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CERTIFICATION OF PORK PRODUCTS

Tomas Nilsson and Ken Foster

The objective of this paper is to provide insights on the welfare distributional impact on consumer and producer welfare resulting from the development and implementation of a credence certification program in the U.S. pork sector. The certification program can provide various levels of tracking and tracing in the marketing chain. The modeling framework follows that of Nilsson (2005), which encompasses product differentiation and substitution across meat products at the consumer level and across live animal types at the farm level. Processors and retailers have potentially bilateral market power and can supply either or both certified and conventional meat products. One of the key findings is that while as the conventional market contracts and the certified market expands as expected, the magnitude depends on whether suppliers are single-or multiproduct providers. On aggregate, total welfare increases by 15 to 24 percent depending on industry structure.

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Copyright 2005 by Tomas K. H. Nilsson and Ken Foster. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on such copies. Corresponding author: Tomas Nilsson, Tomas.Nilsson@Alumni.Purdue.Edu. Nilsson is Assistant professor in Department of Rural Economy at the University of Alberta. Foster is Professor in the Department of Agricultural Economics Purdue University. The authors wish to acknowledge the contributions from the members at the Department of Agricultural Economics and Department of Economics at Purdue University and Department of Economics, SLU, Uppsala. Special thanks to Phillip Abbott, Corinne Alexander, Hans Andersson, Jim Eales, Clas Eriksson, Joan Fulton, Jayson Lusk, Doug Miller, Valentina Galvani, Dan Kovenock, Dayton Lambert, Stephen Martin, Phillip Paarlberg, Paul Preckel and Bo Öhlmer for comments on earlier versions of this paper. Obviously, the usual disclaimer applies.

1. Introduction

An issue that has come to the forefront of economic inquiry today is the impact on consumer well-being from new product standards through voluntary certification and labeling programs. Certification programs are increasingly popular in the U.S. economy especially in the live animal industry foremost because of two factors. First, crucial food attributes are unverifiable and unobservable but important in the minds for some consumer segments.¹ There is immense pressure from the public and consumer interest groups on agribusinesses to meet concerns regarding credence qualities such as environmental degradation, food safety and animal welfare issues. Second, certification presents an opportunity for upstream suppliers, i.e. live animal producers to secure market access to profitable marketing opportunities and potentially alleviate oligopsony power in the live animal stages.

In this vein, food credence certification can be of tremendous importance to food suppliers because it does not only meet consumer concerns but also provides access to potentially profitable niche-markets. For example, the National Pork Board has instituted voluntary programs such as the Pork Quality Assurance program (PQA), the Swine Welfare Assurance Program (SWAP), and the Take Care – Use Antibiotics Responsibly program. The PQA and Take Care programs were instituted in 1989 and 2004 respectively to address proper antibiotic use on farms. SWAP started in 2003 as an effort to guarantee ethical live animal treatment on farms and in slaughter plants. Furthermore, the National Council of Chain Restaurants (NCCR), and the Food Marketing Institute (FMI) launched the Animal Welfare Audit Program (AWAP) in February 2004 to meet

¹ Credence attributes are unobservable and unverifiable product characteristics (Darby and Karni, 1973).

the public concerns about the housing and treatment of animals on farms and in slaughter plants.²

Public decision-makers are also taking an active interest in implementing certification programs. For example, Texas A&M University developed in cooperation with industry representatives an animal welfare program targeted to live animal transporters. On a federal level, U.S. Department of Agriculture (USDA) agencies are controlling the National Organic Program (NOP), the Process Verification Programs (PVP), and the Country of Origin Labeling Act (COOL). The NOP stipulates the standards for organic food products, and uses independent auditors to certify compliance with the NOP guidelines. Compliance with the PVPs also uses third party auditors but program participants can design their own protocol. The COOL is a voluntary labeling scheme to inform the consumer about the country of origin for meat. Here, the retailer and the processor must document the country of origin for beef, lamb, pork, fish, perishable agricultural commodities and peanuts. The program will become mandatory on September 30, 2006.³

² However, the compelling question is whether these industry initiatives provide credibility for concerned consumers and add value for compliant pork producers because strict supplier compliance is not ensured. The auditor is unable to fine suppliers that are in violation of the protocols. Hence, a credible certification scheme most likely requires design and oversight by an independent and nonpartisan third party or a group with recognized authority in the certification area. Roller (2004) studies suitable certification programs that may be appropriate for Indiana pork producers. He suggests that certification protocols such as the Animal Welfare Guidelines of the Humane Farm Animal Care Group may be an appropriate choice for certification in the U.S. pork markets.

³ Lack of political support is the main reason why the U.S. Department of Agriculture cannot implement the program. There is some discussion that the COOL may be implemented jointly with the National Animal Identification System, e.g. Anderson and Hudson (2004).

However, the welfare distributional impact from certification and labeling programs in the U.S. food market is by in large an unresolved issue. Although there is concern about food safety, environmental degradation and animal welfare, not all consumers are willing to pay for a credence certification program that alleviates these concerns. Hence, the certified products may be imperfectly substitutable to the existing conventional food products on aggregate. The problem for the consumer that prefers the certification program is whether the new product enhances consumer welfare. The problem for the consumer that prefers the conventional product is whether the certification causes adverse price movements and therefore worsens consumer welfare in the conventional market. From the perspective of the live animal producer and the intermediary firm, the problem is that the certification may cause a consumer demand expansion or contraction. Specifically, the supplier problem is to choose to supply either in the conventional or the certified market or in both markets.⁴ From a positive perspective, the intriguing question is how firm strategic behavior and preference heterogeneity determines economic efficiency and the distribution of welfare when suppliers launch a voluntary certification program. When the certified product does not fully replace the conventional product, the conventional market competes with its certified counterpart. The interaction between the certified and conventional markets may enhance or erode firm market power. Consequently, the welfare impact from the

⁴ Consumer well-being, consumer welfare or consumer surplus are utilized interchangeably throughout the paper and refer to the value in dollars that the consumer attach of being able to consume the particular product. Producer profitability, producer surplus refer to returns to the quasi-fixed factors of production, also known as Ricardian rents.

differentiation program depends on not only on relative prices and the distribution of consumers' preferences but also on the competitive structure between firms.

The objective of this study is to shed light on the economic implications of certification and labeling, with an application to the U.S. pork markets. The research question is, how does certification and labeling affect consumer and producer surplus when consumers have heterogeneous preferences and firms have market power? The hypothesis is that the welfare distributional impact on consumer and producer welfare is a function of individual consumer preferences, firm marginal cost as well as the competitive conduct in the industry.

The certification program provides a pre-specified range of credence attributes, which are product quality attributes that are unverifiable from the consumer's perspective but verified in a third-party independent auditing scheme. The certification program controls the presence of credence attributes as the product passes through the market stages. For example, the program may regulate or prohibit the usage of antibiotics, growth-promoting hormones, feed ingredients, regulate slaughtering practices and control retail shelf location.⁵

This study is counterfactual in nature, because as of April 2005, a national voluntary certification program is forthcoming in the U.S. pork markets.⁶ The pork markets in this context involve the whole food supply chain from pork producers, packers, processors, distributors to retailers or other food outlets. The reference point is

⁵ Retail shelf space and location is a key predictor in determining the number of units sold for a particular good, see Corstjens and Doyle (1981).

⁶ The analytical and numerical model however assumes that there is a small initial market share for the certified good. Currently a segment of niche-firms supplies pork products that provide credence guarantee. Moreover, these niche-firms are owned by larger conventional processing and retailing firms.

therefore the current market situation, which is referred to as the ex-ante equilibrium or the pre-certification market situation. The hypothetical equilibrium subsequent to the introduction of the certification program is referred to as the ex-post equilibrium, or the post-certification market situation.

The analytical model builds on Random Utility Maximization (RUM) theory (McFadden, 1974). Aggregate demand and supply are found by aggregating individual demand and supply functions over the population. The product market in consideration in this analysis is the U.S. fresh cut pork markets, which involves the live animal (pork producer) stages, meatpacking and retailing industries. The meatpacking and retail industry is treated as an intermediate firm in this analysis. Market sources argue that the fresh cuts market represents the greatest market potential because the cuts are labeled in a uniform and consistent manner and included in the food pyramid. Additionally, the four largest meatpacking firms have a national scope and could potentially implement a food system wide certification scheme because they carry brands that are recognized by the consumers.

Information about supply and demand for the ex-ante equilibrium is obtained from current prices and production levels. Demand information regarding the certified good originates from the stated preference study by Nilsson. The marginal cost of certification is approximated from cost studies of certification programs (Foster, 2004; Roller, 2004). Stakeholders in the agribusiness industry and policy makers considering implementing and supervising meat certification programs may find the results of importance when developing audit schemes within the scope of voluntary certification programs.

Throughout, the following notation is employed. For notational convenience, denote scalars as lower- and uppercase letters, e.g. x, X ; vectors are boldfaced lowercase letters, e.g. $\mathbf{x} = [x_1, x_2, \dots, x_m]'$; matrices are boldfaced uppercase letters, e.g. \mathbf{X} . Moreover, live animal and retail demand and supply is subscripted as (F, R) , respectively. Because the products are otherwise homogenous, we refer to the conventional product as the low (quality) product and the certified pork product as the high (quality) product denoted as (L, H) , respectively. The subsequent section reviews some of the previous conceptual and empirical studies. Chapter 3 presents the model and Chapter 5 continues with an empirical application. Chapter 6 concludes.

2. Previous studies

An important determinant of demand is the consumer perception of product quality. However, if some products are superior to others in the minds of the consumers the intriguing question that arise is what motivates a firm to become a multiproduct supplier instead of providing just the highest-quality variety? Lancaster (1990) provides a conceptual argument for the underlying motivations behind multiproduct behavior. In his view, there are foremost three factors that may explain multiproduct firm behavior, namely scope economies, entry-deterrence and providing better match between consumer

preferences and product attributes (1990: 201).⁷ Gilbert and Matutes (1993) develop a model in which all consumers agree on the quality ranking to analyze the economic implications of a new product introduction. They find that all firms have incentive to introduce the maximum number of product varieties. From an entry deterrent perspective thus, the incumbent firm has incentive to prevent entry by “filling up” the product space.⁸ With respect to Lancaster’s third factor, the firm has incentives to increase total demand by providing a better match between heterogeneous consumers and differentiated products. Brander and Eaton (1984) build on this notion and coin the terms market segmentation and market interlacing. In market segmentation, multiproduct firms supply products that are close own-brand substitutes. In market interlacing however, firms supply products that compete with the competitor’s product. Brander and Eaton provide some intuition why firm would have this type of strategic behavior. They argue that firm strategic behavior can be regarded as a sequential three-stage game. In the first stage firms choose whether to entry or to stay out. In the second stage, firms make decisions about the product line. In the third stage, the firm maximizes profit with respect to price

⁷ The scope economies perspective comes derives Baumol, Panzar and Willig contestable market theory (Baumol, 1982; Baumol, Panzar and Willig, 1983). The contestable market theory in its essence states that markets are always perfectly competitive. If there is free entry and incumbent firms earn positive economic profits, potential entrants have incentives to enter the market thus thereby lowering firm profits. However, if the incumbent firms have economies of scale and/or scope in production, there is some question to whether the economic outcome as stipulated by Baumol and Baumol, Willig and Panzar holds. Nevertheless, the notion of firm level economies of scale and scope argument is somewhat formalized by the latter authors.

⁸ Two classical references in this direction are Schmalensee (1978) and Scherer’s (1979) studies of the 1972 case between Federal Trade Commission and, at that time, the three leading U.S. ready-to-eat breakfast cereals manufacturers. Schmalensee and Scherer argue that the incumbent firms engaged in product introduction to prevent new entry and altogether introduced more varieties than socially optimal. Hence, an excessive product introduction exceeded the benefits from matching heterogeneous consumer preferences with a diverse range of product attributes.

or quantities. They argue that their decision-making model hold particularly strong relevance for business decision makers picture because they “understand, before anything is actually produced, how the non-cooperative output game will work” (p.332). However, despite the fact that they provide a rigorous treatment of firm behavior, consumers are assumed having a quadratic utility function so the individual consumer would always prefer to consume several differentiated varieties see LaFrance (1985) and LaFrance and Hanemann (1989).

In a similar fashion, Bulow, Geanakoplos and Klemperer (1985a, 1985b) study how the competitive behavior between suppliers changes when the option arises to serve two independent markets. They show that producer profit, as well as consumer surplus may decrease when firms segment the markets. However, there is no substitution in demand because the product markets are disconnected.

The literature on food certification and labeling in imperfectly competitive environments take somewhat of a different route. Caswell and Mojduszka (1996) and others for example argue that the food marketplaces suffer from asymmetric information, “consumers may have misperceptions of the risks and hazards of consuming particular foods” (1996: 1248). They reckon, “Food producers will supply food quality if it is profitable for them or if they are required to do so. The contribution to profitability may stem from increased product differentiation, sales, perhaps price, or from avoidance of costly events such as food borne illness outbreak with associated tort liability” (1996: 1248). Therefore, voluntary labeling and certification can increase total sales and provide a cost effective solution without government interference (1996: 1251).

Marette, Crespi and Schiavina (1999), and Crespi and Marette (2001 and 2002) also argue that the problem is one of asymmetric information but in addition there is imperfect competition involved too. The certified product is assumed superior to the conventional, or vertically differentiated: sold at same prices, all consumers would strictly prefer the certified product. While their policy implications are rather straightforward, the behavioral assumptions built in the model are important drivers of these results. For example, there is some controversy whether it is a problem of incomplete or asymmetric information. Gathering, analyzing and providing food quality information are costly activities for the firm. Antle (2001) argues that if firms are not required to collect this information there is a problem of incomplete information. Moreover, from a consumer standpoint, because consumers have heterogeneous preferences it is uncertain whether all consumers would prefer the certified product see also Antle (1996). Furthermore, Lutz (1997), Lutz, Lyon and Maxwell (2000) and Nilsson et al (2003) suggest that the functional forms of demand, production cost and type of strategic behavior drives the results in the vertical product differentiation model with vertical product differentiation. Additionally, in a real-world context the single-product framework may hold little relevance, because retailers may choose to stock several product varieties. In this spirit, Sexton (2000) remarks that agricultural economics fails to incorporate the notion of multiple levels of market power and multiproduct technology.

The model presented here capitalizes on some of the fundamental aspects brought up in the literature review that may influence the welfare distributional impact of a certification and labeling program. As suggested by Antle, not all consumers may prefer

the certified product because consumers have heterogeneous preferences. Moreover, there is no asymmetric information, rather one of imperfect information. Therefore, the certified product is relatively more expensive than the conventional product. Schroeter and Azzam, Perloff and Hyde and Sexton suggest that firms are potentially both multiproduct providers and have bilateral market power. In the model presented here, consumers have heterogeneous preferences, intermediary firms have market power and upstream firms may differ with respect to production costs.

Figure I presents the economic unit of analysis, which is adapted from Nilsson and Foster (2004). The partial equilibrium economy consists of three types of agents: consumers, intermediary firms and upstream firms. The upstream firm is also referred to as the producer. The producer is involved in the primary production stage, and utilizes the production inputs capital, labor and land to produce an intermediary product. The intermediary firm, also referred to as the downstream firm, produces the finished good by using the intermediary product and other production inputs such as capital and labor. The consumer buys the finished good in the downstream consumer market. The downstream market is also referred to as the retail market.⁹

Consumers in this economy have potentially heterogeneous preferences. Without loss of generality, it is assumed that a consumer represented in the figure is one of three types. First, there is a distribution of consumers denoted as HIGH strictly prefers the certified finished good. This group may strictly prefer credence characteristics, be a high-income group, exhibit high degrees of risk aversion, preferences for product attributes etc. Second, the consumer distribution denoted as LOW strictly prefers the conventional

⁹ Recall that the letter L and H is to represent the conventional and certified good, respectively.

finished good. The group may be extremely price sensitive and care relatively less about credence characteristics, further discussed below. The third group finally, denoted as the **INDIFFERENT** group consists of consumers that are price and credence characteristic sensitive. The purchase decision for the latter segment depends thus on the relative prices and the individual preferences for certification. Therefore, the demand encompasses thus aspects of both vertical and horizontal product differentiation because on aggregate, the products are imperfect substitutes at equal product prices.

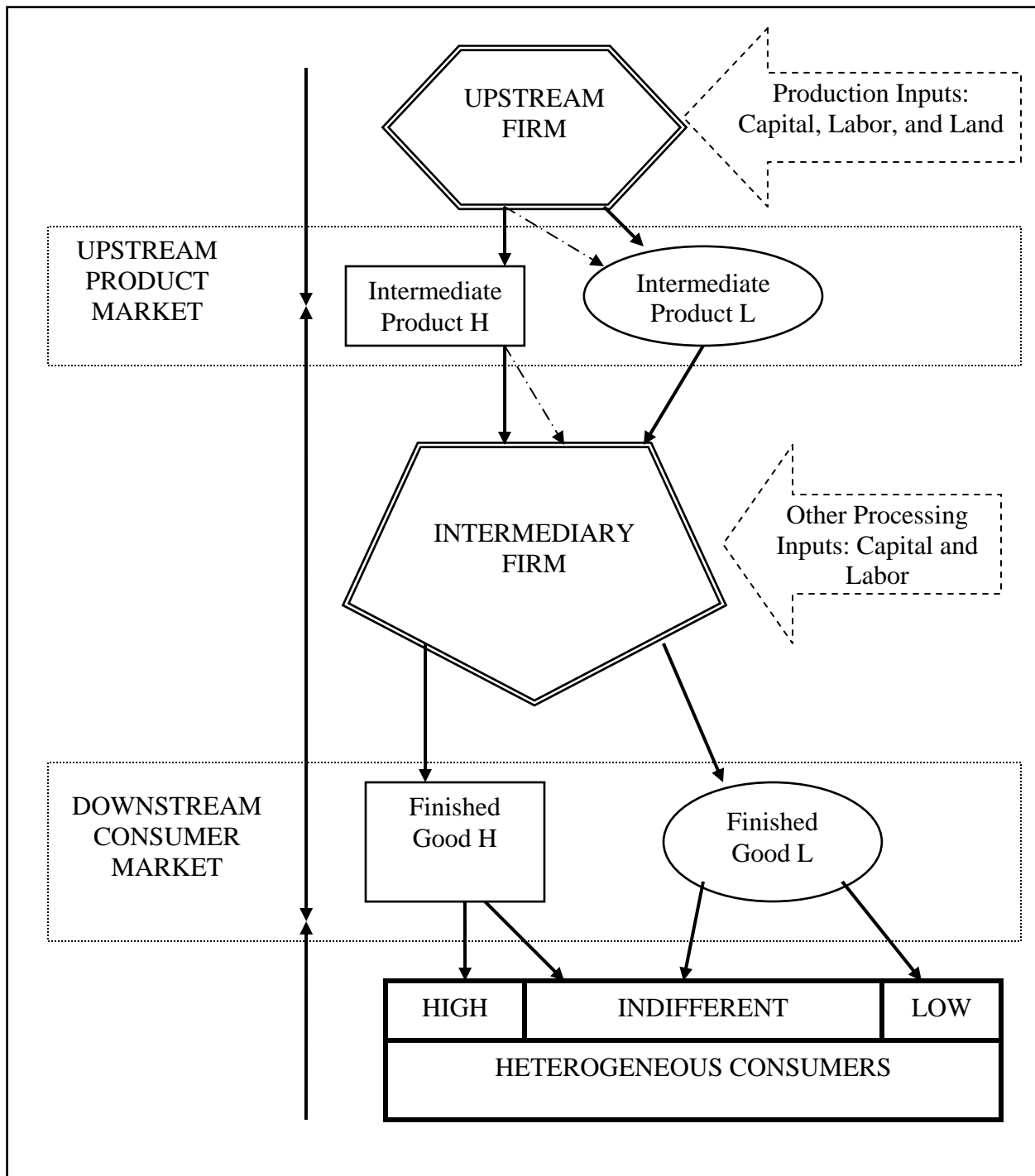


Figure I. Conceptual Model of the U.S. Pork Supply Chain. Source: author's construction.

3. Partial Equilibrium Model

The consumer face a set of discrete choices and maximize utility in a random-utility fashion e.g. McFadden (1974).¹⁰ All other economic activities are exogenous in this framework and referred to as the outside option or the outside good. In particular, the consumer maximizes utility by choosing the option that provides the highest level of utility. The options consist of buying and subsequently consuming one unit of conventional or certified pork chop, or purchase an outside good. The population consists of N consumers. The finite choice set each consumer faces is denoted as $C = \{L, H, O\}$, where (L) refers to the conventional product, (H) the certified product and finally (O) the outside option. Thus, this is an incomplete demand system because all other choices are aggregated into an outside option. The i^{th} product contains a vector of attributes $\mathbf{x}_i = [B_i, A_i, P_i]'$, where B_i is the brand dummy for the i^{th} product, A_i the credence certification attribute dummy, and P_i is the product price. The vector of attributes that

¹⁰ This model is similar to the one that is used by the U.S. Department of Justice (DOJ) and the Federal Trade Commission (FTC) in determining the consumer welfare impacts from mergers see Werden and Froeb (1994). The model presented here and the one used by DOJ and FTC both normalize the price of the outside good to zero (1994: 410). There are subtle differences, however. In the DOJ and FTC model for example, the market share for the outside good is a function of the aggregate demand elasticity and so is exogenous (1994: 410). In this paper, however, the market shares are endogenous. Additionally, the utility vector for the outside good is endogenous because it is a function of relative prices, market shares and elasticities, whereas the demand model by DOJ and FTC has normalized the utility vector for the outside good to a constant (1994: 411).

describe the conventional product is $\mathbf{x}_L = [B_L, 0, P_L]'$, the certified product

$\mathbf{x}_H = [B_H, A_H, P_H]'$ and the outside good is normalized to a zero vector so $\mathbf{x}_O = [0, 0, 0]'$.

The indirect utility function consists of a systematic utility component that may vary across individuals and an idiosyncratic error term that varies across individuals and product choices. Let the n^{th} individual's observable utility component be the vector

$\boldsymbol{\beta}_n = [\beta_{n,B}, \beta_{n,A}, \beta_{n,P}]'$ where the subscript (n) refers to the n^{th} individual, (B) the brand, (A) the credence attribute, and (P) the price, respectively. The idiosyncratic error term is

distributed according to some distribution $u_{ni} \sim (\mathbf{I}, \boldsymbol{\Sigma})$. The n^{th} consumer conditional

indirect utility function for the i^{th} product is a function of the inner product of the utility vector and the product characteristics and an additive idiosyncratic error

$$V_{ni} = \mathbf{x}_i \boldsymbol{\beta}' + u_{ni}. \quad (1)$$

The product $\mathbf{x}_i \boldsymbol{\beta}'$ is the part-worth utility, also referred to as the systematic utility (Louviere, Hensher and Swait, 2000). The part-worth utility can be regarded as a base utility that all consumers receive independently on their location in the distribution. The total level of utility is also a function of the idiosyncratic error, however. If the error terms are IID double exponential the purchase probabilities becomes McFadden's conditional Multinomial Logit, a.k.a. the MNL (McFadden, 1974; Andersson, de Palma and Thisse, 1991). The total direct demand for the i^{th} product is found by summing the purchase probabilities over the total market potential M_R so total direct demand becomes,

$$Q_{R,i} = M_R s_{R,i}, i \in .C, \quad (2)$$

where $s_{R,i}$ is the purchase probability, $Q_{R,i} = Q_{R,i}(\mathbf{x}_i; \boldsymbol{\beta}, \mathbf{x}_{-i}, M_R)$, $i \in .C$ is demand and the subscripts refers to the i^{th} finished or retail market, which is a function of all product characteristics, including prices, the utility vector ($\boldsymbol{\beta}$) and the total retail market size M_R . Inverse demand is found by solving for the prices in Equation (2). The indirect demand for the i^{th} product is,

$$P_i = \phi_i + \beta_P^{-1} \ln \left[\frac{Q_{R,i}}{M_R - Q_{R,L} - Q_{R,H}} \right], i = L, H . \quad (3)$$

A final remark is important at this point. While the specification presented above is semi-logarithmic, there are subtle differences between this model and the linear demand model. Hausman suggests that linearized models are preferred over discrete demand models such as the logit presented here and the Spence-Dixit-Stiglitz model. The reason is that the discrete demand models fare badly especially in an empirical context because it enforces an unreasonable substitution pattern (1994: 22-23).¹¹ However, the utility function that generates linear demands under the conditions stated above is quadratic so each consumer would strictly be better off consuming several product varieties.¹²

¹¹ Barry, Levinsohn and Pakes develop an empirical demand model from random utility theory that potentially has reasonable substitution patterns. However, the model does not have a closed form analytical solution.

¹² Moreover, for a linear demand system to be well- behaved and integrate to a proper utility function, the assumption of no income effects must be imposed, which is the first part of La France's Theorem 2 (pp. 160).

Moreover, because income effects is not in the inverse demand, the area under the Marshallian demand curve but over the equilibrium price is the correct measure of consumer surplus.¹³

The upstream supplier, i.e. the live animal producer maximizes utility of profit and is a price-taker in the input and output markets. The production technology may be characterized by jointness in output so that one unit produced can be sold into different product markets. Because only one output market is of interest in this study it is assumed that the supplier can sell to two output markets, one aggregate output market and the one studied here. The demand for the aggregate market is assumed perfectly elastic. The producer per-unit profit is,

$$\pi_i = z_i r_i^1 + (1 - z_i) r_i^0 - w_i, \quad (4)$$

where the subscript denote the activity choice, (r_i^1, r_i^0) denote the prices the supplier receives for the i^{th} product from each product market and (w_i) is the constant marginal cost of production. The superscript on the output prices refers to the product market, where 1 is the active product market of study in this analysis and 0 the constant market. The index (z_i) refers to the share of one unit of output that is allocated to the active market, $z_i \in [0,1]$. The per-unit profit can be seen as a residual claim left to cover other economic costs not directly attributed to a particular production activity.

The producer faces the same choice set as the consumer, denoted as $C = \{L, H, O\}$. It is natural to refer to the choice set as production activities, which are

¹³ Nilsson derives the analytical expression for the consumer surplus. Comparative statics on the surplus expressions are ambiguous however, because exogenous terms appear in both the numerator and the denominator.

conventional (L), certified (H) intermediary products, or participates in an outside activity (O). The latter production activity is referred to in this analysis as the outside option.¹⁴ Hence, the utility maximization problem for the n^{th} supplier for the i^{th} product becomes,

$$U(\pi_{ni}) = z_{ni}r_i^1 + (1 - z_{ni})r_i^0 - w_i + v_{ni}, \quad (5)$$

where v_{ni} is an idiosyncratic utility error term that may vary across suppliers and production activities. The share of output allocated to the active market may differ across production volume and suppliers. For purpose of analytical tractability however, the share parameter, the production costs and the other aggregate market is held constant. Moreover, the idiosyncratic error term is assumed following an IID double exponential distribution. The inverse supply is derived analogous to the demand case,

$$r_i = \alpha_i + \alpha_r^{-1} \ln \left[\frac{Q_{F,i}}{M_F - Q_{F,L} - Q_{F,H}} \right], i = L, H. \quad (6)$$

The producer surplus is calculated as the area over the supply curve under the equilibrium price level. The surplus is Ricardian Rent, i.e. return to quasi-fixed production factors see discussion in Schmitz et al (2002).

The intermediary firms play a Cournot-Nash-Novshek game, in which each firm maximizes profit with respect to output levels with a constant marginal cost of transforming the live animal into a retail product. The profit maximization problem for the n^{th} firm is,

¹⁴ See Lusk and Hudson (2004), and Windle and Rolfe (2005) for a recent empirical application of RUM theory in a supplier context.

$$\begin{aligned} \text{Max } \pi(q_{L,n}, q_{H,n}) = & P_L(Q_L, Q_H)q_{L,n} + P_H(Q_H, Q_L)q_{H,n} \\ & - r_L(Q_L, Q_H)q_{L,n} - r_H(Q_H, Q_L)q_{H,n} - c_L q_{L,n} - c_H q_{H,n}, \end{aligned} \quad (7)$$

where $P_i(Q_i, Q_j)$ and $r_i(Q_i, Q_j)$ are the inverse demand and supply, respectively, $q_{i,n}$ the n^{th} firm output, and c_i the firm's constant marginal cost of production for $(i, j = L, H, i \neq j)$. Note that this formulation also encompasses the single product firm's optimization problem by omitting the expressions $(q_{j,n}, P_j, r_j, c_j)$. For the multiproduct firm, there are two first order conditions. Dropping the subscript for the firm to avoid confusion, the first order conditions are,

$$\begin{aligned} \frac{\partial \pi}{\partial q_i} = & P_i - r_i - c_i + \frac{q_i}{\beta} \left(\frac{M_R - Q_j}{Q_i(M_R - Q_L - Q_H)} \right) + \frac{q_j}{\beta} \left(\frac{1}{M_R - Q_L - Q_H} \right), \\ & - \frac{q_i}{\alpha} \left(\frac{M_F - Q_j}{Q_L(M_F - Q_L - Q_H)} \right) - \frac{q_j}{\alpha} \left(\frac{1}{M_F - Q_L - Q_H} \right) = 0 \end{aligned} \quad (8)$$

for $(i, j = L, H, i \neq j)$. The expression $q_i \beta^{-1} ((M_F - Q_L) Q_i^{-1} (M_F - Q_L - Q_H))^{-1}$ is the own-product markup whereas $q_{-i} \beta^{-1} (M_R - Q_L - Q_H)^{-1}$ is the cross-product markup in the downstream markets. Consequently, in the multiproduct case, products in the product mix can influence several product markets simultaneously. The expression

$q_i \alpha^{-1} ((M_F - Q_{-i}) Q_i^{-1} (M_F - Q_L - Q_H))^{-1}$ is the own-product markdown and

$q_{-i} \alpha^{-1} (M_F - Q_L - Q_H)^{-1}$ the cross-product markdown. If the firm is a single-product

provider, the cross-product expressions cancel. If the conventional and certified product are homogeneous, the first order conditions would reduce to those stated by previous researchers, e.g. Appelbaum, Azzam and Sexton where the price spread is determined by

the own price elasticity of demand, the supply elasticity, as well as the conjectural elasticities in the output and input markets.

Here, however, the new product introduction may have a countervailing market power effect in several markets, i.e. the markup (markdown) in the output (input) market may decrease as the degree of product differentiation increases. This occurs because of the increased substitution possibilities provided to consumers (upstream suppliers) in the downstream (upstream) market. Therefore, in the first order condition, the first term on the right hand side and the first term on the left hand side of the equality sign is referred to as the direct or own-competitive effect, whereas the second term is referred to as the indirect or cross-competitive effect. It is therefore plausible that for the multiproduct firm, there may be strong anti- or pro-competitive effects in the post-certification scenario.

There are a total of (n) intermediary firms in the certified and conventional markets. In the ex-ante scenario, the certified market is assumed perfectly competitive. Therefore, in the ex-ante scenario with single-product intermediary firms, there are $(n/2)$ firms that can influence the conventional upstream and downstream prices through their strategic behavior whereas the $(n/2)$ intermediary firms in the certified market are price-takers. In the ex-post scenario however, the intermediary firms in the certified market can influence the market price through their strategic behavior. The ex-ante scenario is plausible in circumstances where the intermediary firm applies a simple cost-plus pricing for the certified product while it is in its maturing stages. The ex-post scenario can thus represent a situation where the manager knows more about the market conditions and can price the certified product accordingly to his optimizing behavior.

4. An Application: U.S. Pork

The partial equilibrium model presented above is applied in the U.S. pork market. The intermediary firm processes the live animal to a finished consumer good, fresh pork cuts. The markets for other pork products are held constant in the analysis. The certification program can control a particular product attribute or the processes by which the product passes through the marketing channel. The program may for example regulate, or prohibit the usage of antibiotics, growth-promoting substances, enforce environmental compliance, require humane animal treatment in production, regulate the retail-shelf location, etc.

It is assumed that the intermediary industry-C4 is 100 percent, so four firms operate in the market. It is assumed that the intermediary firm is either perfectly competitive, a single-product bilateral oligopolistic firm or a multiproduct bilateral oligopolistic firm.¹⁵

Total consumption of pork chop is derived from public sources. For the last recorded year, 2003, the total consumption pork in carcass weight was 19.4 billion pounds. The retail price for the conventional pork cut is 3.45 dollars per pound see Nilsson for details. In 2003, the average farm price received for pork is 0.70 dollars per pounds. The loin consists of 18% of the carcass (NPB, 2005). In this study, it is assumed that only the pork loin can be labeled. It is however, a conservative level because up to 50% of the carcass can potentially be uniquely certified and labeled. The conversion factor carcass to retail weight is 0.78 (ERS, 2005). Consumption of loin in retail weight is therefore 2.71 billion pounds. The initial market share for certified is set at 5 percent of

¹⁵ See Nilsson for scenarios that are more elaborate. The scenarios presented here, however, encompasses the results presented in Nilsson.

total current consumption, 0.14 billion pounds. Nilsson describes the procedure for which the demand, supply and intermediary firm marginal cost functions are parameterized and Table 1 displays the results from calibrating demand and supply using the baseline data.

Table 1. Calibrated Inverse Demand and Supply Functions.

	Variable	Units	Conventional	Certified	None
DEMAND	Intercept		2.91*	3.57*	---
	Slope coefficient		-1.52	-1.52	---
	Price	\$/lbs	3.45*	6.13	0.00*
	Quantity	billion lbs	2.58*	0.14*	5.85
	Market share	%	30.0	2.00	68.0
SUPPLY	Intercept		1*	3.58	---
	Slope coefficient		0.08	0.08	---
	Price	\$/lbs	0.70*	1.33	0.00*
	Quantity	billion lbs	2.58*	0.14*	46.3
	Market share	%	5.30	0.20	94.5

Notes: The figures are rounded. Total consumption in carcass weight is 19.4 billion pounds (bn lbs). The loin consists of 18% of the carcass. The conversion factor carcass to retail weight is 0.78. Consumption of loin in retail weight is 2.71 bn lbs. Fixed variables denoted by a “*”. Initial market share for certified is set at five percent of total current consumption, 0.14 bn lbs. Total retail market size (M_R) is 8.57 and total farm market size (M_F) is 49.0 bn lbs. Sources: USDA, NPB and author’s calculation.

The retail price premium for the certified good is 78 percent ($=6.13/3.45-1$), whereas the farm price premium is somewhat higher at 90 percent. Because of the jointness in output, the farm price represents the price for just a share of one unit of output. That is, if the farmer supplies one certified live animal to the retail market, the total price the farmer receives is $\pi_H = z1.33 + (1 - z)r^0 - w_H$, where z is the share of live animal that can be sold as pork chops, i.e. 18 percent, and (r^0, w_H) the price received for the other parts of the live animal and the production costs per live animal, respectively.

The calibrated marginal cost for the conventional multiproduct, single-product and perfectly competitive firm is 2.33, 2.34 and 2.75 pounds per pound. The certified marginal cost is 5.75, 5.97 and 6.31 dollars per pound. However, in the ex-post scenario, the constant marginal cost for the certified products is assumed fifty percent higher than the conventional marginal cost. Note that this assumption implies that the certified marginal cost decreases in comparison to its ex-ante counterpart and the certified cost decreases by 39, 58 and 35 percent, respectively. The relative reduction in marginal cost can be motivated for two reasons. First, because the conventional and certified products are otherwise homogenous and the certification program is launched in a national scale, the certified supply chain can utilize the conventional supply channels. There are anecdotal evidences that smaller firms have higher (constant) marginal cost of production because of differences in production technology. Antle (2001: 315) shows that smaller domestic processing firms have relatively higher variable production costs because of technological differences. For example, the mean average animal and labor cost for the small pork processing plants is 0.72, whereas 0.63 dollar per pound for large plants. Large plants are defined as supplying more than 100 million pounds annually. Additionally, Ollinger et al (2005) discusses the structural changes in the U.S. meat supply chain and suggest that small firms exit over time because they have relatively higher production costs than the larger counterparts. Therefore, it is assumed that the ex-post suppliers adopts the conventional production and processing technologies and thereby manage to lower production costs. Anecdotal evidence seems to support this argument for certified firms that currently are serving markets with credence guaranteed meat products, moreover these niche firms are privately owned by the large-scale

processing firms. Second, economic feasibility studies of certification indicate that an animal certification program shifts the processor-retailer's marginal cost by at most fifty percent relative to conventional production (Roller, 2004; Foster, 2004).

5. Discussion of Results and Findings

Figure II depicts the demand and supply shifts in the conventional market under perfect competition. Consumers and producers switch from the conventional market to the certified market, so there is a decrease in demand and supply in the conventional market.

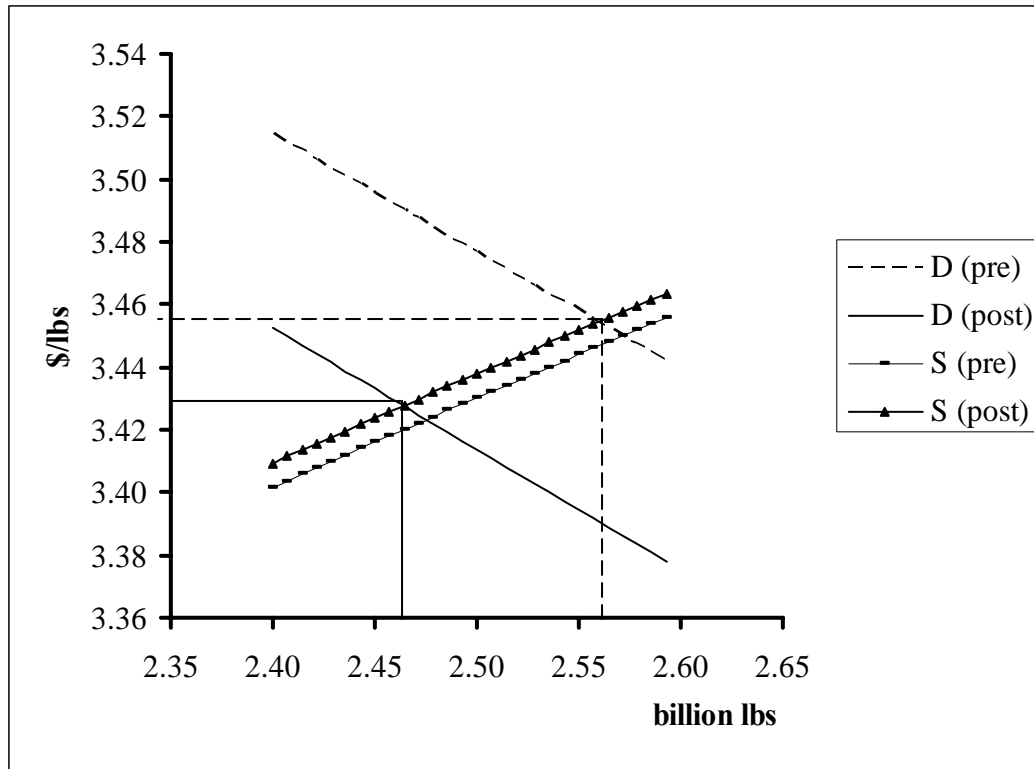


Figure II. The Conventional Market under Perfect Competition. The downward sloping demand curve is labeled “D”, the upward sloping supply curve “S” is the sum of the marginal cost of processing and the farm supply. The dotted lines represent the ex-ante scenario and the bold lines the ex-post scenario. Source: author’s calculation.

In the certified market, the retail price decreases by 15 percent from 7.64 to 6.53 dollars per pound. The farm price increases by 81 percent from 1.33 to 2.40 dollars per pound, see Figure III.

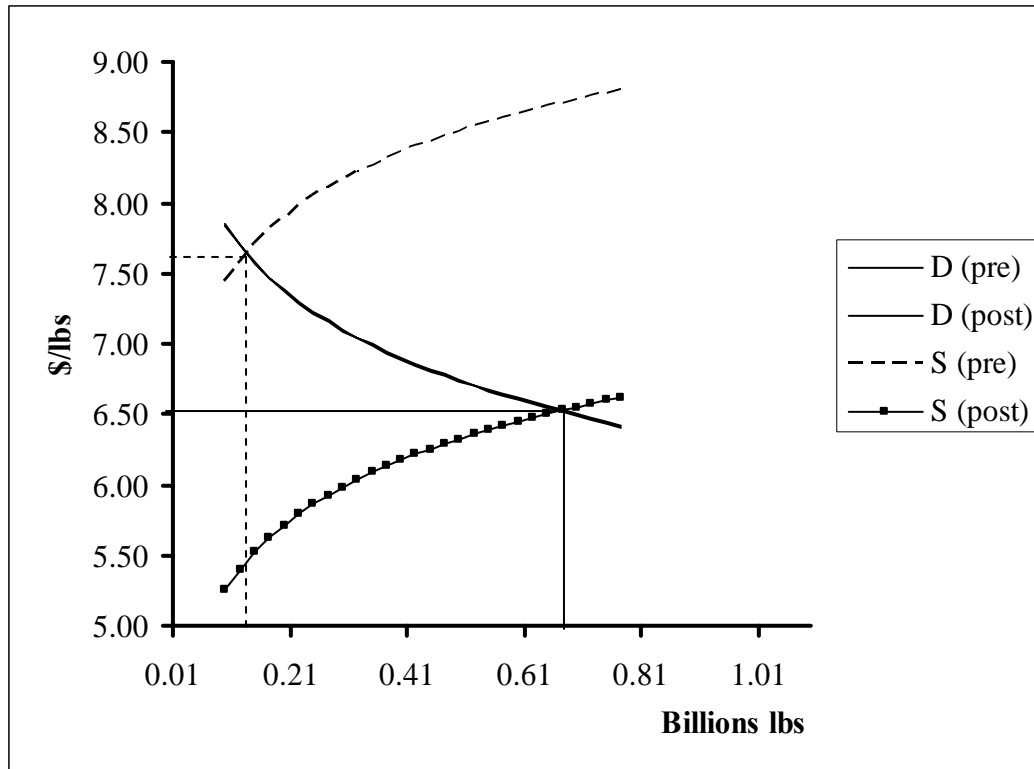


Figure III. The Certified Good Market under Perfect Competition. The downward sloping demand curve is labeled “D”, the upward sloping supply curve “S” is the sum of the marginal cost of processing and the farm supply. The dotted lines represent the ex-ante scenario and the full lines the ex-post scenario. Source: author’s calculation.

As seen in Figure III there is a relatively smaller shift in demand than the shift in supply. Two factors cause a shift in the downstream supply, which is an aggregation of upstream producer supply and intermediary firm marginal cost. The first factor is the reduction in the intermediary firm’s marginal cost. The marginal cost for the certified good decreases from 6.31 to 4.13 dollars per pound. Thus, the certified supplier marginal cost is 50 percent above the conventional it is a net reduction of 53 percent in comparison to the ex-ante scenario. The second factor is that upstream producers exit the conventional markets and enter the certified market.

Table 2 displays the new ex-post equilibrium levels for all three scenarios.

Table 2. Ex-Post Equilibrium.

	Perfect Competition	Single-product	Multiproduct
Total volume (bn lbs)	3.14	3.36	3.05
Relative market share	0.27	0.40	0.29
Conventional			
Quantity (bn lbs)	2.46	2.40	2.36
Retail price (\$/lbs)	3.43	3.42	3.47
Farm price (\$/lbs)	0.68	0.66	0.65
Marginal cost (\$/lbs)	2.75	2.20	2.33
Certified			
Quantity (bn lbs)	0.67	0.97	0.69
Retail price (\$/lbs)	6.53	6.26	6.52
Farm price (\$/lbs)	2.40	2.64	2.41
Marginal cost (\$/lbs)	4.13	3.30	3.50

Notes: The single- and multiproduct scenarios refer to the 4-firm bilateral oligopoly.

Source: author's calculation.

The largest ex-post total consumption, measured as conventional plus certified volume, resides in the single-product bilateral oligopoly case, whereas the multiproduct case has the lowest ex-post volume. In perfect competition, however, the conventional volume is the largest of the three scenarios. The reason is that the imperfectly competitive firms can restrain the conventional output. In particular, the multiproduct firm restrains output relatively more than does the single-product firm. Moreover, the certified volume in the imperfectly competitive regime is relatively higher than in perfect competition. The driving reason why these differences are observed is that the firm optimality conditions are functions of relative prices and costs as well as firm conduct. The impact of certification relative to the ex-ante equilibrium becomes clearer upon calculating the percentage change in prices and quantities depicted in Table 3.

Table 3. Percentage Changes in Equilibrium Prices and Quantities.

	Perfect Competition	Single-product	Multiproduct
Total volume (bn lbs)	16	24	13
Conventional			
Quantity (bn lbs)	-4	-7	-8
Retail price (\$/lbs)	-1	-1	0
Farm price (\$/lbs)	-3	-5	-7
Certified			
Quantity (bn lbs)	398	614	409
Retail price (\$/lbs)	-15	-18	-15
Farm price (\$/lbs)	81	99	81

Notes: The single- and multiproduct scenarios refer to the 4-firm bilateral oligopoly.
Source: author's calculation.

From the table it is clear that while as there is an expansion of total consumption in the ex-post environment the changes in each of the markets is relatively different. For example, for the multiproduct case the conventional market contracts relatively more and the certified market expands relatively less than in perfect competition. This change is accompanied by a relatively larger decrease in conventional farm price and an unchanged retail price. This effect is caused by the fact that the multiproduct provider can influence the price-spread through its direct and indirect effect. However, as indicated earlier, although the multiproduct firm profit is lower than for the equivalent single-product case, the multiproduct firm appears to be somewhat more resilient to change, i.e. it manages to withhold its grip on both markets. This resilience to change can be seen in the single-product case above where the conventional retail and farm prices decrease as much as in perfect competition. Continuing, in the certified market, the prices in the multiproduct and perfect competition case increased nearly the same amount, however, the volume increased more in the former case. In the single-product case, there is a relatively larger

expansion in output and the price-spread shrunk relatively more than in the multiproduct case. The relative changes in welfare are summarized in Table 4 below.

Table 4. Percentage Changes in Welfare.

		Perfect Competition	Single-product	Multiproduct
Conventional	CS	-4	-6	-8
	PS	-4	-7	-8
	Profit		-12	7
	TW	-4	-6	-5
Certified	CS	422	668	433
	PS	401	621	412
	TW	412	1036	655
Both markets	CS	14	23	10
	PS	15	24	12
	Profit		27	46
	TW	15	24	19

Notes: The single- and multiproduct scenarios refer to the 4-firm bilateral oligopoly. CS is consumer surplus; PS is producer surplus; Profit is intermediary firm profit; TW is the sum of consumer and producer surplus and intermediary firm profit. In the multiproduct case, the profit row in the both market section is total intermediary firm profits; the profit row in the conventional and certified section refers to the profit that accrue to the firm in the aforementioned markets. Source: author's calculation.

As depicted by the table, the distributional impact from certification on consumers and producers depends on the competitive structure of the industry. For both the single- and multiproduct firm, conventional consumers and producers surplus decreases relatively more than in perfect competition. For the multiproduct firm, consumer and producer surplus decrease relatively more than in the single product case. Moreover, the multiproduct firm profit increase in the conventional market whereas profit decreases for the conventional single-product firm. In the certified market, consumer and producer surplus increase more than in the other two scenarios.

On aggregate therefore, consumer and producer surplus increase relatively more in the single-product than the multiproduct or perfect competition scenario. Moreover, multiproduct firm profit increases relatively more than in the other two scenarios. Total welfare, measured as the sum of consumer and producer surplus and intermediary firm profits, increases the most in the single-product scenario because of the relatively larger expansion in the certified market.

6. Summary

Introducing a voluntary certification and labeling program in a marketplace where consumers have heterogeneous preferences and firms have potentially market power lead to a situation in which the certified product cannot replace the conventional product. Although the certified good market expanded by between 400 to 800 percent, the conventional market remained quite large in the ex-post equilibrium. Thus, the certified good could not replace the conventional product. Two determinants drive this result, namely the distribution of consumer preferences and the upward sloping marginal cost curve. There is a welfare increase by 15 percent in the perfect competition scenario. Moreover, in comparison to a situation where the intermediary firms are single product versus multiproduct providers, the model predicts that the multiproduct firm retains some market power ex-post certification. The numerical results indicate that markets become more competitive when firms are single product providers. In particular, the multiproduct provider can cause a price increase in the conventional market despite the demand contraction. The primary driver of this result comes from the fact that the firm can control the output in both markets via a direct and indirect effect that act as a pro-competitive

dampening effect. This insight may be in somewhat contrast to Brander and Eaton's discussion. They argue, "A fairly common historical pattern is for firms to expand the scope of their product offerings and compete more directly with each other as the market grows" (1984, p.323). However, the results presented here indicate that markets become relatively more competitive when firms are single product providers. The mere fact that the firm can influence the market via the direct and indirect effect softens the competition.

In summary, the contribution of this paper is three-fold. First, the firm strategic behavior boils down to a simultaneous decision process, rather than sequential, via the mere formulation of the optimization problem. Although Brander and Eaton argue that sequential managerial decision processes are more realistic, it is not exactly the contention of the workings of the studied industry. Firm strategic behavior is a simultaneous process and not sequential. Second, the partial equilibrium economy is consistent with utility maximization theory in which the consumers have heterogeneous preferences and regard products as both vertically and horizontally differentiated. This is an important distinction from previous studies. Stole derives the firm optimality conditions in terms of elasticities. However, in our model, there is a shift in demand and supply so the formulation provides little guidance. Gilbert and Matutes work in a vertical product differentiation framework, whereas in this study, consumers have heterogeneous preferences and thus value products differently.

The third contribution is that the study provides guidance to the stakeholders in the industry. The certification program may be a profitable strategy that ensures market access, alleviates market power, and expands the consumer-end market. While the model

predicts that a lion's share of total consumption comes from the conventional supply chain, the certified product market does expand. A pork producer weighting the pros and cons of engaging in a certification program should consider its own cost of production. If the pork producer cannot commit to the certification program, she may incur a surplus loss. For the packer-retailer, the program may be a profitable strategy that matches heterogeneous consumer demand preferences with extensive certified and conventional product diversification. Thus, by supplying products with different product attributes, firms differentiate among different consumers on basis of their different willingness to pay for different product attributes.

For policy makers, the model offers insight on whether the program reduces the intermediary firms' abilities to influence the market price via its strategic behavior. An increase of the product variety may provide a better match between consumers with heterogeneous tastes and products with different quality attributes. Hence, consumers concerned about the environment, animal welfare and antibiotic residues may find the program beneficial as the retailer supply products that better match their preferences, hence enhance their well-being.¹⁶

¹⁶ Moreover, the economic model presented here does not capture the potential economic benefits that the certification may provide from reducing or eliminating economic externalities. In such instance, the welfare increase presented here is likely to be understated.

REFERENCES

- Aiginger, Karl, 1999, "The Use of Game Theoretical Models for Empirical Industrial Organization," *Competition, Efficiency, and Welfare: Essays in Honor of Manfred Neumann*, Boston; Dordrecht and London: Kluwer Academic: 253-277.
- Akerlof, George A., 2001, "Prize Lecture, Behavioral Macroeconomics and Macroeconomic Behavior," In: *Les Prix Nobel, the Nobel Prizes 2001*, Tore Frängsmyr (Ed.), Stockholm: 365-394.
- Anderson, John D., and Darren Hudson, 2004, "Potential Impact of Country-of-Origin Labeling on Beef Industry Structure," *Choices*, 19(4): 21-24.
- Andersson, Simon P., Andre de Palma, and Jacques-Francois Thisse, 2001, *Discrete Choice Theory of Product Differentiation*, Cambridge and London: the MIT Press, 423 p.
- Antle, John M., 2000, "No Such Thing as a Free Safe Lunch: The Cost of Food Safety Regulation in the Meat Industry," *American Journal of Agricultural Economics*, 82(2): 310-22.
- Antle, John M., 2001, "Economic Analysis of Food Safety," In: *Handbook of Agricultural Economics, 1B, Marketing, Distribution and Consumers*, Bruce L. Gardner, and Gordon C. Rausser (Eds.), Handbooks in Economics, 18, Amsterdam; London and New York: Elsevier Science, North-Holland: 1083-1136.
- Baumol William J., 1982, "Contestable Markets - An Uprising in the Theory of Industry Structure," *American Economic Review*, 72 (1): 1-15.
- Baumol William J., John C. Panzar, and Robert D. Willig, 1983, "Contestable Markets - An Uprising in the Theory of Industry Structure - Reply," *American Economic Review*, 73 (3): 491-496.
- Boessen Christian, John D. Lawrence, and Glenn Grimes, 2003, "Production and Marketing Characteristics of U.S. Pork Producers," *Agricultural Economics Working Paper 2004-4*. Internet: <http://www.porkboard.org/EconMktInfo/Production%20and%20Marketing2003.doc>, Accessed: 5 April, 2005.

- Bulow, Jeremy I., John D. Geanakoplos, and Paul D. Klemperer, 1985, "Multimarket Oligopoly: Strategic Substitutes and Complements," *Journal of Political Economy*, 93(3): 488-511.
- Bulow, Jeremy I., John D. Geanakoplos, and Paul D. Klemperer, 1985, "Holding Idle Capacity to Deter Entry (The Role of Investment in Entry Deterrence)," *Economic Journal*, 95(127): 178-82.
- Caswell, Julie A., and Eliza M. Mojduszka, 1996, "Using Informational Labeling to Influence the Market for Quality in Food Products," *American Journal of Agricultural Economics*, 78(5): 1248-1253.
- Corstjens, Marcel, and Peter Doyle, 1981, "A Model for Optimizing Retail Space Allocations," *Management Science* 27(7): 822-833.
- Crespi, John M., and Stéphan Marette, 2001, "How Should Food Safety Certification Be Financed?" *American Journal of Agricultural Economics*, 83(4): 852-862.
- Darby, Michael R., and Edi Karni, 1973, "Free Competition and the Optimal Amount of Fraud," *Journal of Law and Economics*, 16(1): 67-88.
- Esfahani, Elizabeth, 2003, "PETA Accuses Smithfield Food Inc. of Cruelty to Pigs," *Richmond Times-Dispatch* (VA), HTML: <http://search.epnet.com/direct.asp?an=2W62287231476&db=nfh>, Accessed: 7 May 2003.
- Foster, Kenneth A., 2004, *Education Committee of the Indiana Pork Producers Association*, Purdue University Extension Meeting, 30 November 2004.
- Gilbert, Richard J.; Matutes, Carmen, 1993, "Product Line Rivalry with Brand Differentiation," *Journal of Industrial Economics*, 41(3): 223-241.
- Golan, Elise, Fred Kuchler, and Lorraine Mitchell, 2001, "Economics of Food Labeling," *Journal of Consumer Policy*, 24(2): 117-184.
- Halkias, Maria, 2002, "Safeway Promises PETA It Will Dump Inhumane Suppliers," *The Dallas Morning News* (TX), HTML: <http://search.epnet.com/direct.asp?an=2W71827184115&db=nfh>, Accessed: 7 May 2003.
- Hausman, Jerry A., 1994, "Valuation of New Goods under Perfect and Imperfect Competition," *NBER Working Papers 4970*, National Bureau of Economic Research Inc, 32 p.

- Henderson, Jason R., 2001, "Market Conduct in the U.S. Pork Industry and the Impact of Changing Market Conditions and Capacity Constraints," *PhD Dissertation*, Purdue University, 172 p.
- Henson, Spencer, and Mario Mazzocchi, 2002, "Impact of Bovine Spongiform Encephalopathy on Agribusiness in the United Kingdom: Results of an Event Study of Equity Prices," *American Journal of Agricultural Economics*, 84(2): 370-386.
- Kinnucan, Henry W., 2003, "Optimal Generic Advertising in an Imperfectly Competitive Food Industry with Variable Proportions," *Agricultural Economics*, 29(2): 143-158.
- Klemperer, Paul, 1992, "Equilibrium Product Lines: Competing Head-to-Head May Be Less Competitive" *American Economic Review*, 82(4): 740-756.
- LaFrance, Jeffrey T., 1985, "Linear Demand Functions in Theory and Practice," *Journal of Economic Theory*, 37(1): 147-166.
- LaFrance, Jeffrey T., and Michael W. Hanemann, 1989, "The Dual Structure of Incomplete Demand Systems," *American Journal of Agricultural Economics*, 71(2): 262-274.
- Lancaster, Kelvin, 1990, "The Economics of Product Variety – A Survey," *Marketing Science*, 9(3): 189-206.
- Lusk, Jayson L., and Ted C. Schroeder, 2002, "Effects of Meat Recalls on Futures Market Prices," *Agricultural and Resource Economics Review*, 31(1): 47-58.
- Lusk, Jayson L., Bailey Norwood, and Ross Pruitt, 2004, "Consumer Demand for a Ban on Subtherapeutic Antibiotic Use in Pork Production" *in submission*, 40 p.
- Lutz, Stefan, 1997, "Vertical Product Differentiation and Entry Deterrence," *Journal of Economics*, 65(1): 79-99.
- Lutz, Stefan, Thomas P. Lyon, and John W. Maxwell 2000, "Quality Leadership When Regulatory Standards are Forthcoming," *Journal of Industrial Economics*, 48(3): 331-349.
- Marette, Stephan, John M. Crespi, and A. Schiavina, 1999, "The Role of Common Labeling In a Context of Asymmetric Information," *European Review of Agricultural Economics*, 26(2): 167-178.

- Martin, Stephen, 2002, *Advanced Industrial Economics*, Malden, Mass: Blackwell Publishers, 660 p.
- McDonald's Corporate Press Release, 2003, "McDonald's Calls for Phase-Out of Growth Promoting Antibiotics in Meat Supply, Establishes Global Policy on Antibiotic Use." *McDonald's Corporation*, HTML:
<http://www.mcdonalds.com/corporate/press/corporate/2003/06192003/index.html>,
Accessed: 21 June 2003.
- Moorthy, K., and Sridhar I.P.L. Png, 1992, "Market Segmentation, Cannibalization, and the Timing of Product Introductions," *Management Science*, 38(3): 345-360.
- Mussa, Michael and Sherwin Rosen, 1978, "Monopoly and Product Quality," *Journal of Economic Theory*, 18(2): 301-17.
- Muth, Mary K., and Michael K. Wohlgenant, 1999, "A Test of Market Power Using Marginal Input and Output Prices with Application to the U.S. Beef Processing Industry," *American Journal of Agricultural Economics*, 81(3): 638-643.
- National Pork Board (NPB), 2005, <http://www.porkboard.org/EconMktInfo/default.asp/>,
Accessed 5 April 2005.
- Nelson Phillip, 1970, "Information and Consumer Behavior," *The Journal of Political Economy*, 78(2): 311-329.
- Nelson Phillip, 1974, "Advertising as Information," *The Journal of Political Economy*, 82(4): 729-754.
- Nelson Phillip, 1975, "The Economic Consequences of Advertising," *The Journal of Business*, 48(2): 213-241.
- Nevo, Aviv, 2001, "Measuring Market Power in the Ready-to-Eat Cereal Industry," *Econometrica*, 69(2): 307-42.
- Nevo, Aviv, 2003, "New Products, Quality Changes, and Welfare Measures Computed From Estimated Demand Systems," *Review of Economics & Statistics*, 85(2): 266-276.
- Nilsson, K. H. Tomas, 2005, "Essays on Product Choice, Certification and Imperfect Competition," *Unpublished Dissertation Chapter*, Purdue University, 250 p.

- Nilsson, K. H. Tomas, and Ken Foster, 2004, "Product and Process Certification in Imperfectly Competitive Markets," *Selected Paper American Agricultural Economics Association*, 23 p.
- Nilsson, K. H. Tomas, Paul Preckel, Bo Öhlmer, and Hans Andersson, 2003, "Revisiting the Role of Common Labeling in a Context of Asymmetric Information: Critique and Extensions," *ERSA Conference Papers*, European Regional Science Association, 50 p.
- Ollinger, Michael, Sang V. Nguyen, Donald Blayney, Bill Chambers, and Ken Nelson, 2005, "Structural Change in the Meat, Poultry, Dairy, and Grain Processing Industries," *Economic Research Report*, ERR3, 32 pp.
- Osterberg David, and David Wallinga, 2004, "Determinants of Rural Health, Addressing Externalities from Swine Production to Reduce Public Health and Environmental Impacts," *American Journal of Public Health*, 94(10): 1703-1708.
- Packaged Facts, 2005, <http://www.packagedfacts.com/>, Accessed 4 April 2005.
- Piggott, Nicholas E., and Thomas L. Marsh, 2004, "Does Food Safety Information Impact U.S. Meat Demand?" *American Journal of Agricultural Economics* 86(1): 154-174.
- Piggott, Nicholas E., and Thomas L. Marsh, 2004, "Does Food Safety Information Impact U.S. Meat Demand?" *American Journal of Agricultural Economics* 86 (1), 154-174.
- Roller, Jason R., 2004, *the Indiana Pork Certification Program: The Components, Costs, and Potential Viability*, Masters Thesis, Purdue University, 170 p.
- Scherer, F. M., 1979, "The Welfare Economics of Product Variety: An Application to the Ready-To-Eat Cereals Industry," *Journal of Industrial Economics*, 28(2): 113-135.
- Schmalensee, Richard, 1978, "Entry Deterrence in the Ready-To-Eat Breakfast Cereal Industry," *Bell Journal of Economics*, 9(2): 305-328.
- Schmitz, Andrew, Hartley Furtan, and Katherine Baylis, 2002, *Agricultural Policy, Agribusiness, and Rent-Seeking Behaviour*, University of Toronto Press, 511 p.
- Schroeter John R., and Azzeddine Azzam, 1990, "Measuring Market Power in Multi-Product Oligopolies: The U.S. Meat Industry," *Applied Economics*, 22(10): 1365-1376.

- Sexton, Richard J., 2000, "Industrialization and Consolidation in the U.S. Food Sector: Implications for Competition and Welfare," *American Journal of Agricultural Economics*, 82(5): 1087-1104.
- Shaked, Avner, and John Sutton, 1982, "Relaxing Price Competition through Product Differentiation," *The Review of Economic Studies*, 49(1): 3-13.
- Spence, A. Michael, 2001, "Prize Lecture, Signaling in Retrospect and the Informational Structure of Markets," In: *Les Prix Nobel, The Nobel Prizes 2001*, Tore Frängsmyr (Ed.), Stockholm: 407-444.
- Spence, Michael, 1976, "Product Selection, Fixed Costs, and Monopolistic Competition," *The Review of Economic Studies*, 43(134): 217-235.
- Stole Lars, 2003, "Price Discrimination and Imperfect Competition," *Prepared for the Handbook of Industrial Organization version December 22, 2003*, HTML: web.mit.edu/14.271/www/hio-pdic.pdf, Accessed 23 March 2005.
- Sutton, John, 1986, "Vertical Product Differentiation: Some Basic Themes," *The American Economic Review*, 76(2): 393-398.
- Thomsen, Michael R., and Andrew M. McKenzie, 2001, "Market Incentives for Safe Foods: An Examination of Shareholder Losses from Meat and Poultry Recalls," *American Journal of Agricultural Economics* 83(3): 526-537.
- Tirole, Jean, 1988, *the Theory of Industrial Organization*, Cambridge, Mass, MIT Press, 479 p.
- U.S. Department of Agriculture, Economic Research Service (ERS), 2005, "Red Meat Yearbook," HTML: <http://www.ers.usda.gov/Data/sdp/view.asp?f=livestock/94006/>, Accessed: May 2, 2005.
- U.S. Department of Health and Human Services (HHS), 2002, "HHS, USDA Take Next Step in Obesity Fight, Secretaries Thompson and Veneman Meet With Leaders from Food Industry," News Release, HHS Press Office and USDA Press Office, HTML: <http://www.hhs.gov/news/press/2002pres/20021015c.html>, Accessed: March 27, 2005.
- Van Ravenswaay, O. Eileen, and John P. Hoehn, 1996, "The Theoretical Benefits of Food Safety Policies: A Total Economic Value Framework," *American Journal of Agricultural Economics*, 78(5): 1291-1296.

Werden, Gregory J., and Luke M. Froeb, 1994, "The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy," *Journal of Law, Economics and Organization*, 10(2): 407-426.