the experiment. Effects of a single country and two region origins on consumers' perceptions were measured to represent the country of origin and region of origin effects. The survey was conducted in a US University town.

However, the randomization of respondents and high response rate improved sample selection bias and sufficiently contributed to the validity of findings. Pre-test conducted to measure the appropriateness of food product and all levels of information cues (product origin and price) for this experiment allows to convince the reader about potential validity of findings from smoked salmon experiment to other food products.

Results from estimation and analysis in previous section suggest that country of origin effect on perceived food safety and perceived food quality found to be significant supporting H1a and H1b (see tables 1.6 and 1.7). These results are consistent with previous quality perception literature (White and Cundiff, 1978; White, 1979; Han and Terpstra 1988; Ettenson et al. 1988; Hong and Wyer 1989; Hong 1989; Johansson 1989; Roth and Romeo 1992; Ahmed et al. 1995) suggesting that consumers rely on country of origin effect to infer the quality of food product. The present research was able to extend this result to

perceived food safety concluding that consumers use country of origin cue as way to infer the safety of food product.

Results from estimation and analysis for the main region of origin effects provide different perspectives where as if product is identified with Alaska, the region of origin is significant supporting H2a and H2b (see table 1.6 and 1.7) but it is not significant if it is identified with British Columbia failing to support H2a and H2b (see table 1.6 and 1.7). These results are also consistent with quality perception literature (Ittersum et al. 2003; Mus 2006). But they are also extended to safety perception suggesting that consumers highly rely on identity of the region, which is close to their location. Therefore, they associate safety and quality with Alaska but not with British Columbia.

In addition, the findings suggest that consumers must perceive the safety of food to infer its quality. In other words, perception of food safety explains effect of country of origin and region of origin effects (supporting H3a) on perception of food quality (see table 1.4). This result contributes to previous literature studying quality perception of food in evaluation process where perception of food safety was probably implicitly assumed. However, difference across perception of various extrinsic cues such as brand, advertising and label, which were not tested in present experiment may provide opposite or possibly confirm these findings.

Insignificant result for mediation effect of perceived quality (H3.b) means that consumers determine their willingness to buy not only through perception of food quality but also perception of food safety (see table 1.5). Both of these mediation effects might be analyzed in future involving different products and more extrinsic cues.

Summary of results (see tables 1.5 and 1.6) for H4 a and H4b suggest that price has a significant moderation effect for region of origin. [24] Price does not moderate a functional relationship between country of origin cues, and perceived food safety (Baron and Kenny, 1986). Present study identifies three-way interaction effects (see tables 1.9), which are complicated to interpret.

Findings from tables 1.9 show that product sampling does not affect the direction of relationship between product origin and perceived food safety in the presence of high price. But the results change from high price to low price conditions where an opportunity to sample product shifts dramatically perceived food safety up (see figure 1.4 and 1.5). Intuitively, due to the low price on the label, consumers were not sure about quality and safety of food, and therefore, their likelihood of purchasing food was low. Once they obtained opportunity to taste the product, they found low price for sampled product as a good deal (or discount).

Theoretical and empirical evidence from the present study could be expanded into new research investigating effects of multi-cues such as intrinsic and extrinsic attributes of food. Such effort including the current may educate managers to successfully promote their food products using mostly preferred cues and create a number of potential research perspectives.

[24] Since prices is introduced as a moderator main effect is not hypothesized.

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**Figure. 1.1. Conceptual Framework**

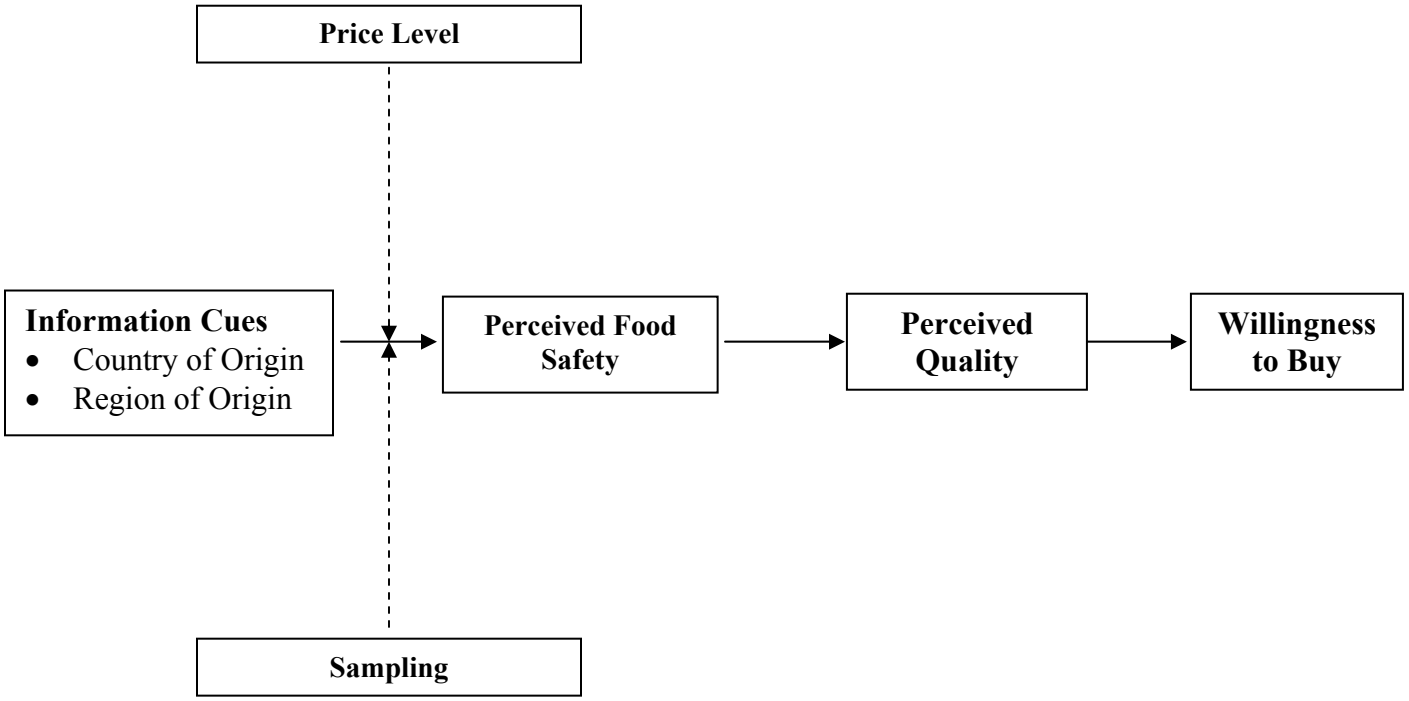


**Table 1.1. Four Control Conditions and Twelve Experimental Treatments**

| Experiment Treatments and Conditions | | | No of Subjects |
|---|---|---|---|
| **Product Sampling** | **Price Level** | **Product Origin** | |
| Sampling | $2.99 | Control | 26 |
| Sampling | $2.99 | USA | 25 |
| Sampling | $2.99 | British Columbia | 25 |
| Sampling | $2.99 | Alaska | 25 |
| Sampling | $5.99 | Control | 24 |
| Sampling | $5.99 | USA | 25 |
| Sampling | $5.99 | British Columbia | 25 |
| Sampling | $5.99 | Alaska | 25 |
| Non-Sampling | $2.99 | Control | 26 |
| Non-Sampling | $2.99 | USA | 26 |
| Non-Sampling | $2.99 | British Columbia | 25 |
| Non-Sampling | $2.99 | Alaska | 25 |
| Non-Sampling | $5.99 | Control | 26 |
| Non-Sampling | $5.99 | USA | 26 |
| Non-Sampling | $5.99 | British Columbia | 25 |
| Non-Sampling | $5.99 | Alaska | 25 |
| | | Total | 404 |

**Table 1.2. List of Estimated Models**

| N. of Model | Dependent Variable | Observations from Conditions | Independent Variables | Interaction terms |
|---|---|---|---|---|
| Model 1 | Perceived Food Quality | No Sampling<br>Product Origin - All[25]<br>Price – both levels | Price<br>Product Origin (All) | Price X Product Origin |
| Model 2 | Perceived Food Safety | No Sampling<br>Product Origin – All<br>Price – both levels | Price<br>Product Origin (All) | Price X Product Origin |
| Model 3 | Perceived Food Quality | No Sampling<br>Product Origin - All<br>Price – both levels | Price<br>Product Origin (All)<br>Perceived Food Safety | Price X Product Origin |
| Model 4 | Willingness to buy | Both Sampling and non-sampling<br>Product Origin - All<br>Price – both levels | Price<br>Product Origin (All) | Price X Product Origin |
| Model 5 | Perceived Food Quality | Both Sampling and non-sampling<br>Product Origin – All<br>Price – both levels | Price<br>Product Origin (All) | Price X Product Origin |
| Model 6 | Willingness to buy | Both Sampling and non-sampling<br>Product Origin - All<br>Price – both levels | Price<br>Product Origin (All)<br>Perceived Food Quality | Price X Product Origin |
| Model 7 | Perceived Food Safety | No Sampling<br>Product Origin (Alaska and Control)<br>Price – both levels | Price<br>Product Origin | Price X Product Origin |
| Model 8 | Perceived Food Safety | No Sampling<br>Product Origin (USA and Control) Price – both levels | Price<br>Product Origin | Price X Product Origin |
| Model 9 | Perceived Food Safety | No Sampling<br>Product Origin (British Columbia and Control)<br>Price – both levels | Price<br>Product Origin | Price X Product Origin |

[25] It means that all four conditions of product origin such as Control, Alaska, USA and British Columbia

**Table 1.3. Contd. List of Estimated Models**

| | | | | |
|---|---|---|---|---|
| Model 10 | Perceived Food Quality | No Sampling<br>Product Origin (Alaska and Control)<br>Price – both levels | Price<br>Product Origin | Price X Product Origin |
| Model 11 | Perceived Food Quality | No Sampling<br>Product Origin (USA and Control) Price – both levels | Price<br>Product Origin | Price X Product Origin |
| Model 12 | Perceived Food Quality | No Sampling<br>Product Origin (British Columbia and Control)<br>Price – both levels | Price<br>Product Origin | Price X Product Origin |
| Model 13 | Perceived Food Safety | No sampling<br>Sampling<br>Product Origin (Alaska and Control)<br>Low price | Sampling<br>Product Origin | Sampling X Product Origin |
| Model 14 | Perceived Food Safety | No sampling<br>Sampling<br>Product Origin (USA and Control)<br>Low Price | Sampling<br>Product Origin | Sampling X Product Origin |
| Model 15 | Perceived Food Safety | No sampling<br>Sampling<br>Product Origin (British Columbia and Control)<br>Low price | Sampling<br>Product Origin | Sampling X Product Origin |
| Model 16 | Perceived Food Safety | No Sampling<br>Sampling<br>Product Origin – All<br>Price – both levels | Sampling<br>Price<br>Product Origin (All) | Price X Product Origin<br>Price X Sampling<br>Sampling X Product Origin<br>Sampling X Price X Product Origin |

**Table 1.4. Two-Way ANOVA (Mediation Analysis I)**

| Variables | Type III SS | df | Mn. Sq. | F | Pr>F |
|---|---|---|---|---|---|
| *Model 1* | | | | | |
| Intercept | 3831.80 | 1 | 3831.800 | 2351.687 | 0.000 |
| Price*** | 50.90 | 1 | 50.902 | 31.240 | 0.000 |
| Product Origin*** | 22.114 | 3 | 7.371 | 4.524 | 0.004 |
| Product Origin X Price** | 13.855 | 3 | 4.618 | 2.834 | 0.039 |
| R Squared | 0.212 | | | | |
| Adjusted R Squared | 0.184 | | | | |
| *Model 2* | | | | | |
| Intercept | 3974.279 | 1 | 3974.279 | 2331.300 | 0.000 |
| Price*** | 86.620 | 1 | 86.620 | 50.811 | 0.000 |
| Product Origin*** | 21.982 | 3 | 7.327 | 4.298 | 0.006 |
| Product Origin X Price*** | 21.085 | 3 | 7.028 | 4.123 | 0.007 |
| R Squared | 0.277 | | | | |
| Adjusted R Squared | 0.251 | | | | |
| *Model 3* | | | | | |
| Perceived Food Safety*** | 135.903 | 1 | 135.903 | 144.455 | .000 |
| Price | 1.142 | 1 | 1.142 | 1.213 | .272 |
| Product Origin | 2.856 | 3 | .952 | 1.012 | .389 |
| Product Origin X Price | 3.199 | 3 | 1.066 | 1.134 | .337 |
| R Squared | 0.547 | | | | |
| Adjusted R Squared | 0.529 | | | | |

** and*** denote statistically significant at 5 and 1% level.

**Table 1.5. OLS estimation (Mediation Analysis II)**

| Variables | Coef. | Std.Err. | t value | Pr > F |
|---|---|---|---|---|
| *Model 4* | | | | |
| Intercept | 1.9133 | 0.2458 | 7.78 | 0.0001 |
| Perceived Quality *** | 0.5000 | 0.0527 | 9.50 | 0.0001 |
| R-Square | 0.3086 | Ad. R-Square | | 0.3052 |
| *Model 5* | | | | |
| Intercept | 1.3215 | 0.2105 | 6.28 | 0.0001 |
| Perceived Safety*** | 0.6824 | 0.0451 | 15.11 | 0.0001 |
| R-Square | 0.5307 | Ad. R-Square | | 0.5284 |
| *Model 6* | | | | |
| Intercept | 1.3306 | 0.24944 | 5.33 | 0.0001 |
| Perceived Safety*** | 0.1996 | 0.07143 | 2.80 | 0.0057 |
| Perceived Quality*** | 0.4409 | 0.07143 | 5.78 | 0.0001 |
| R-Square | 0.4072 | Ad. R-Square | | 0.4013 |

*** denotes statistically significant at 1% level.

**Table 1.6. Two-Way ANOVA for Perceived Safety**

| Variables | Type III SS | df | Mn. Sq. | F | Pr>F |
|---|---|---|---|---|---|
| *Model 7* | | | | | |
| Intercept | 1918.257 | 1 | 1918.257 | 933.721 | 0.000 |
| Price*** | 42.297 | 1 | 42.297 | 20.588 | 0.000 |
| Product Origin (Alaska)*** | 14.425 | 1 | 14.425 | 7.021 | 0.009 |
| Product Origin X Price *** | 10.645 | 1 | 10.645 | 5.182 | 0.025 |
| R Squared | 0.248 | | | | |
| Ad. R Squared | 0.225 | | | | |
| *Model 8* | | | | | |
| Intercept | 1967.331 | 1 | 1967.331 | 1271.048 | 0.000 |
| Price*** | 11.345 | 1 | 11.345 | 7.330 | 0.008 |
| Product Origin (USA)*** | 15.655 | 1 | 15.655 | 10.114 | 0.002 |
| Product Origin X Price*** | 0.009 | 1 | 0.009 | 0.006 | 0.939 |
| R Squared | 0.149 | | | | |
| Ad. R Squared | 0.123 | | | | |
| *Model 9* | | | | | |
| Intercept | 1717.201 | 1 | 1717.201 | 933.987 | 0.000 |
| Price*** | 43.089 | 1 | 43.089 | 23.436 | 0.000 |
| Product Origin (Br. Col) | 2.071 | 1 | 2.071 | 1.127 | 0.291 |
| Product Origin X Price** | 11.044 | 1 | 11.044 | 6.007 | 0.016 |
| R Squared | 0 .235 | | | | |
| Ad. R Squared | 0 .212 | | | | |

** and*** denote statistically significant at 5 and 1% level.

**Figure 1.2. Estimated Perceived Food Safety**

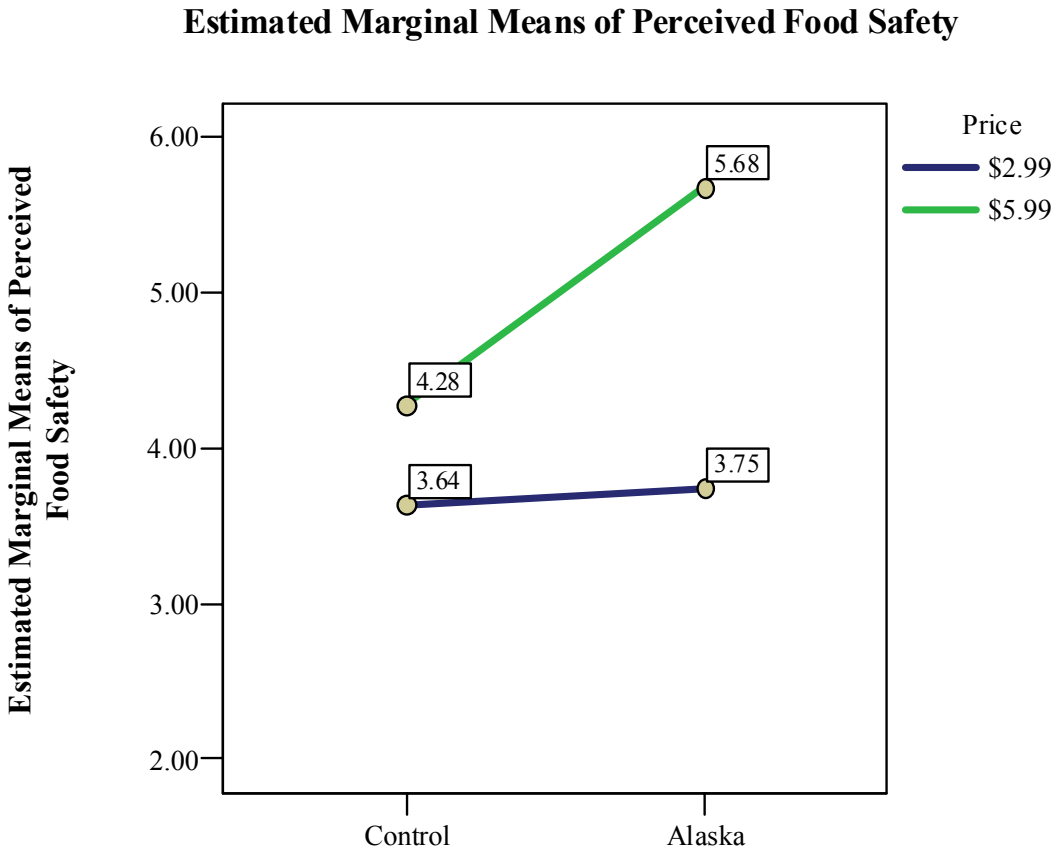


**Figure 1.3. Estimated Perceived Food Safety**

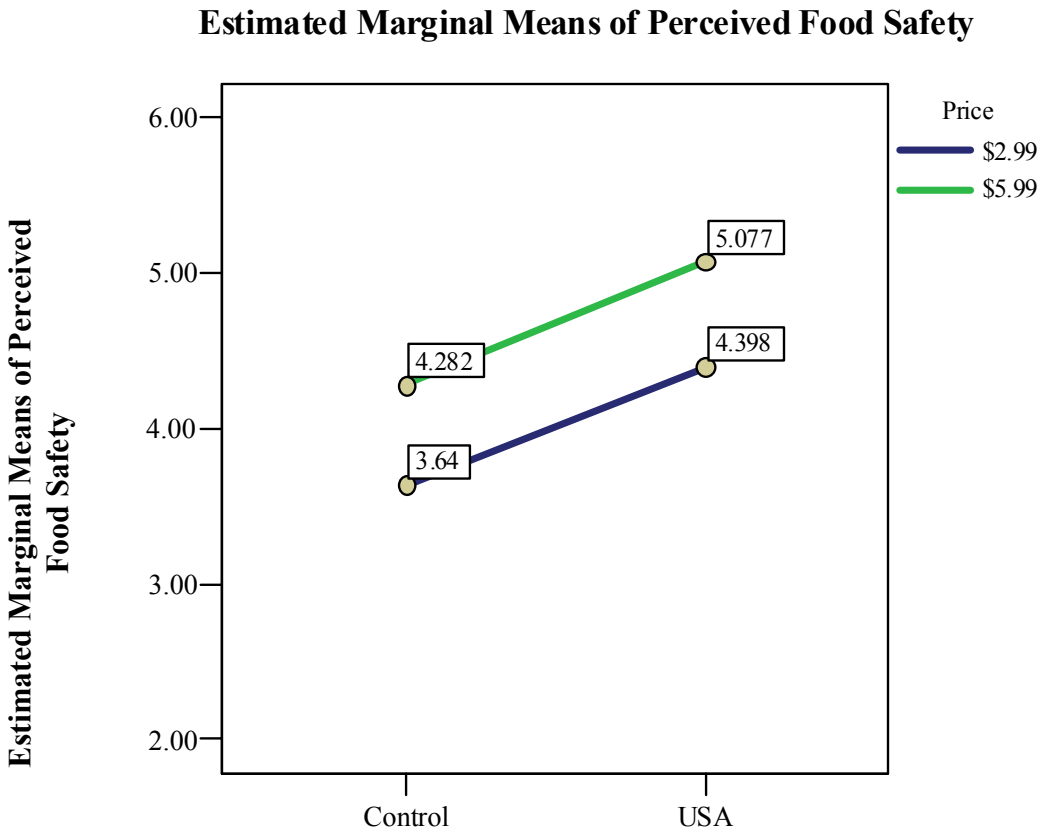


**Figure 1.4 Estimated Perceived Food Safety**

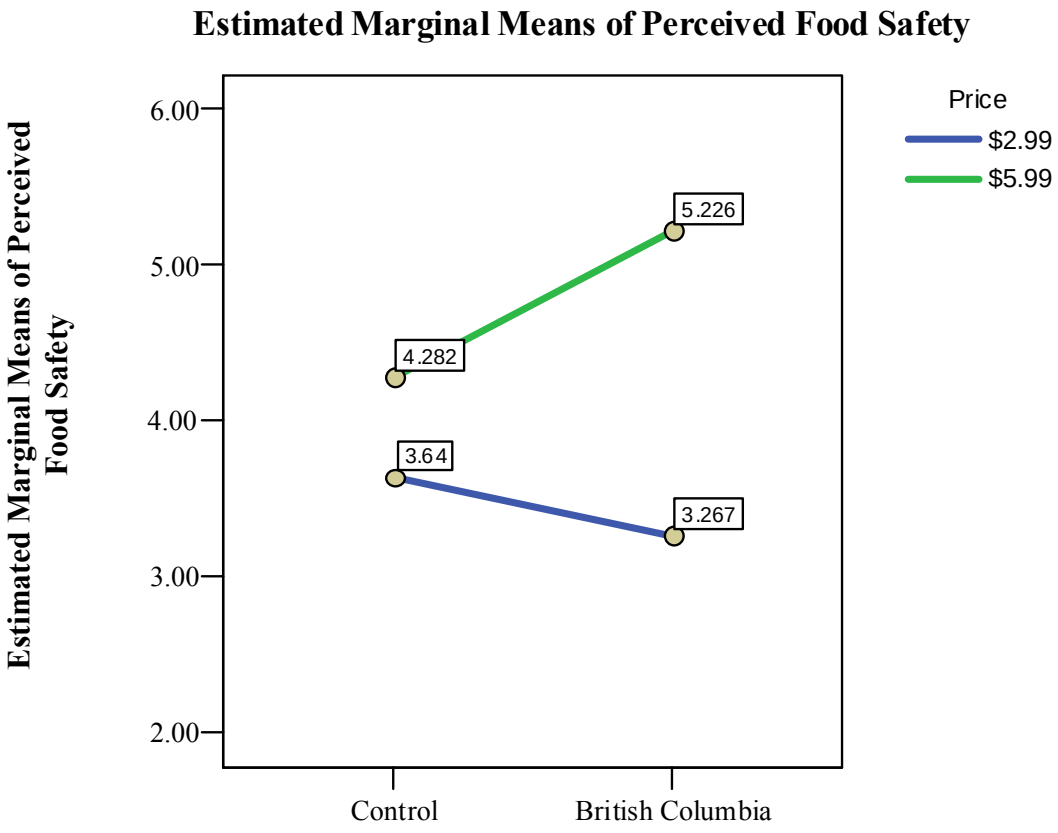


**Table 1.7. Two-Way ANOVA for Perceived Quality**

| Variables | Type III SS | df | Mn. Sq. | F | Pr>F |
|---|---|---|---|---|---|
| *Model 10* | | | | | |
| Intercept | 1826.863 | 1 | 1826.863 | 1002.489 | 0.000 |
| Price*** | 30.392 | 1 | 30.392 | 16.677 | 0.000 |
| Product Origin (Alaska)*** | 14.500 | 1 | 14.500 | 7.957 | 0.006 |
| Product Origin X Price *** | 12.068 | 1 | 12.068 | 6.622 | 0.012 |
| R Squared | 0.239 | | | | |
| Ad. R Squared | 0.216 | | | | |
| *Model 11* | | | | | |
| Intercept | 1887.010 | 1 | 1887.010 | 1081.262 | 0.000 |
| Price** | 7.538 | 1 | 7.538 | 4.320 | 0.040 |
| Product Origin (USA)*** | 16.962 | 1 | 16.962 | 9.719 | 0.002 |
| Product Origin X Price | .471 | 1 | .471 | .270 | 0.604 |
| R Squared | 0.149 | | | | |
| Ad. R Squared | 0.123 | | | | |
| *Model 12* | | | | | |
| Intercept | 1658.306 | 1 | 1658.306 | 891.230 | 0.000 |
| Product Origin (Br. Col) | 3.198 | 1 | 3.198 | 1.719 | 0.193 |
| Price*** | 15.189 | 1 | 15.189 | 8.163 | 0.005 |
| Product Origin X Price | 3.453 | 1 | 3.453 | 1.856 | 0.176 |
| R Squared | 0 .106 | | | | |
| Ad. R Squared | 0 .078 | | | | |

** and*** denote statistically significant at 5 and 1% level.

**Table 1.8. Two-Way ANOVA for Perceived Safety (Product Sampling)**

| Variables | Type III SS | df | Mn. Sq. | F | Pr>F |
|---|---|---|---|---|---|
| *Model 13* | | | | | |
| Intercept | 3503.584 | 1 | 3503.584 | 1977.227 | 0.000 |
| Product Origin (Alaska)*** | 32.405 | 3 | 10.802 | 6.096 | 0.001 |
| Sampling*** | 31.219 | 1 | 31.219 | 17.618 | 0.000 |
| Sampling X Price *** | 32.320 | 3 | 10.773 | 6.080 | 0.001 |
| R Squared | 0.216 | | | | |
| Ad. R Squared | 0.188 | | | | |
| *Model 14* | | | | | |
| Intercept | 1664.121 | 1 | 1664.121 | 1117.890 | 0.000 |
| Product Origin (USA)*** | 16.372 | 1 | 16.372 | 10.998 | 0.001 |
| Sampling | .000 | 1 | 0.000 | 0.000 | 0.993 |
| Sampling X Price | .042 | 1 | 0.042 | 0.028 | 0.868 |
| R Squared | 0.100 | | | | |
| Ad. R Squared | 0.073 | | | | |
| *Model 15* | | | | | |
| Intercept | 1457.607 | 1 | 1457.607 | 844.491 | 0.000 |
| Product Origin (Br. Col) | 2.598 | 1 | 2.598 | 1.505 | 0.223 |
| Sampling** | 10.915 | 1 | 10.915 | 6.324 | 0.014 |
| Sampling X Price*** | 12.222 | 1 | 12.222 | 7.081 | 0.009 |
| R Squared | 0 .130 | | | | |
| Ad. R Squared | 0 .103 | | | | |

** and*** denote statistically significant at 5 and 1% level.

**Table 1.9. Estimated Results for Three-Way ANOVA for Perceived Safety**

| Variables | Type III SS | df | Mn. Sq. | F | Pr>F |
|---|---|---|---|---|---|
| *Model 16* | | | | | |
| Intercept | 8931.313 | 1 | 8931.313 | 5867.013 | 0.000 |
| Sampling*** | 33.568 | 1 | 33.568 | 22.051 | 0.000 |
| Price*** | 121.191 | 1 | 121.191 | 79.611 | 0.000 |
| Product Origin (All)*** | 54.860 | 3 | 18.287 | 12.013 | 0.000 |
| Sampling X Price* | 4.360 | 1 | 4.360 | 2.864 | 0.091 |
| Sampling X Pd. Origin** | 13.591 | 3 | 4.530 | 2.976 | 0.032 |
| Product Origin X Price | 7.476 | 3 | 2.492 | 1.637 | 0.180 |
| Sample. X Price. X Pd. Org*** | 23.329 | 3 | 7.776 | 5.108 | 0.002 |
| R Squared | 0.304 | | | | |
| Ad. R Squared | 0.277 | | | | |

** and*** denotes statistically significant at 5 and 1% level.

**Figure 1.5. Estimated Perceived Food Safety in Non-Sampling Condition**

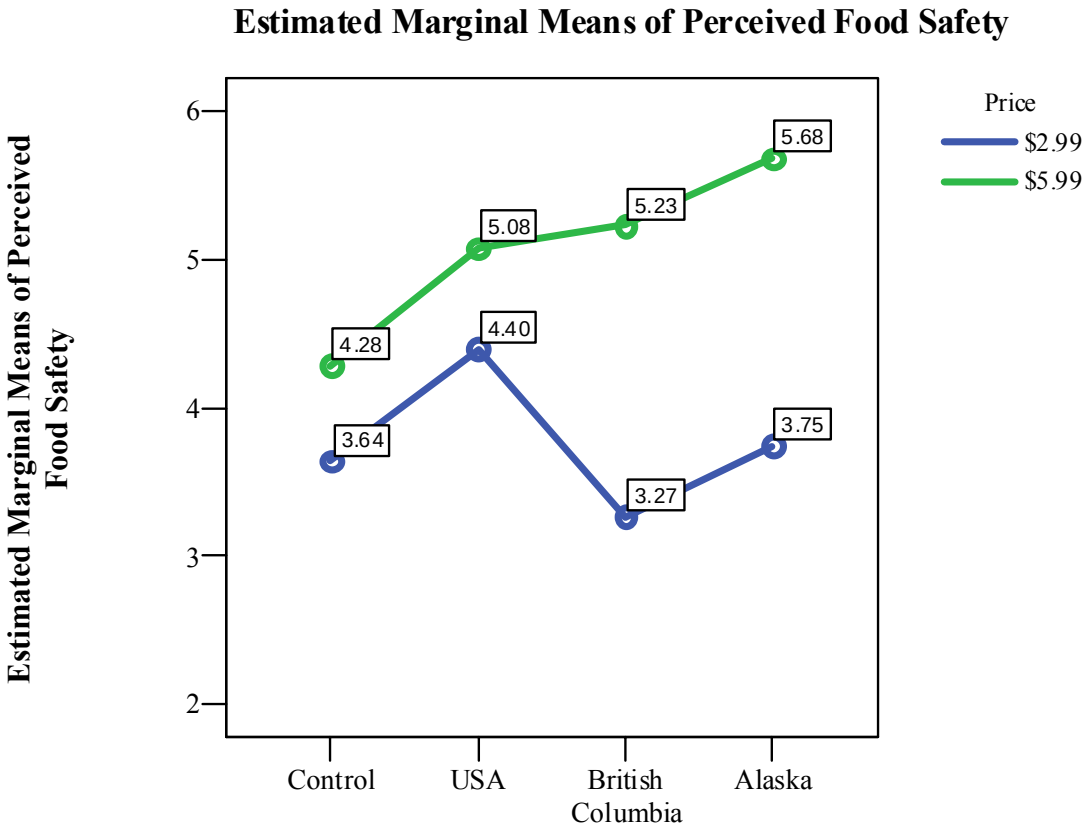
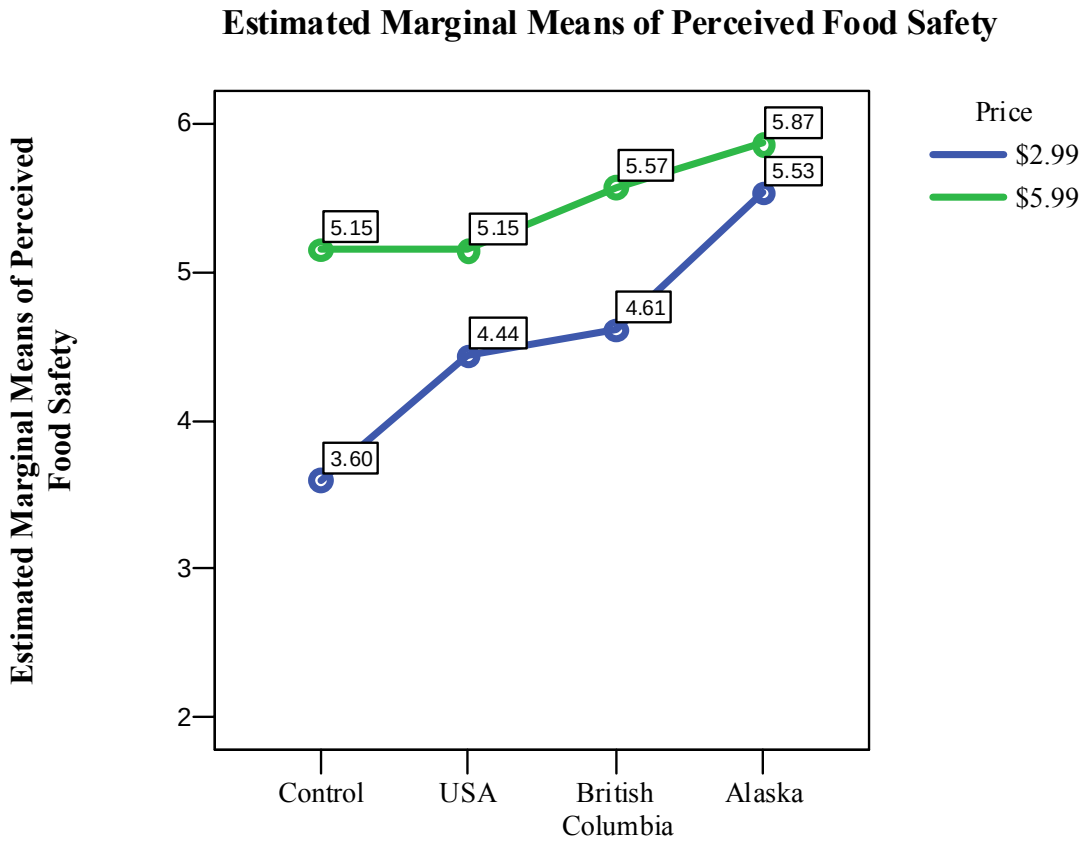


**Figure 1.6. Estimated Perceived Food Safety in Sampling Condition**



# CHAPTER FOUR

# CONSUMERS' PREFERENCES FOR SMOKED SALMON: CONJOINT BASED EMPIRICAL EVIDENCE


## Summary

A conjoint based choice experiment was conducted to elicit consumer preferences for various smoked salmon attributes. Three smoked salmon attributes: production method, product origin and price, were used to create twenty four smoked salmon alternatives. All parameters for preferences were estimated by random parameters logit to overcome the problem of irrelevant independence of alternatives. The results suggest that consumers' preferences are positively affected if the origin of product is identified with Alaska and negatively affected if identified with USA. The estimations show consumer preferences for cold smoked wild salmon over smoked farmed salmon. The study computes the trade-offs between attribute levels showing that consumers are willing to pay premium for wild smoked salmon and smoked salmon from Alaska but want discount for British Columbia.

**Key words:** smoked salmon, consumer preferences, choice-based conjoint experiment, random parameters logit.

**Introduction**

Salmon has been an important part of the human diet since pre-historic times as can be seen in Neanderthal cave paintings in France and North America. Native Americans in the United States and those living in Canada relied upon salmon as source of food for thousands of years (Knapp et al. 2007). There are five primary species of Pacific salmon (Chinook – *Oncorhynchus tshawytscha*, sockeye - *O. nerka*, coho - *O. kisutch*, pink – *O. gorbuscha* and chum – *O. keta*). Atlantic salmon are primarily from aquaculture with a very limited but growing amount of fish from a wild harvest.

The salmon industry has experienced dramatic changes over the past two decades. Two of the major trends give rise to this. The first is the rapid and sustained growth in farmed salmon around the world. Salmon from aquaculture constituted two percent of world supply in 1980 and increased up to 65 percent of world supply in 2004. As the result of developments and changes in the kinds of available salmon products, the timing of production, market quality standards and organization of the industry, world salmon markets were fundamentally transformed. The second change was a steep decline in the value of North American wild Alaska salmon catches from more than $800 million in the late 1980s to less than $300 million for the period 2000-2004. The decline in value of wild salmon was much due in large part to fierce price competition with farmed salmon. Unfortunately, Alaska industry was one of the biggest losers from this competition and its revenues in 2002 were $141 million, roughly 38 percent of average revenues received during 1990 and 1995 (Knapp et al. 2007).

In general, Americans consume salmon more than they have in the past. Salmon is commonly consumed as: *canned*, *frozen* and *fresh*. Knapp et al. (2007) report that

Americans consume annually 284,000 metric tons of salmon. Some 34.4 percent of consumers consume salmon 3-4 times a year and 26.9 percent consume salmon at least once a month. On the other hand, 26.4 percent of participants never consume salmon and 12.3 percent consume salmon more than a year (Gaedeke, 2001). The survey reports reasons for limiting consumption of fresh or frozen salmon among respondents being cost (52%), freshness integrity (50%), taste or flavor (49%), and availability (45%). In addition, some 36% of the respondents indicate smell as an influencing decision to limit salmon consumption and 17% cite family attitudes as a barrier to salmon consumption (Gadaeke, 2001). [26]

Several other studies have been conducted to elicit consumers' preferences for characteristics and attributes of salmon. Most of salmon attributes that consumers want to know about are production methods (Knapp et al. 2007), origin of product, price and some physical attributes such as color and texture (Gadaeke, 2001).

*Production method* describes whether salmon is caught wild or farmed raised. Due to heterogonous quality perceptions arising from different production methods for salmon products (Knapp et al. 2007), salmon producers differentiate their products based on the production methods. Holland and Roheim (1998) find wild salmon to be significantly preferred to farmed salmon. Another important attribute of salmon product is price since it indicates quality of salmon products or what production method is employed (Holland and Roheim, 1998).

*Price and its different levels* help consumers to determine their quality and safety perceptions about the product, which in its turn leads to willingness to pay (Ahmadov, 2008). Holland and Roheim (1998) also found that price for salmon to be significant. Sylvia et al.

[26] The respondents could check more than one reason. Therefore, the sum of percents is not 100.

(1996) show quality to be the most important salmon attribute followed by price and flesh color. In addition to these cues (Cox, 1962), consumers prefer to know where salmon is caught (Cardinal et al. 2004). Origin of product could be in terms of country of origin and region of origin. In general, consumer preferences for different production (e.g., wild versus farmed), origin of product and pricing methods are also correlated with the marketing promotions of various industry groups (Knapp et al. 2007). Some groups promoting wild Alaskan salmon often emphasize that Alaskan salmon are harvested from the cold, clean waters of the Pacific. Other groups supporting farmed salmon argue about salmon being farmed in sites selected by growers for their clean waters (Holland and Roheim, 1998). Therefore, identifying salmon product with a specific region or country enables consumers to successfully evaluate product by incorporating region or country specific attributes.

The present research assumes that these arguments could hold in the case of the smoked salmon products. A market segment of smoked salmon products is a relatively small but a growing segment of fresh and frozen salmon as value-added fillets that accounts for smoked salmon products. If smoked salmon product was consumed as a luxury good two decades ago, now, smoked salmon product is consumed as a normal good (Cardinal et al. 2004). Developments in consumer trends over the last decade are the main reasons contributing to new status of smoked salmon products and its world-wide distribution.

A wide range of raw salmon characteristics contributing to the flavor and acceptability of smoked salmon as well as many different salting and smoking techniques, give a rise to a myriad of smoked salmon attributes available on the market. Consumers may have homogenous and heterogeneous preferences for those attributes (e.g., color) and attribute levels (e.g., level of salt) receive information about those attributes through food label and previous exposure to the product (Cardinal et al. 2004). Cardinal et al. (2004)

evaluated 60 different smoked salmon products to characterize the qualities of products available to European consumers in six countries (Belgium, Denmark, France, Germany, Italy and the United Kindgom). The results show the main discriminating factors of the smoked salmon to be color, smoke intensity and saltiness perception. Séménou et al. (2007) studied the preferences for the smoked salmon in European countries using a set of 30 samples demonstrating the characteristic variability of cold-smoked salmon available in six European countries (Belgium, Denmark, France, Germany, Italy, and the United Kingdom). The study reveals that consumers' preferences for smoked salmon are affected by the country of origin, sensory descriptions and the physical properties of the products. However, their study as well as all previous non-smoked and smoked salmon studies did not analyze effects of country of origin and region of origin effects together with effects of production methods on consumers' preferences. In addition, none of these studies compared effects of country of origin to effects of region of origin, which affect consumers' perceptions and preferences.

Therefore, the current research focuses on examining the effects of different production methods (wild versus farmed) and pricing strategies (premium versus medium versus low price) and country of origin versus region of origin cues on consumers' preferences. The present study helps to understand whether there is propensity in the smoked salmon niche industry to differentiate farmed smoked salmon from wild smoked salmon and implement different pricing strategies based upon differences in these production methods; and also to determine if prominent labeling of the country or region of origin would influence consumer's purchase decisions (or product evaluation).

The purpose of this study is to answer the above questions. To do so, a general theoretical framework is presented in the first section, an econometric model using

theoretical framework is specified in the second section. In the last two sections, the design of the experiment and analysis of the data used to support theoretical evidence are discussed.

## THEORETICAL FRAMEWORK

In real life, consumers derive their utility not only from consuming food products but also from different attributes of the food products (Lancaster 1971; McFadden 1986). Food attributes enable consumers to evaluate food and determine their willingness to pay. The current theoretical model used is built on the framework introduced by Hanemann (1984) and involves three attributes of smoked salmon, which are production method (two levels - wild versus farmed), origin of salmon (four levels – two country of origin and two region of origin), and price (three levels – premium, medium and low). For the sake of simplicity, price is treated as value of product alternative and exclude price from the vector of attributes. However, combination of two attribute levels with different prices across choice (or product) situations generates twenty four different products of smoked salmon, each of which is differentiable by at least a single different level of attribute (Lancaster 1971; Novshek and Sonnenschein, 1979). Therefore, it is assumed that consumer prefers to only one product at any time if he or she is given all feasible choice sets. An individual consumer has a utility function defined over product alternative (smoked salmon) $x_1,...,x_n$, where $x_j \subset X$, and ordinary commodities $q$, where $q$ is defined as the numeraire.[27] The consumer's utility also depends on the attributes, which are denoted by $b_{1k},....,b_{nk}$, of product alternative or $x$'s. Note that consumer takes or treats those attributes with $k$ levels as exogenous. To ensure the rational behavior (or rational preference) of the decision maker, the author introduces the

[27] The model assumes that $q$ is a vector of goods, one of which is taken as the numeraire (Lancaster, 1971; Hanemann, 1984)

following assumptions based on the axiom of completeness from the preference theory (Mas-Colell et al. 1995; Ahmadov 2008) by defining a binary relation $\succeq$ on $X$ :

**(1)** $$x_j \succeq x_i \text{, then } x_j \succ x_i \text{ and } x_j \sim x_i \ \forall i \neq j$$

being interpreted as "product alternative $j$ weakly preferred to another product alternative $i$ in choice set (or situation)". Note that $j$ and $i$ are defined for the sake of simplicity without explicitly defined choice set. But both of the product alternatives are in the same choice situation denoted by $t$ or set as $jt, it$ .

Using the assumption in (1), the existence of the assumption (2) is ruled out, which author considers to be very critical condition for rationality of individual's preferences and individual's behavior: [28]

**(2)** $$x_j \underset{?}{\overset{\geq}{\leq}} x_{j-1}$$

binary relation in the second assumption means that both of product alternatives are *incomparable*. All product alternatives in the present model are assumed to comparable by satisfying the axiom of completeness. Note that completeness satisfies reflexivity[29] (Mas Collel et al. 1995). Finally, the author introduces another vector into the utility function of the consumer, which is denoted by $z$ as consumer's individual characteristics (gender, age, income). [30] These characteristics may influence consumer's preferences. To simplify model set up, the author defines product alternatives in terms of exogenous attribute levels $x_j\left(b_{jk}\right)$,

[28] Note that you have two incomparable alternatives, and those product alternatives cannot be compared due to various reasons; information or knowledge about the specific attributes or levels of attributes of the product. Cognition may also play a significant role.

[29] The author in his cited paper introduces the proofs in terms of theory and evidence for existence of cognitive and non-cognitive preferences under different axioms from general preference theory.

[30] It is assumed that $z_i$ is a vector of individual's characteristics affecting preference and mean of random parameter distribution in random parameter logit framework (Green and Hensher 2003).

which enters into well-defined utility function as $u\left(x_1\left(b_{1k}\right),...,x_N\left(b_{Nk}\right),q,z\right)$ satisfying quasi-concave functional properties in $x_j, q$.[31] An individual chooses $x, q$

**(3)** $$U_i\left(x_j\left(b_{jk}\right),q,z\right)$$

**(4)** $$s.t. \qquad y=\sum_j p_j x_j\left(b_{jk}\right)+q$$

**(5)** $$x_j x_i = 0 \qquad \forall j \neq i$$

**(6)** $$x_j \geq 0, q \geq 0$$

where $p_j$ is the price of the product alternative, the price of $q$ is normalized to one, $y$ is income, and equation (4) is the budget constraint of the individual. Due to the nature of discrete choice models, the selection of product alternative in equation (4) allows only fixed amount of ordinary goods denoted by $q$ to be purchased for the given income. Since the product alternatives are provided in fixed quantity and only a single product alternative can be chosen. Equation (5) is necessary condition for discrete choice models, as individual can not choose both alternatives at a time. Non-negative constraints in equation (6) are also necessary in the individual's choice making process with respect to his or her utility maximization problem. Note that in continuous choice models, the constraints (6), specially the first constraint must be set to satisfy non-zero condition. It is also assumed that all my choice (or product) alternatives are relevant and $x_j$'s are mutually exclusive based on (2) and

[31] Quasi-concavity of the utility function satisfies other axioms from preference theory in addition one discussed in previous section.

(4) conditions. In other terms, all irrelevant alternatives were excluded from the feasible set. [32]

In order to solve the utility maximization problem, "weak complementarity" condition (Hanemann, 1984) must be satisfied as follows:

**(7)** $$\frac{\partial \mathrm{U}\left(x_j\left(b_{jk}\right), q, z\right)}{\partial b_{ik}} = 0 \qquad iff\ x_i = 0, \forall i \neq j$$

The condition (7) means that individual's utility will not be affected by other non-selected product alternative. Using the previous conditions (1) – (7), the following conditional indirect utility function is expressed as:

**(8)** $$\bar{U}_j = \bar{u}\left(y - x_j\left(b_{jk}\right), q, z\right)$$

Note that for the sake of the simplicity, a single consumer model is discussed, which will be expanded into $m$ consumer model.

In order to specify the econometric model, the conditional indirect utility can be transformed into an unconditional indirect utility function as proposed by Hanemann (1984):

**(9)** $$\bar{V}_i\left(y, b_{jk}, p_j, q, z\right) = \max\left(\bar{v}_1\left(b_{1k}, y - p_1 x_1, q, z\right), \ldots, \bar{v}_N\left(b_{1k}, y - p_N x_N, q, z\right)\right)$$

The equation (9) captures the discrete choice, given exogenous product alternatives and attributes with different fixed levels. Finally, it is assumed that an individual chooses $x_j$ if and if the following condition holds:

**(10)** $$\bar{v}_j\left(b_{jk}, y - p_j x_j, q, z\right) > \bar{v}_i\left(b_{ik}, y - p_i x_i, q, z\right) \qquad \forall j \neq i$$

The condition (10) is very important for further discussion and model specification. Note that theoretical model did not explicitly specify individual attributes the present research is

[32] The author relies on the pre-test results to measure the relevance of attribute levels and product alternatives. Green and Hensher (2003) suggest the exclusion of all irrelevant product alternatives.

studying. The main objective in the theoretical section was to build theoretical evidence testable or could can be operationalized using the data.

## EMPIRICAL FRAMEWORK

In this section, a random utility model specification is introduced based upon the previous conditions (1) – (7). A random utility model arises when it is assumed that, although a consumer's utility is deterministic for the consumer, it must still contain some components, which are unobservable to the modeler (or econometrician). These components are commonly treated as random variables (McFadden, 1986). The unobservable component in the utility could be characteristics of the consumer and / or attribute of the commodities (Green and Hensher, 2003). The concept combines two ideas, which have a long history in economics – the idea of unobserved variables in econometric models and the idea of a variation in tastes among individuals in a population (Hanemann, 1984). Using the previous conditions (9) – (10) and also following the proposition by McFadden (1974) to link the deterministic behavior model with a statistical human behavior, the following function is introduced:

**(11)** $$\overline{v}_j\left(b_{jk}, y - p_j x_j, z, \varepsilon_j\right) > \overline{v}_i\left(b_{ik} y - p_i x_i, z, \varepsilon_i\right) \quad \forall j, i \subset C_k \;\&\; j \neq i$$

Only difference between condition (10) and condition (11) is that $\varepsilon_j$ and $\varepsilon_i$ disturbance terms are defined as the individual's unobserved component (behavior) with regard to $j$ and $i$ alternatives. Those terms with specified distributions consists of two parts: the variable $\gamma$ is an individual specific component, and $\phi_j$ or $\phi_i$ is stochastic and reflects the idiosyncrasies of individual tastes for the alternative $j$ or $i$ (McFadden 1974). As respondents

are randomly chosen, the unknown individual specific component can be defined as a random disturbance term, which is denoted by $\gamma + \phi_j = \varepsilon_j$ or $\gamma + \phi_i = \varepsilon_i$. If the model is transformed from a single consumer model into a multi-consumer model by defining number of consumers by $m$ where $m = 1,...,N$, the probability of consumer $m$ choosing product alternative $j$ out of choice set $C_k$:

**(12)** $$P\left(j \middle| C_k\right) = P\left\{\bar{v}_{mjt}\left(y - p_{jt}x_{jt}\left(b_{ikt}\right), z, \varepsilon_{jt}\right) > \bar{v}_{mit}\left(y - p_{it}x_{it}\left(b_{ikt}\right), z, \varepsilon_{it}\right) \quad \forall j, i \subset C_k \;\&\; \forall j \neq i\right\}$$

where $C_k$ denotes the choice set and $C_k = \{A, B, C, D\}$. The error term is introduced additively into equation (12) and indirect unconditional utility function is transformed into $\bar{v}_{mjt} = x_{mjt}\beta$:

**(13)** $$P\left(j \mid C_k\right) = P\left(x_{mjt}\beta + \varepsilon_{mjt} > x_{mit}\beta + \varepsilon_{mit} \quad \forall j, i \in C_k \;\&\; j \neq i\right)$$

In the multinomial logit model specification, the random components are assumed to be independently and identically distributed with an extreme value type I distribution (Gumbel). In the case of independently and identically distributed extreme value disturbances, the probability of an individual $m$ choosing the $j$ product alternative can be expressed as follows:

**(13)** $$P\left(j \mid C_k\right) = \frac{e^{x_{mjt}\beta}}{\sum_{i \in C} e^{x_{mit}\beta}}$$

Note that estimations in the MNL specification encounter with two main limitations: (1) its assumption of independence from irrelevant alternatives (IIA), (2) limitation in modeling variation in tastes of respondents. Both of those limitations motivate authors to consider alternative specifications (Greene and Hensher, 2003). IIA property states that the ratio of choice probabilities between two alternatives in a choice set is unaffected by changes

in that choice set. If this assumption is violated the MNL should not used (Greene and Hensher, 2003). One of the possible alternatives that relax the homoskedasticity assumption of the MNL model is the nested MNL model. Difference between two model specifications is that nested MNL model allows product alternatives to be placed in subgroup. Such specification is assumed to allow variance to differ between the subgroups but to be the same within each group.

The second limitation is challenging in other model specifications where there is taste variation among respondents due to observed and /or unobserved heterogeneity. Observed heterogeneity can be incorporated into a systematic part of the model by allowing for interaction between socio-economic characteristics and attributes of product alternatives or constant terms. Another alternative model specification is the latent class model (LCM) which is a semi-parametric variant of the MNL. These two reasons make LCM less flexible model than the mixed logit model. Firstly, LCM approximates the underlying continuous assumptions with discrete one. Secondly, LCM does not require the author to make specific assumptions about distributions of parameters across individuals. Greene and Heshner (2003) define this model specification as random parameters (or mixed) logit model.

In a random parameter model the vector of preferences $\beta$ can vary over some density $f(\beta \mid \omega)$, where $\omega$ are the true parameters of the distribution. The distribution assumption of the parameters allows us to introduce two estimates of preference: an estimate of the population mean $d$ and an estimate of stochastic differences in taste $s_m$ where it is assumed that $\beta = d + s_m$. Using the later expression in the random utility function, the following random parameters logit model for utility function is defined as:

**(14)** $$U_{mjt} = x_{mjt}\left(d + s_m\right) + \varepsilon_{mjt}$$

Note that estimations were done using above equation.[33] In estimations, the normal distribution for all parameter estimates was specified, which is common.

## CHOICE-BASED CONJOINT EXPERIMENTS

In present study, choice-based conjoint experiment (CBCE) is used, this technique is sometimes referred to be defined as a discrete-choice study. CBCE represents a stated preference technique allowing consumers to make choice decisions from a set of experimentally designed products or packages. These packages are defined as a bundle of product's attributes (Louviere, 1988). In the market research, CBCE have been used to estimate the value of market goods, the trade-off between food quality attributes and market share of those products (Louviere, 1991). Lusk and Schroeder (2004) describe reasons characterizing the frequent use of choice experiments. The first reason is that CBCEs are flexible because numerous attributes can be simultaneously valued whereas the conventional contingent valuation methods require a large number of questions to achieve the same level of complexity. The second reason is that CBCE are consistent with random utility theory and Lancaster's theory of consumers demand suggesting that consumers derive their utilities from the consumption of attributes captured in a good. The third reason is that CBCE quantifies main effects and most interaction effect depending on the experimental design, compared to most other conjoint analysis using "main effects only" assumptions. The fourth reasons is that every CBCE question is typically framed in a manner closely resembling

[33] Tthree different software packages such as SAS, STATA and NLOGIT 3 were used to estimate parameters. However, he found some minor differences in 6 digit results. Relying on the previous literature, the author represents the results obtained from NOLIGT 3, which has more appropriate modification to handle some of critical issues for discrete choice demand models.

consumer's purchasing decisions since the choice of products is a simple and natural task that everyone can easily understand (Sawtooth, 1999). The fifth reason is that analysis of CBC data is simpler relative to ratings - or rankings-based conjoint data (Louviere, 1988; Louviere, 1991).

## EXPERIMENT DESIGN AND DATA DESCRIPTION

The main objectives of the present study are to determine whether (1) different smoked salmon production methods affect consumers' preferences, (2) how much country of origin and region of origin, matter to consumers, and (3) how consumers feel about different price levels when they buy smoked salmon products. In order to answer these questions, the author pre-selected three attributes; price, product origin and production method. The next step in the process was to identify the levels of those attributes. Levels for the production methods were selected from previous literature; wild and farmed (Holland and Roheim, 1998). Pre-selected names of country of origin and region of origin names were discussed with faculty and students. Finally, names chosen for the country of origin and region of origin for the smoked salmon were USA, Canada and Alaska, British Columbia. The price level was measured by asking undergraduate students from food science class ($N$=32) "what low or high price you are willing to pay for this product from the range given below – please, write down your price choices for high and low price anchored with two levels US $2.99 as the lowest and US $7.99 as the highest**.**" The results show that lowest price choice was ($M$ = 3.10, $SD$ = .22) and the medium price choice was ($M$ = 5.95, $SD$ = 1.11). Using the information from pre-test and analyzing actual price range in the market, prices were set for US $5.99 the high price level and US $2.99 for the low price level. In addition, a premium price level is included to the study, which was US $7.99.

Based on the three levels of price (US $2.99, US $5.99 and US $7.99), two production methods (farmed and wild), four origins (two names of country of origin and two names of the region of origin (see table 2.1), a full factorial experiment consisting of 3x2x2x2=24 unique smoked salmon product alternatives was designed. Due to the potential problems arising from the use of a fractional factorial design (Lourviere and Woodworth, 1983), the design was kept as a full set of product alternatives. Product alternatives were blocked into 6 choice sets (see Table 2.2) where in each choice set represented 4 product alternatives. Respondents saw 6 choice sets in the questionnaire. Too many choice sets might cause respondents to be fatigued of questions and they may not show their actual stated preference for the last choice sets. In order to overcome this problem, six versions (see table 2.2) of choice experiments were developed from available 6 choice sets as (see table 2.3) where consecutive number of choice sets switch from one respondent to another.

***Survey and Data Description***

The data were collected from 409 respondents at the catering facility in a US University campus during February 2008. The facility was appropriate for the study since it provides various food products to customers. In order to avoid potential selection bias, from everyone entering the facility was asked to participate in the experiment; acceptance of the invitation was 92.62%. As a reward for participation, every respondent was given a 3-dollar discount coupon for any purchase at the facility.

The sample selection was relatively representative of the characteristics of the population in the study area (see Table 2.4). There was relatively equal number of representatives of males and females in the study. The income distribution of the respondents was also typical to the income of population in the study area. More detailed summary statistics for the demographic variables are presented in Table 2.4. After

eliminating incomplete surveys, 401 surveys remained for a total of 9624 observations (or 2406 choice situations). [34]

Actual experiment for the current study was conducted after the experiment, which also involved tasting cold smoked salmon and evaluating it. The previous experiment had a very different set of questions to be answered and both of those experiments were segregated from each other by different scenarios (see Annex I – III). Both of these factors helped to control "carrying information" or "carrying out effects" from one experiment to another. However, the tasting effect was analyzed and found to be non-significant.

***CBC Data Analysis***

In this section, the estimation of the base model with no demographic interaction terms to measure only main effects was described. The estimated results of the model I (see table 2.5, columns 1 and 2) show that price has negative effect on utility but other attributes such as the production method (or type), Alaska except British Columbia has positive effect on utility. Intuitively, the effect of the price on the utility and preferences is consistent with traditional consumer theory (Mas Colell, 1995). Therefore, the observed coefficient is negative. Note that the selection of low priced product alternative may not be only interpreted by the interplay of price and demand. It could be possible that respondent had to choose the low priced alternative since other product alternatives in the same choice situation (or set) do not satisfy axioms of rational preferences (Ahmadov, 2008). [35]

[34] Note that each choice situation consists of four product alternatives.
[35] It is assumed that respondent has cognitive and non-cognitive preferences, which are satisfied by the same axioms for their existence. However, it is possible that consumers can not judge quality of the product or be able to compare it with other products if those products do not exist and very abstract. In this situation, consumers are confused and choose the alternative that is more realistic.

The estimation of the model with attribute and demographic interaction terms was carried out using the following utility function as in model III:

**(15)** $$U_{mjt} = \beta_1 price + \beta_2 type + \beta_3 Alaska + \beta_4 USA + \beta_5 BritCol + \delta_1 priceXtype + \delta_2 priceXAlaska + \delta_3 priceXUSA + \delta_4 priceXBritCol + \delta_5 typeXAlaska + \delta_6 typeXUSA + \delta_7 typeXBritCol + \alpha_1 genXprice + \alpha_2 conXAlaska + \alpha_3 conXUSA + \alpha_4 conXBritCol + \alpha_5 incomeXprice + \varepsilon_{mjt}$$

where $\beta, \alpha$ and $\delta$ are parameters to be estimated. Empirically defined utility function allows to measure main and desired interactions terms. The interaction terms (see table 2.5) show how other attributes and individual characteristics modify the effect of the multiplied attribute on the probability choice.

The statistical significance of the models is examined by using likelihood ratio tests of the null hypothesis that all slope estimates are zeros. L-R Chi-square values in models I through III are 1876.06, 2026.19 and 2101.10 respectively. Note that the probability that the LR Chi-square is greater than the corresponding critical value is less than 0.01 in each model, meaning that the null is rejected.

It is true that the estimates for interactions between a pair of attributes in Model II and Model III are difficult to explain. However, the most of the interactions terms from pair of attributes such as type and price, and price and Alaska have a significant positive effect on utility but interaction term of price with British Columbia have a significant negative effect on utility based on the estimated results from both Model II and Model III (see columns 3,4,5 and 6 in table 2.5). Intuitively, these results mean that price with its different levels make Alaska and different type of production methods such as farmed versus wild positively affect consumers' preferences. But consumers' preferences are negatively affected by British Columbia if the latter is interacted with levels of price.

In addition, the estimated results also suggest that while type X Alaska have a positive significant effect on utility, type X USA has a negative significant effect on utility. Similar interpretation could be also suggested for reported interactions effects. Type of smoked salmon makes Alaska positively affect utility of the consumer. Or Alaska could be moderator to make type of smoked salmon to positively affect utility of the consumer.

The interaction effects of attributes with some demographic variables from the model III (see columns 5 and 6 in table 2.5) suggest that while gender makes price positively affect utility of consumer, the country where respondents are from makes Alaska, type of the production method and USA affect negatively the utility of consumer. In addition, other significant interaction effects are reported.

***Trade-offs within Attributes***

Coefficients of variables (only if there are significant) in CBCE design providea certain advantage such as to measure the trade-offs for attributes. For the sake of the simplicity, the model IV was used to compute the trade-offs for attributes (see table 2.6):

**(16)** $$U_{mjt} = \beta_1 price + \beta_2 type + \beta_3 Alaska + \beta_4 USA + \beta_5 BritCol + \alpha_1 incomeXprice + \varepsilon_{mjt}$$

Taking the total derivative of the utility function in equation (16) by assuming that income at their means, the following equation is obtained.

**(17)** $$d\hat{U}_{mjt} = \beta_1 dprice + \beta_2 dtype + \beta_3 dAlaska + \beta_4 dUSA + \beta_5 dBritCol + \hat{\alpha}_1 income * dprice + \varepsilon_{mjt}$$

Total derivative of equation 16 allows us to calculate one attribute 'trade-off by assuming the utility and other attributes except price face no change. The trade-off of changing attribute of changing from farmed to type production method can be expressed as:

**(18)** $$\frac{dprice}{dtype} = -\left[\frac{\hat{\beta}_2}{\hat{\beta}_1 + \hat{\alpha}_1 income}\right]$$

Using mean value of mean value of the wage, and coefficients from table 2.5, the calculated trade-off of changing from farmed to wild smoked salmon production method is:

**(19)**

$$\frac{dprice}{dtype} = 10.79$$

The results means that the price of the smoked salmon has to increase 1.10 USD per unit (4 oz) to keep the utility unchanged if the smoked salmon alternative is switched from farmed to wild. Similarly, all other trade-offs were computed. Table 2.7 represents all trade-offs based on the model IV. Models II and III are used to compute all trade-offs. However, the computation of the model II and III becomes more complicated, since there are very many interaction effects involved and most of variables are categorical nature.

Estimated trade-offs are identical with the marginal Willingness to-Pay (WTP). The positive sign means that consumers are willing to pay a premium for gaining utility, while the negative means that consumers want a discount for compensating lost in utility. The trade-offs are also functions of respondent's demographic characteristics, such as income. It means that the income effects were technically stimulated on the trade-offs. It is also true that increase of incomes raises the trade-offs and the income can also weaken price effects on probability of choice.

## CONCLUSIONS

The smoked salmon industry is gradually switching from a small niche market segment into a separate large market offering many opportunities for new salmon products. Heterogeneous consumers' preferences for different cold smoked salmon attributes drive this process. The present study threw lights on how consumers' preferences are affected by

different cold smoked attributes and found interesting results, which to some degree are consistent with findings of the previous non-smoked salmon products.

Some of previous studies and consumer analysis (Gadaeke 2001; Knapp et. al. 2007,) suggest that consumers have increased consumption of the smoked salmon. The increased consumption of any product will positively affect the interplay of demand and supply issues, which is a benefit to the industry players. However, the key issues in successful product development and promotion is to choose the product with correct attributes since those attributes will drive product preference and choice.

The main objective of the present study was to examine the main attributes of salmon and their affects on consumer preferences. In addition to the previous literature focusing on mostly salmon, but not on smoked salmon, the present study was able to confirm previously shown results in the case of smoked salmon. The results obtained from this study suggest that smoked salmon origin identities such as Alaska positively and USA negatively affects consumers' preferences compared to Canada. In other words, consumers prefer Alaska smoked salmon to Canada, which also suggests that consumers are positively affected by the region identity specific to the product. However, consumers do not prefer to USA since cue of USA compared to region of origin cues such as Alaska and British Columbia might not provide product specific information. It means that consumers can associate Alaska and British Columbia with smoked salmon product but they may find it hard to associate smoked salmon with all states of USA.

Examining all of these effects within the framework of the conjoint based choice model provides advantage of measuring effects of different product attributes in different combinations (see table 2.2). The results for those attributes are found to be significant. In the case of the price effect, the observed result is consistent with consumer theory, where

increase in price decreases demand for the product (Mas-Collel et al. 1995). This result is also consistent with findings of Sylvia et al. (1996) study, where the price was most significant cue. In the context of the present study, the measure is affect on consumer preferences. In the case of smoked salmon type, the result suggests that consumers prefer smoked wild salmon to smoked farmed salmon (Holland and Roheim, 1998).

The present study contains a number of significant implications for the smoked salmon industry by offering the marginal willingness to pay for the change of the attribute level. The estimated marginal willingness to pay show that consumers willing to pay premium prices for changes in attribute levels. Higher level of willingness to pay were observed in switching attribute levels of farmed to wild and Canada to Alaska.

The results for interaction of some attributes and demographic variables suggest that consumers' preferences are also affected by where they live in. Their income also significantly affects their perceptions of the smoked salmon types. It is also interesting to observe how gender interacts with different price levels. Note that there is also limited number of studies conducted to measure these interaction effects. These interaction effects in addition to main effects may provide a large number of implications for industry players such as (a) how to differentiate smoked salmon products in accordance with type across different gender and income of consumers, and (b) how to price smoked salmon products across different gender and locations of consumers. Note that list of these implications could be extended.

Further studies might be needed to better picture heterogeneous preferences of consumers for different attributes of the smoked salmon, but that is beyond the focus of the present research. However, the present research provides consistent support to some of the

results obtained in the previous non-smoked and smoked salmon studies and presents new perspectives for future research.

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**Table 2.1. Selected Levels and Attributes Used in Conjoint Based Choice Experiment**

| *Attributes* | *Levels* |
|---|---|
| Price (USD per 4 oz) | 2.99, 5.99 and 7.99 |
| Origin of the smoked salmon | USA, Alaska, Canada and British Columbia |
| Production Method (or type) | Wild and Farmed |

**Table 2.2. Twenty Four Profile with Six Choice Set in CBC Design**

| Choice Set | Alternative | Attributes | | |
|---|---|---|---|---|
| | | Price (USD per 4 oz) | Type | Origin |
| 1 | 1 | 2.99 | Wild | Alaska |
| | 2 | 5.99 | Farmed | British Columbia |
| | 3 | 7.99 | Wild | Canada |
| | 4 | 2.99 | USA | USA |
| 2 | 1 | 5.99 | Wild | Canada |
| | 2 | 2.99 | Farmed | British Columbia |
| | 3 | 5.99 | Wild | Alaska |
| | 4 | 7.99 | Farmed | USA |
| 3 | 1 | 2.99 | Farmed | Alaska |
| | 2 | 5.99 | Wild | USA |
| | 3 | 7.99 | Farmed | Canada |
| | 4 | 7.99 | Wild | British Columbia |
| 4 | 1 | 2.99 | Farmed | Canada |
| | 2 | 7.99 | Wild | USA |
| | 3 | 5.99 | Farmed | Alaska |
| | 4 | 2.99 | Wild | British Columbia |
| 5 | 1 | 2.99 | Wild | USA |
| | 2 | 5.99 | Farmed | Canada |
| | 3 | 7.99 | Farmed | British Columbia |
| | 4 | 7.99 | Wild | Alaska |
| 6 | 1 | 5.99 | Wild | British Columbia |
| | 2 | 7.99 | Farmed | Alaska |
| | 3 | 2.99 | Wild | Canada |
| | 4 | 5.99 | Farmed | USA |

**Table 2.3. An Example of Choice Set in CBCE (with shopping scenario for smoked salmon)**

Imagine that you are in a local grocery store shopping for smoked salmon. As you approach the section with fish products, you notice **different smoked salmon alternatives**. You decide to examine all alternatives since you are planning to buy smoked salmon today.

a. Please, check your most preferred *smoked salmon product*.

| *Product Attributes* | *Product* 1 | *Product* 2 | *Product* 3 | *Product* 4 |
|---|---|---|---|---|
| Price per 4 oz. | $5.99 | $2.99 | $7.99 | $7.99 |
| Type of smoked salmon | wild | farmed | wild | farmed |
| Origin of Product | Canada | British Columbia | Alaska | USA |

**Table 2.4. Individual Characteristics of Survey Respondents**

| *Individual characteristics* | *Mean* | *Standard deviation* |
|---|---|---|
| Age | 27 | 9.14 |
| Gender (female) | 53.9% | -- |
| Country born (USA) | 77.5% | -- |
| Some college or technical school education | 47.1% | -- |
| Family size | 2.18 | 1.47 |
| Income mean (per month) | 3255[36] | |
| Groceries purchase (weekly) | 46.9% | -- |
| Groceries purchase (monthly) | 23.9% | -- |
| Smoked salmon purchase (monthly) | 32.6% | -- |
| Smoked salmon purchase (never) | 14.5% | -- |
| Smoked salmon consumption (appetizer) | 51.1% | -- |
| Smoked salmon consumption (sandwich) | 14.5% | -- |

[36] Note that the author uses 3.93 as the mean for the income in calculations, since the coefficients were estimated from categorical income levels.

**Table 2.5. Estimated Results for Random Parameters (Normal Distribution)**

| | Model I | | Model II | | Model III | |
|---|---|---|---|---|---|---|
| | Coef. | Std.Err. | Coeff. | Std. Err. | Coef. | Std. Err. |
| *Attributes* | | | | | | |
| Price | -0.1468*** | 0.0128 | -0.2365*** | 0.4387 | -0.2496** | 0.1001 |
| Type (1=Wild) | 1.2711*** | 0.0511 | 2.1617*** | 0.2742 | 2.4451*** | 0.2927 |
| Alaska | 0.7599*** | 0.0366 | -2.4248*** | 0.4364 | -2.5713*** | 0.4495 |
| USA | -0.0671*** | 0.0479 | 4.4333*** | 0.7802 | 4.7484*** | 0.7968 |
| British Columbia | -0.0871 | 0.0458 | -0.2150 | 0.3103 | -0.2808 | 0.3194 |
| Canada[37] | -0.6057 | | -1.7935 | | -1.8963 | |
| ***Interaction with other attributes*** | | | | | | |
| Price X Type | | | -0.0157 | 0.0428 | -0.0468 | 0.0450 |
| Price X Alaska | | | 0.3271*** | 0.05893 | 0.3716** | 0.0603 |
| Price X USA | | | -0.1912** | 0.08448 | -0.1871** | 0.0846 |
| Price X British Columbia | | | -0.0690 | 0.0565 | -0.0803 | 0.0573 |
| Type X Alaska | | | 2.8977*** | 0.3918 | 3.0117*** | 0.4034 |
| Type X USA | | | -5.7104*** | 0.8273 | -6.1188*** | 0.8527 |
| Type X British Columbia | | | 1.2741*** | 0.2995 | 1.3874*** | 0.3060 |
| *Interaction with demographics* | | | | | | |
| Gender X Price | | | | | 0.8713 | 0.05486 |
| Country X Alaska | | | | | -0.0202** | 0.0089 |
| Country X USA | | | | | -0.0164** | 0.0083 |
| Country X British Columbia | | | | | 0.0249*** | 0.0076 |
| Income X Price | | | | | -0.0151 | 0.1042 |
| *Statistics* | | | | | | |
| Observations | 9624 | | 9624 | | 9624 | |
| Log Likelihood | -2373 | | -2298 | | -2261 | |
| LR chi2 | 1876.069 | | 2026.198 | | 2101.10 | |
| Prob>ch2 | 0.0000 | | 0.0000 | | 0.0000 | |
| McFadden Adj R2 | 0.28193 | | 0.30328 | | 0.31367 | |

*,** and *** denote statistically significant at 10%, 5% and 1% levels, respectively.

[37] Coefficient of Canada is computed by summing coefficients of Alaska, USA and British Columbia and then multiplied with negative sign. Since Canada was eliminated in effect coding to prevent perfect confounding (Hensher et al. 2005).

**Table 2.6. Estimated Parameters for Base Model with Income and Price Interaction**

| *Attributes* | Coefficients | Standard Deviation |
|---|---|---|
| Price | -0.1181*** | 0.0193 |
| | | |
| Type (wild=1) | 1.2716*** | 0.0511 |
| Alaska | 0.7603*** | 0.0367 |
| USA | -0.0670 | 0.0479 |
| British Columbia | -0.0871* | 0.0459 |
| Canada | -0.6062 | |
| *Interaction of income with price* | | |
| Income X price | -0.0073** | 0.0036 |
| *Statistics* | | |
| Observations | 9624 | |
| Log Likelihood | -2663.04 | |
| LR chi2 | 1244.09 | |
| Prob>ch2 | 0.00000 | |
| McFadden Adj R2 | 0.19490 | |

** and *** denote statistically significant at 5% and 1% levels, respectively.

**Table 2.7. Trade-Offs in Conjoint Choice Based Experiment (based on Model IV)**

| Attributes | Trade-Off Directions | Trade-Offs in USD / 4 oz |
|---|---|---|
| Type | Farmed $\Rightarrow$ Wild | 10.79 |
| Origin | Canada $\Rightarrow$ Alaska | 6.46 |
| Origin | Canada $\Rightarrow$ British Columbia | -0.76 |
| Origin | Alaska, USA, British Columbia $\Rightarrow$ Canada | -5.10 |

## ANNEX I

### Questionnaire on shopping for cold smoked salmon (non-product sampling)

Imagine that you are in a local grocery store shopping for a smoked salmon. As you approach the section with fish products, you notice **salmon products**. Since you are looking for **a smoked salmon**, you decide to examine both sides of the product label to learn more about the product. You examine both sides of the product label to see whether or not you may consider it for a purchase.

**Items for Perceived Quality**

**All things considered I would say this smoked salmon has**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Poor overall quality | | | | | | Excellent overall quality |

**This smoked salmon should be of**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very poor quality | | | | | | Very good quality |

**Items for Willingness to Buy**

**The likelihood of purchasing this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low | | | | | | Very high |

**My willingness to buy this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low | | | | | | Very high |

**The probability that I would consider buying this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low | | | | | | Very high |

**Items for Perceived Food safety**

**I think this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| No safe at all | | | | | | Very safe |

**The risk of getting sick from this smoked salmon is low**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Strongly disagree | | | | | | Strongly agree |

**This smoked salmon is prepared so that it does not have any risk to my health**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Strongly disagree | | | | | | Strongly agree |

**Items for Manipulation Check**

**Did the label state the country of origin of the product?**

Yes □ No □

If yes, please, write down the country of origin _____

**Did the label state the region of origin of the product?**

Yes □ No □

If yes, please, write down the region of origin_____

**Is the price for the smoked salmon low or high?**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low | | | | | | Very high |

**ANNEX II**

**Questionnaire on shopping for cold smoked salmon**
**(product sampling)**

**Have you actually tasted the smoked salmon sample?**

**YES** □ **NO** □

Imagine that you are in a local grocery store shopping for a smoked salmon. As you approach the section with fish products, you notice **salmon product** with a free sample for tasting. Since you are looking for **a smoked salmon**, you decide to taste **the salmon**. Before tasting **the smoked salmon**, you examine both sides of the product label to learn more about the product. After you have examined the product label, you decide to taste and smell **the smoked salmon** to see whether or not you may consider it for a purchase.

**Items for Perceived Quality**

**All things considered I would say this smoked salmon has**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Poor overall quality | | | | | | Excellent overall quality |

**This smoked salmon should be of**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very poor quality | | | | | | Very good quality |

**Items for Willingness to Buy**

**The likelihood of purchasing this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low | | | | | | Very high |

**My willingness to buy this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low | | | | | | Very high |

**The probability that I would consider buying this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low | | | | | | Very high |

**Items for Perceived Food safety**

**I think this smoked salmon is**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| No safe at all | | | | | | Very safe |

**The risk of getting sick from this smoked salmon is low**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Strongly disagree | | | | | | Strongly agree |

**This smoked salmon is prepared so that it does not have any risk to my health**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Strongly disagree | | | | | | Strongly agree |

**Items for Manipulation Check**

**Did the label state the country of origin of the product?**

Yes □ No □

If yes, please, write down the country of origin _____

**Did the label state the region of origin of the product?**

Yes □ No □

If yes, please, write down the region of origin_____

**Is the price for the smoked salmon low or high?**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| Very low | | | | | | | | Very high |

**Was the texture of the smoked salmon that you tasted real or unreal?**

Real □ Unreal □

**Was the color of the smoked salmon that you tasted real or unreal?**

Real □ Unreal □

**Was the taste of the smoked salmon that you tasted real or unreal?**

Real □ Unreal □

**Was the flavor of the smoked salmon that you tasted real or unreal?**

Real □ Unreal □

**Was the appearance of the smoked salmon that you tasted real or unreal?**

Real □ Unreal □

## ANNEX III

### Questionnaire for cold smoked salmon choice based conjoint experiment

Imagine that you are in a local grocery store shopping for a smoked salmon. As you approach the section with fish products, you notice **salmon products**. Since you are looking for **a smoked salmon**, you decide to examine **all product options** available to choose **the smoked salmon option that you mostly prefer to**.

**a. Please, check your most preferred *smoked salmon option*.**

| ***Product Attributes*** | ***Option* 1** | ***Option* 2** | ***Option* 3** | ***Option* 4** |
|---|---|---|---|---|
| **Price per 4 oz.** | $5.99 | $7.99 | $2.99 | $5.99 |
| **Type of smoked salmon** | wild | farmed | wild | farmed |
| **Origin of Product** | British Columbia | Alaska | Canada | USA |

**b. Please, check your most preferred *smoked salmon option*.**

| ***Product Attributes*** | ***Option* 1** | ***Option* 2** | ***Option* 3** | ***Option* 4** |
|---|---|---|---|---|
| **Price per 4 oz.** | $2.99 | $5.99 | $7.99 | $7.99 |
| **Type of smoked salmon** | farmed | wild | farmed | wild |
| **Origin of Product** | Alaska | USA | Canada | British Columbia |

**c. Please, check your most preferred *smoked salmon option*.**

| ***Product Attributes*** | ***Option* 1** | ***Option* 2** | ***Option* 3** | ***Option* 4** |
|---|---|---|---|---|
| **Price per 4 oz.** | $5.99 | $2.99 | $5.99 | $7.99 |
| **Type of smoked salmon** | wild | farmed | wild | farmed |
| **Origin of Product** | Canada | British Columbia | Alaska | USA |

**d. Please, check your most preferred *smoked salmon option*.**

| ***Product Attributes*** | ***Option* 1** | ***Option* 2** | ***Option* 3** | ***Option* 4** |
|---|---|---|---|---|
| **Price per 4 oz.** | $2.99 | $5.99 | $7.99 | $7.99 |
| **Type of smoked salmon** | wild | farmed | farmed | wild |
| **Origin of Product** | USA | **Canada** | British Columbia | Alaska |

**e. Please, check your most preferred *smoked salmon option*.**

| ***Product Attributes*** | ***Option* 1** | ***Option* 2** | ***Option* 3** | ***Option* 4** |
|---|---|---|---|---|
| **Price per 4 oz.** | $2.99 | $7.99 | $5.99 | $2.99 |
| **Type of smoked salmon** | farmed | wild | farmed | wild |
| **Origin of Product** | Canada | USA | Alaska | British Columbia |

**f. Please, check your most preferred *smoked salmon option*.**

| ***Product Attributes*** | ***Option* 1** | ***Option* 2** | ***Option* 3** | ***Option* 4** |
|---|---|---|---|---|
| **Price per 4 oz.** | $2.99 | $5.99 | $7.99 | $2.99 |
| **Type of smoked salmon** | wild | farmed | wild | farmed |
| **Origin of Product** | Alaska | British Columbia | Canada | USA |

## ANNEX IV

### Questionnaire for general information on respondent

**Sex of Participant: M F**

**Where are you originally from? Country_____State_____**

**Where have you been living mainly for last 10 years? Country_____State_____ City_____**

**What year were you born? _____**

**What is your first language? _____**

**What is the highest level of education that you have completed? (please, check one of the following options):**

Some high school or less High school graduate Some college or technical school

Technical school or community college graduate College graduate

Post graduate education (master, doctoral) Professional degree (MD, JD)

**What degree (or major) are you in? _____**

**What is your household size (number of family members, currently living with you in your house)?_____**

**What is your monthly household income?**

less than $500 $500-1000 $1001-2500 $2501-4000 $4001-5500 $5501-7000

$7001-8500 $8501-10000 $10001-12500 $12501-15000 greater than $15000

**How often do you buy groceries?**

Daily □ 2-3 times per a week □ Weekly □ Biweekly □ Monthly □

None □ Other □ please, specify_____

**How often do you buy smoked salmon?**

Daily □ Weekly □ Biweekly □ Monthly □ None □ Other □ please, specify_____

**How do you most commonly eat smoked salmon?**

Appetizer _____
Salad _____
Sandwich _____
Other _____ please, specify_____

**Please rank the following factors in terms of their importance to you in choosing the smoked salmon product (1=most important, 5=least important):**

Healthy
Safety
Price
Origin
Quality

**What do you think the researcher wants to study within the experiment?**

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