Quality Policy,
Market Structure and Investment Behavior
in the Food Marketing Chain

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Abstract

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This thesis, consisting of four articles, analyzes quality in relation to consumer demand and market structure, and the potential problem of asset fixity at primary level. All four articles, directly or indirectly, relate to different parts of the food marketing chain. Article I examines country of origin as a quality cue from a consumer perception perspective. This is an empirical article applied to the market for fresh meat in Sweden where the characteristics of consumers are related to how important they perceive the labelling "Swedish" to be in evaluating (i) the eating quality and (ii) the food safety of pork, beef and chicken.

Article II examines how ownership structure affects the equilibrium within a two-stage duopoly framework where firms first choose what qualities to produce and then compete in prices. Specifically, cooperatives and investor-owned firms are analyzed. It is shown that firms can have a structural cost advantage due to ownership structure in addition to the high-quality advantage identified in previous literature. The equilibrium outcomes are examined and the policy implications of the different structures are discussed.

In a multi-product oligopoly framework article III examines what qualities firms choose to produce and the conditions for when firms choose specialization versus *head-to-head* competition. The conditions for symmetric and asymmetric equilibria are identified and discussed. It is shown that *head-to-head* competition rather than specialization is a common outcome and that *holes* may be left in the product line.

Finally, article IV examines the impact of uncertainty on investment behavior in the U.S. hog production using an endogenous threshold model. The results indicate that the investment behavior is characterized by three regimes (investment, disinvestment and inaction) and thus yield support for asset fixity in sow investments. The importance of accounting for investment rigidity when estimating hog supply and variable input demands is highlighted. While quality is not explicitly modelled in article IV, the potential problem of asset fixity examined has implications for quality policy.

Key words: quality, meat marketing chain, country of origin, endogenous quality choice, ownership structure, vertical integration, product line competition, *head-to-head* competition, investment asymmetry, asset fixity, U.S. hog industry.

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Preface

During my time as a doctoral student I have, as almost seems compulsory for a doctoral student, despaired many times. Now, when the thesis is finally in print I want to extend my gratitude to all those who, in different ways, have helped me to complete my doctoral studies.

First, I would like to thank my advisors. Hans Andersson who, in better times and worse, have believed in my ability to finalize my thesis and who have supported me over the long haul. As I do not share your intent interest in Arsenal and football, your similes have sometimes been hard to grasp. Other times, however, they have been right on the spot. Despite your fondness of sometimes provoking people around you, it is evident that your heart is in the right place. Your support have been much appreciated. So, thank you Hans! Clas Eriksson has been my assistant advisor during the later part of my work on this thesis. Clas has an aptitude for encouraging and constructive criticism. I think many of us at the department have experienced this after seminars and whenever one asks for his opinion. Thank you Clas for taking the time, your involvement in my work has, I believe, been the crucial injection that I needed to finalize the thesis!

A special thank to Ficre Zehaie for his constructive discussion on many occasions. He once read a draft of one of my papers, commented upon it, read a revised version and exclaimed - Aha, now I understand what you mean. Talk about constructive criticism. Thanks also to Monica Campos, especially for comments concerning the "kappa"; to Rob Hart, ever so helpful be it economics, Tex or just plain English; to Mark Brady, who also has contributed when it comes to English. I also thank Azzedine Azzam for constructive comments concerning article II and Sten Nyberg for reviewing article III in this thesis.

There are many colleagues and friends at the Department of Economics, past and present, who have contributed towards making my time as a graduate student at the department a rewarding one. When writing this acknowledgement many stories and thoughts concerning different people and events came to mind. I started to write some of them down but stopped, realizing that this is intended to be a short acknowledgement. So, instead I sincerely thank you all as a group.

During my time as a doctoral student I visited Minneapolis in the U.S. on more than one occasion. I would like to thank the people at the Department of Applied Economics, University of Minnesota, for making my time there so rewarding. A special thanks to Donald Liu for the rewarding academic cooperation and friendship. Relating to the time I spent in Minnesota "the n-herd" has to be mentioned. Discussions on academic topics aside, I appreciate that you took me in and let me see some of the American ways. So thanks Steff, Bob, Brenda, Scott, Brian and Faith. I am still waiting for you all to come visit the old world. A thanks also to Terje who during my first time in the U.S. bridged the gap between the American and Scandinavian way - it was nice to sometimes be able to "snacke norsk".

Finally, I pay homage to my family and friends for all encouragement and support over the years. Without you this thesis would not have been.

Ruben Hoffmann
Uppsala, April, 2006

Articles appended to the thesis

I   Country of origin — a consumer perception perspective of fresh meat. *British Food Journal* 102(3), 211-229, 2000.

II Ownership Structure and Endogenous Quality Choice: Cooperatives versus Investor-Owned Firms. *Journal of Agricultural & Food Industrial Organization* 3:8, 1-24, 2005.

III Product Line Competition and Vertical Integration in Vertically Differentiated Markets.

IV Estimating Investment Rigidity within a Threshold Regression Framework: The Case of U.S. Hog Production Sector. *American Journal of Agricultural Economics* (forthcoming)
    B. Boetel, R. Hoffmann and D. Liu.

Contents

Quality Policy, Market Structure and Investment Behavior in the Food Marketing Chain

Articles I–IV

1 Introduction

There are two observations pertaining to the food industry that have driven much of the research presented in this thesis. The first observation is that there has been an increased focus on quality and that quality assurance schemes have become increasingly common over the years. The other observation is that vertically integrated cooperatives are common in many agricultural markets, and that cooperatives in these markets often compete with investor-owned firms. These observations relate to the Swedish food industry as well as the food industry in many other countries.

The increased focus on food quality in recent years can be explained by changing consumer preferences, negative publicity concerning food safety and food quality, and increased international competition as a result of deregulation. Faced with the problems of, for example salmonella, BSE (mad cow disease), e-coli, different quality assurance schemes have been implemented. Some of these have been initiated by the industry, some by the government, some by third parties and some in collaboration between different parties. While some of these quality assurance schemes are exclusively for internal use, the food marketing chain has also developed several quality assurance schemes and private labels to be communicated to consumers (e.g., Northen, 2000). By developing quality assurance schemes and requiring suppliers to implement these, companies downstream are able to control the quality of the final product and ultimately to gain consumer trust, and potentially an increase in market shares and profits.

The globalization has substantially influenced quality policy. In the interest of free trade the roles of national regulations have been circumscribed. Different countries, or groups of countries, represent different views on what food quality and food safety really constitutes. For example, the EU and the U.S. represent different views concerning the use of hormones in meat production and concerning genetically modified products (see e.g., Sheldon, 2002; Fulton and Giannakas, 2004; Lusk et al., 2003; Alfnes and Rickertsen, 2003). Given the institutional framework of the WTO, such different views can naturally lead to that a more liberal, exporting country accuses a more restrictive, importing country of protectionism.

Within the EU, regulations pertaining to the internal market state that goods should be allowed to move freely between member states.[1] Hence, national regulations that may be considered to be trade barriers have to be approved by the EU by exemption. While individual member countries may impose regulations concerning the domestic production practices, they have generally no right to ban imports from other EU member states produced according to the national regulations in the exporting countries. Hence, the role of national regulations by member states has been circumscribed which increases the importance of quality assurance schemes implemented by the industry or by third parties.

The increased focus on quality in the food marketing chain has resulted in an increased need for vertical integration and other forms of vertical coordination. Menard and Klein (2004), examining the organizational structure of the EU and

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[1] See especially Articles 28-30 of the EC Treaty available at
$http : //europa.eu.int/comm/enterprise/regulation/goods/art 2830 en.htm.$

the U.S. agricultural sectors, emphasize the importance of network organizations in agricultural markets. Network organizations constitute a compromise between the benefits of centralized control and the benefits of decentralized decision making with respect to incentives and information, relying on relational contracts rather than only formal written agreements. One traditional kind of network organizations, common in the agricultural sector in many countries, is producer cooperatives.[2] The aim of an agricultural cooperative is to assist the members/farmers in producing and marketing their output.[3] While cooperatives dominate some markets they usually compete with investor-owned firms. The market share of the cooperatives naturally differs between countries and sectors. Within the EU-15, the market shares of the agricultural cooperatives are substantial in many markets. For example, dairy cooperatives are present in all 15 countries and have a market share of 80% or more in nine of these countries. While cooperatives are less dominating concerning meats and cereals, cooperatives have a market share of at least 50% in six of the countries for each of the product groups[4].(Van Bekkum et al., 1997; Juliá and Server, 2003) In the U.S. there were more than 3,000 agricultural cooperatives, half of which were marketing cooperatives, accounting for 25– 30% of total farm marketing and supply expenditures in 2001 (Giannakas and Fulton, 2005; USDA, 2003).

Given the effects that globalization of the food market and the increased focus on quality have on consumer demand it is important to understand quality policy from a consumer perspective. Furthermore, it is well-known that the organizational structure of firms operating in the same market is crucial for the market outcome. Given the coexistence of firms with different structures in many agricultural markets, it is important to better understand how the market outcome is affected by different organizational structures when quality policy is taken into account. Furthermore, Loyd et al. (2001) have shown that the magnitude of price shifts due to food scares may be greater further up-stream the marketing chain, i.e. that the change in input prices is larger than the change in output prices.

This thesis analyzes quality in relation to consumer demand and market structure. Furthermore, the potential problem of asset fixity at primary level is examined. An overview of the articles in this thesis is given in table 1. All four articles, directly or indirectly, relate to the food marketing chain. Specifically, article I and article IV, which are of empirical nature, directly relate to the meat marketing chain while article II and article III may be related to the meat marketing chain although they are of a more general theoretical nature. The articles cover different parts of the marketing chain. Article I examines the consumer side of the market, article II and III examines the primary and secondary level of the marketing chain using a game theoretic approach, and article IV analyzes the primary level.

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[2] In Sweden the first farm cooperative was formed as early as 1850 (van Boekel et al., 1997).

[3] There exist many different kinds of cooperatives but they can they be said to be either marketing cooperative, buying the output generated by the members and marketing the goods to firms/customers downstream the marketing chain, or supply cooperatives, supplying inputs required by the members, or a combination of the two. Whenever cooperatives are mentioned in this thesis it first and foremost refers to marketing cooperatives.

[4] For at least one kind of meat.

Table 1: Overview of the articles

		Articles			
		I	II	III	IV
Nature of article	- empirical	x			x
	- theoretical		x	x	
Level of the marketing chain					
	- primary level		x	x	x
	- secondary level		x	x	
	- consumer level	x			
Heterogeneity	- producers		x	x	
	- consumers	x	x	x	
	- products (quality)	x	x	x	$a)$
Strategic interactions, game theory			x	x	
Institutional aspects, industrial structure		$b)$	x	x	
Uncertainty		$x^{c)}$			x
Cost structure	- fixed		x		$x^{d)}$
	- variable, CRS		x	x	
	- variable, DRS		x	x	x

$a)$ While not explicitly modelled the result has implications for quality policy as discussed in the text. $b)$ The institutional aspect is only considered in the respect that the regulatory framework is essential for the article. $c)$ The type of product characteristics considered are primarily of such nature that consumers have to rely on quality assurance schemes in order to obtain the relevant information. $d)$ Focuses on quasi-fixed inputs.

Articles I-III are all concerned with some aspect of quality as shown in table 1. While quality is not explicitly modelled in article IV, the conclusion that producers seem to sometimes adjust slower than the market conditions warrant has implications for quality policy. If uncertainty in "traditional" production implies asset fixity then, the adoption of new quality assurance schemes may imply a slow adjustment to new production practices as these may be perceived as entailing additional uncertainty. On the other hand, a quality assurance scheme may be perceived as a possibility of targeting a niche of the market, i.e. a small but higher priced market segment, in which case it would reduce the perceived uncertainty. Hendrikse and Bijman (2001) argue that increased vertical coordination may increase asset fixity as investments become more relationship specific. Given that the increased focus on quality result in an increased need for vertical coordination, the focus on quality is likely to increase asset fixity.

Article I examines country of origin as a quality cue from a consumer perception perspective. This is an empirical article applied to the market for fresh meat in Sweden where the characteristics of consumers are related to how they perceive the labelling of country of origin. The size of the meat marketing chain[5] and the

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[5] The meat consumption in Sweden as well as in the EU is substantial and increasing over time. Meat

inherent types of characteristics undetectable to the individual consumer, such as animal welfare concerns, makes it an interesting industry to study from a quality policy perspective.

Article II examines how the ownership structure of competing firms affect what qualities firms choose to produce, how much of each quality they produce, what prices they charge and how the welfare of producers and consumers are affected by ownership structure. Specifically, vertically integrated marketing cooperatives and investor-owned processing firms are analyzed within a game theoretic framework. Furthermore, the choice of product lines and the effects of entry are discussed.

In a multi-product oligopoly framework, article III examines what qualities firms choose to produce and the conditions for when firms choose specialization versus *head-to-head* competition given that firms may be either vertically integrated or vertically separated between the primary and the secondary levels of the marketing chain.

Article IV examines the impact of uncertainty on investment behavior in the U.S. hog industry using an endogenous threshold model. The U.S. hog production has been characterized by a considerable structural change from smaller to larger scale operations in the last decade.[6] This drastic change can partly be explained by increased access to international markets and various forms of vertical arrangements. The structural change has naturally required greater amounts and more specialized types of capital, thus potentially increasing the problem of asset fixity.

In the next section some theoretical background is presented. First, a brief general introduction concerning quality and product differentiation is given in section 2.1. This is followed, in section 2.2, by a discussion concerning quality from a consumer perspective. In section 2.3 game theory and vertical product differentiation is discussed. The background to and the conclusions of article I is discussed in section 3. Article II and article III are discussed and the conclusions and contributions of each of the articles are presented in section 4 and 5, respectively. This is followed by a presentation of article IV in section 6. In section 7, some ideas for future research are discussed.

2 Product Differentiation, Quality Cues and Game Theory

2.1 Product Differentiation

Most products can be described as consisting of a bundle of characteristics. These characteristics may be quality aspects, location, availability, consumers' information etc. Given the complexity of most products it is rare that any two products are

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consumption within EU-15 averaged 98 kg per capita in 2003. While the consumption in Sweden is among the lowest in the EU it nevertheless amounts to approximately 80 kg per capita. (Abando and Palou, 2006).

[6] For example, the proportion of hogs in operations with more than 5,000 hogs increased from 21% to 53 % between 1994 and 2004 (USDA, 1995/96-2004/05).

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perfect substitutes, i.e. that consumers are indifferent between two goods. Including all potential characteristics of a good would give a more complete description of the good but would make it virtually impossible to analyze issues of industrial organization. Hence, in trying to understand how markets work, theoretical as well as empirical research focus on a subset of these characteristics in combination with some specific characterization of consumer preferences.[7]

Traditionally, the literature on product differentiation has adopted two different approaches to consumer preferences, the non-address approach and the address approach. In the non-address approach it is assumed that consumers gain utility from consuming a variety of products and hence, they buy a variety of brands (see e.g., Chamberlin, 1933). In the address approach, on the other hand, consumers buy only one brand but consumers have heterogenous tastes and hence, differ in their most preferred choice, i.e. they have different "locations" in the preference space. The following presentation is restricted to the address approach which is also referred to as spatial or location differentiation models.

The basic version of a location model is the "linear city" model introduced by Hotelling (1929).[8] Two firms selling homogenous goods — in all but the geographical aspect — are located at the opposite ends of a straight road. This situation is depicted in Figure 1 where consumers are located along the same road at different addresses between $firm\ a$ and $firm\ b$.[9] Hence, if firms charge the same price, consumers differ in their most preferred choice as to which firm to buy from, such that consumers living closer to $firm\ a$ will buy from $firm\ a$ while consumers living closer $firm\ b$ will prefer to buy from $firm\ b$. The products are then horizontally differentiated. Examples of horizontally differentiated goods are for example yoghurt and bread. One consumer may prefer flavored over natural yoghurt and dark bread over white bread while another consumer may prefer natural over flavored yoghurt and white bread over dark bread.
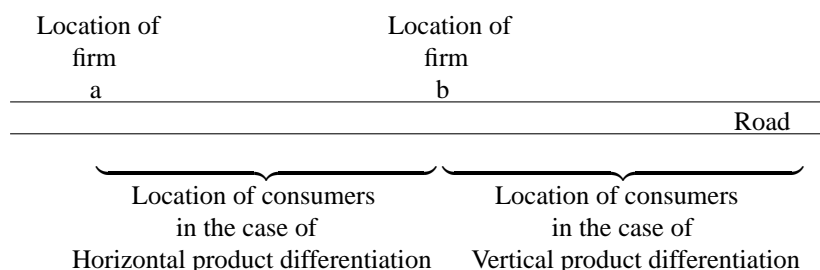
Figure 1: The "linear city" model - Horizontal and Vertical product differentiation

Vertical product differentiation, as opposed to horizontal product differentiation, implies that consumers rank different goods in the same order, i.e. the good

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[7] For a more comprehensive review of product differentiation the reader is referred to for example Eaton and Lipsey (1989), and Beath and Katsoulacos (1991).

[8] Salop (1979) later developed this model and introduced the notion of the "circular city".

[9] Consumers differ either in tastes or in incomes.

preferred over another good by one consumer is also preferred by all other consumers, if the goods are offered at the same price (see e.g., Mussa and Rosen, 1978; Gabszewics and Thisse, 1979; Shaked and Sutton, 1982, 1983). Examples of such goods are grain with different protein content, (usually) fillet compared to cutlet, meat controlled compared to meat not controlled for salmonella, etc.

Referring again to Figure 1, this implies that consumers instead of being distributed between $firm\ a$ and $firm\ b$ are distributed to the right of firm $firm\ b$.[10] Consequently, all consumers would prefer to buy from $firm\ b$ rather than from $firm\ a$. This does not, however, necessarily mean that all consumers will buy from $firm\ b$ as the price at the different locations will differ, or $firm\ a$ will go out of business, and consumers, although they rank the goods in the same order, differ in their location.[11]

While very simplified, this model helps us gain insight as to the behavior of firms and how markets work. The geographical aspect of the "linear city" model is sometimes relevant but can more generally be thought of as a visualization of some one dimensional quality space. Instead of geographical locations, think of Figure 1 as a display of different levels of quality. Then the products of the firms are "located" at different places in the quality space rather than the firms themselves being located at different geographical locations. Similarly, consumers differ in their taste rather than in their geographic location, i.e. they have different "locations" in the quality space. If the products are offered at the same price, and the preferred choice differs between different consumers, then the products are horizontally differentiated while, if consumers agree on the ranking of the products, the goods are vertically differentiated.

The country of origin labelling discussed in article I can be viewed as an attempt to bundle a complex set of characteristics into a one-dimensional quality space. At the time of the study 85-90% of Swedish consumers found the labelling of country of origin helpful in evaluating meat quality/safety (as shown in the article). This indicates that consumers tended to agree on in what order to rank "Swedish" versus imported meat products, i.e. these products are vertically differentiated in some respect. The notion of vertical product differentiation is also adopted in the more theoretically oriented papers, namely, article II and article III.

2.2 Quality from a Consumer Perspective

At the point of purchase, consumers need indicators or cues to be able to evaluate a product. These quality cues can be either intrinsic, i.e cues that are a physical part of the product (such as e.g. color or marbling), or extrinsic, i.e cues that are not a

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[10] Vertical product differentiation implies that consumers are distributed either to the left of $firm\ a$, in which case all consumers would prefer to buy from $firm\ a$, or to the right of $firm\ b$, in which case all consumers would prefer to buy from $firm\ b$. Only the latter case is depicted in the figure.

[11] In many cases the distinction is less clear cut as products may be both horizontally and vertically differentiated. While most consumers would probably rank a BMW or a Mercedes higher than a Skoda or a Lada, in the choice between BMW and Mercedes some consumers would prefer a Mercedes while others would prefer a BMW. If this is the case, BMW and Lada are vertically differentiated while BMW and Mercedes are horizontally differentiated.

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part of but related to the physical product (such as country of origin or brand name). From a consumer perspective quality can be divided into either search, experience, or credence characteristics (Nelson, 1970; Darby and Karni, 1973). Search characteristics imply that the consumer can evaluate the product prior to purchase while experience characteristics can only be evaluated after consuming (or "experiencing") the product, i.e. after buying the product. Credence characteristics, however, can not be evaluated by the individual buyer. Consequently, the consumer has to rely on some second or third party to provide the information, hence the label credence characteristics. Examples of credence characteristics in the food industry are process standards relating to animal welfare or environmental attributes and long-term health hazards.[12] While search characteristics can be readily divided into intrinsic and extrinsic cues, experience and credence characteristics have to be linked to some cue such as, a brand name, a quality assurance scheme, or labelling of country of origin. (Andersson, 1994; Steenkamp, 1989)

Different characteristics may be incorporated into quality assurance schemes. When such schemes are labelled towards the end user they are intended to assure the consumer that the product contains certain characteristics. Thus, quality assurance schemes can be used to communicate credence characteristics that are not otherwise detectable to the individual consumer. They can also be used are to communicate a bundle of characteristics of which some may be search or experience characteristics - which consumers could find out by themselves but at a potentially high cost - and some may be credence characteristics. Consumers link the quality cues perceived as important to an expected level of food quality/safety. What quality cues a consumer perceives as important depends on preferences, socio-economic factors, previous experience, attitudes, etc. This is the scope of the article I.

2.3 Game Theory and Vertical Product Differentiation

The agribusiness sector is characterized by a high degree of concentration in many markets (see e.g., Sexton, 2000; Sexton and Lavoie, 2001; Buccirossi et al., 2002). Thus, in order to capture strategic interaction between competing firms it seems appropriate to use game theory when analyzing quality policy in these markets. Game theoretic models concerning vertical product differentiation can be set up in several different ways depending on the focus of interest. In this section, I will briefly discuss some important aspects of this literature that may be crucial for the solution of the game.

The cost function assumed is essential for the outcome of a strategic game. In the literature on vertical product differentiation cost a distinction is made between fixed and variable costs that differ somewhat from the traditional interpretation of these concepts. Fixed costs generally refer to positive and convex costs of quality, usually quadratic, with zero marginal and average costs of producing one unit of a given quality. While the costs are increasing in the level of quality produced, costs are independent of the quantity produced of any given level of quality. Variable costs, on the other hand, generally refer to positive and convex costs of quality with

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[12] Generally, it can be argued that most process standards in the food industry include credence characteristics.

constant marginal and average costs of producing one unit of a given quality. In article II as well as in article III, the cost of quality is not restricted to the variants traditionally used in the literature on vertical product differentiation but also include the case of decreasing returns to scale.

The existence of a high-quality advantage in endogenous quality models with vertical product differentiation has been well-established in the literature. This implies that a firm producing a higher quality will earn a higher rent than a competitor producing a lower quality. In a duopoly setting with Bertrand competition, Aoki and Prusa (1996) compared the outcomes of a sequential and a simultaneous moves game. Assuming a fixed cost of quality, zero marginal costs, and identical firms they found that the firm producing the high quality would earn a larger profit than the firm producing the low quality in both simultaneous and sequential games. Given Bertrand competition in a duopoly setting Lehmann-Grube (1997) has shown that for all convex fixed cost functions of quality, the firm that chooses the high quality earns higher profits, in simultaneous as well as sequential moves games. Motta (1993) showed that the high-quality firm has an advantage in a simultaneous two-stage game in Bertrand as well as in Cournot competition. He examined the case of fixed as well as variable costs (given constant returns to scale) of quality. Wang (2003) has later showed that there are circumstances in which the high-quality advantage does not exist if the unit variable cost of production is dependent on quality. No general conditions for such circumstances are derived but he argues that there may be a high-quality disadvantage either if the unit variable cost of production rises quickly with quality or if the distribution of consumers is skewed towards the low end of the quality spectrum.[13]

Each individual firm can be assumed to make one or more choices. In a three-stage game, firms first choose whether to enter the market or not, then in a second stage what qualities to produce and then they compete in either prices or quantities. If the decision whether to enter or not is not considered, the game reduces to a two-stage game. As pointed out by Lehmann-Grube (1997), a two-stage game is appropriate when firms incur a substantial fixed cost of quality. In a one-stage game, what qualities to produce and what price to charge or what quantity to produce is decided simultaneously. In the absence of fixed costs, it generally seems more appropriate to assume a one-stage game rather than a two-stage game. In article II, both fixed and variable costs are analyzed and a two-stage game is adopted. In article III on the other hand, no fixed costs are assume and a one-stage game, where the agents simultaneously choose what quality and what quantities to produce, is adopted.

Whether agents act sequentially or simultaneously is another aspect that may substantially affect the outcome of the game.[14] Which approach that is reasonable will depend on the problem at hand. A sequential game may be more appropri-

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[13] Motta (1993) assumes a uniform distribution of consumers, as is common in the literature, and examines unit variable costs quadratic in the level of quality.

[14] Aoki and Prusa (1996), for example, in examining the timing of investments and the level of quality in a Bertrand setting with a fixed cost of quality, found that when agents make their choices sequentially rather than simultaneously, this results in lower investments, higher profits, and lower consumer surplus as well as reduced social welfare.

ate e.g., when new technologies are introduced and the know-how differs between firms, or when entry deterrence is the focus of interest. A simultaneous moves game may be more appropriate for example when firms respond to significant changes in consumer demand due to food scares or as a response to threats of governmental regulations. Firms may also be assumed to move simultaneously if new technologies become available and there is no difference in the know-how among firms. In both article II and article III it is assumed that firms move simultaneously.

In models of vertical product differentiation consumers are generally assumed to differ in either income or in tastes. The demand structure adopted in both article II and article III is a simplified version of the demand structure as presented in Mussa and Rosen (1978) where consumers differ in tastes rather than in income. Similar demand structures have been used in e.g. Metrick and Zeckhauser (1999); Motta (1993); Wang (2003); Wauthy (1996). Markets may be either partially or fully covered. Assuming full market coverage, i.e. that all consumers buy the good in question, seems as a very strong condition. As pointed out by Motta (1993), assuming that the market is fully covered makes it impossible to invert the demand functions which is necessary if one is interested in examining Cournot competition. Shaked and Sutton (1982, 1983) were the first to provide sufficient conditions for partial market coverage. Wauthy (1996) subsequently showed that the distribution of consumer and endogenous quality choice determine whether the market is partially or fully covered. Full market coverage is not assumed in neither article II nor in article III.

3 Article I - "Swedish" as a Quality Cue

As discussed in the introduction, the globalization of the food market implies that the role of national regulatory policy is circumscribed as it becomes more difficult to restrict imports from other countries. However, features specific for production from a certain country can be communicated to consumers by labelling products with country of origin. Article I examines country of origin as a quality cue in the Swedish market for fresh meat.

3.1 Quality Policy in the Swedish Meat Marketing Chain

The time following the Swedish application for EU-membership, Swedish or the "Swedish model" was heavily promoted by producers and media as well as by politicians.[15] Media to a substantial degree focused on the shortcomings in the meat production standards in other EU member countries, politicians fought for what was perceived to be the essence of the Swedish model and producers marketed Swedish products as qualitatively superior. The key features of the "Swedish model" are a stronger emphasis on animal welfare considerations than in EU in general, a prohibition of using antibiotics in the feed in preventive purpose and a unique salmonella control program (Hoffmann and Andersson, 1997).

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[15]See Ekman and Ekman (1995) for a review of the debate in the Swedish media prior to 1995.

As discussed in the introduction, membership in the EU implies that the role of national governmental regulations is circumscribed.[16] Since Sweden applied for membership in the EU, the industry has on a voluntary basis assumed responsibility for some of the regulations previously in place that could be considered trade barriers for other EU-countries. Examples of such are the now voluntary import restrictions on breeding material.(Hoffmann and Andersson, 1997) These were kept by the industry to preserve the good health status of the breeding stock and are presumably perceived as cost efficient by the industry. In contrast, national regulations that increase the cost of domestic production relative to other countries may reduce the competitiveness of the domestic industry. If the Swedish regulatory requirements are cost enhancing, the effect of such regulations will be either limited or may even prove counteractive, in the sense that domestic production may be replaced by imported goods not comprising any of the Swedish regulations, unless the specific characteristics of Swedish produce can be effectively communicated to consumers and that consumers are willing to pay a price premium for domestically produced goods covering the additional production cost.

In the late 1990's, a consumer survey conducted in six European countries (Germany, Ireland, Italy, Spain, Sweden and the UK) revealed that Swedish consumers perceived country of origin as more important than consumers in other countries in evaluating the quality and safety of fresh meat (Becker et al., 1998). The promotion of the "Swedish model" and the finding that consumers in Sweden seemed to rank country of origin higher than consumers in several other countries within the EU was the background to article I.

3.2   Contribution and Conclusions of Article I

The objectives of article I are to examine what factors contribute to whether consumers use country of origin when evaluating fresh meat in the store, to analyze the differences between country of origin as a quality cue for eating quality and for food safety, and to analyze the differences between the meats beef, pork and chicken. Country of origin is in the study assumed to refer to Sweden.

The contributions of article I are of empirical nature. This study is, to the best of my knowledge, the first that examines country of origin as a quality cue in the Swedish market for fresh meat. Previous literature examining the role of country of origin for consumers in other countries has to a large degree focused on the safety aspect of meat. Based on a conjoint analysis Grunert (1997) found that country of origin, as well as other extrinsic cues, had practically no effect on the formation of quality expectations of beef in France, Germany, Spain and the U.K. The country of origin information offered to consumers did, however, not correspond to respondents country of origin in this study. Alfnes (2004) in a stated choice experiment found support that country of origin (COO) matter to Norwegian consumers pertaining to beef.

The analysis is based on a multinomial logit model with socio-economic factors, level of education, information, trust, attitudes concerning meat and price, and

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[16] See especially Articles 28-30 of the EC Treaty.

attitudes concerning the "Swedish model" as explanatory variables. Given the legislation at the time of the study and given how Swedish meat was promoted in the mid 1990's, attitudes towards the importance of animal welfare, concerns about salmonella and concerns about antibiotics were considered as indicators of the attitudes towards the "Swedish model".

Two different models were estimated. In the first model, the probability that consumers find country of origin to be an important quality cue in predicting the eating quality was estimated. Consumers' perceived ability to visually inspect the quality in the shop was expected to be negatively correlated with the dependent variable but was in fact, surprisingly, not found to be statistically significant. This may be interpreted as an indication that consumers perceive intrinsic quality cues, such as animal welfare aspects, being important for the "Swedish model". In the second model, the probability that consumers find country of origin to be an important quality cue for food safety was estimated. The two models were estimated for each of the meats pork, beef and chicken. The results indicate that women and consumers with low income tend to rely more on country of origin compared to men and consumers with high income. In addition, consumers who valued the indicators of the "Swedish model" were, as expected, found to be more likely to perceive country of origin as important.

4 Article II - Quality and Ownership Structure

As discussed in the introduction, agricultural marketing cooperatives with a substantial market share can be found in many agricultural markets. These cooperatives often compete with investor-owned firms. Given the increased emphasis on quality policy in food production article II examines the outcome of a game theoretic duopoly model with vertical product differentiation where firms may be either cooperatives or investor-owned firms.

4.1 Vertical integration and Cooperatives

Agricultural cooperatives are owned by the farmers that are members and, hence, should act in the best interest of these farmers. An agricultural marketing cooperative (COOP) can be viewed as a firm at secondary level vertically integrated with the primary level (see e.g., Sexton, 1986; Tennbakk, 1995). The cooperative then maximizes the joint profits of the cooperative *and* the individual members/farmers combined. In the cooperative literature, several alternative objectives of a marketing cooperative have been suggested. Besides maximizing joint profits the cooperatives could for example maximize profits, producer average (per unit) return, membership or output subject to a no loss constraint, and dividend per unit of input (see e.g., LeVay, 1983).[17]

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[17] In article II it is assumed that the cooperative have a fixed number of members as in Tennbakk (1995). This assumption is adopted as the focus of interest is the strategic behavior of the processing firms and the market outcome rather than the distribution between members and the cooperative. In a different setting the choice whether to join a cooperative or not is discussed in for example Karantininis and Zago (2001); Fulton and Giannakas (2001).

The approach taken in article II is to view cooperatives as vertically integrated between the primary and secondary level of the marketing chain and to assume that the cooperative maximizes the joint profits of the cooperative and the members/farmers supplying the raw material. This approach is the approach taken in e.g., Fulton (1989) and Tennbakk (1995). While article III, rather than discussing cooperatives explicitly, views firms as either vertically integrated or vertically separated, this terminology is, with the approach taken in article II, applicable to a discussion of cooperatives versus investor-owned firms.

Game theoretic literature pertaining to vertical product differentiation that includes the aspect of vertically integrated cooperatives is limited. Assuming a fixed cost, Economides (1999) examined the outcomes of a vertically integrated monopolist with two vertically separated monopolists. He found that integration generated a higher quality at a lower price, resulting in a larger market share, larger consumer surplus as well as profits. Assuming a variable cost of quality Lambertini (1997) compared a profit-maximizing monopolist with a labor-managed monopolist and found that while producing the same quality the latter supplied a significantly lower quality at a lower price.

4.2   Contributions and Conclusions of Article II

Article II examines how ownership structure affects endogenous quality choice and the subsequent equilibrium outcomes. Investor-owned firms (IOFs) and producer cooperatives (COOPs) are analyzed within a duopoly framework including a primary and a secondary level. The firms play a two-stage game. First they simultaneously choose what level of quality to produce and then they compete in prices. Constant as well as decreasing returns to scale are examined. Specifically, the objectives of this article are to identify under what circumstances ownership structure matters in endogenous quality models, to compare the equilibrium outcomes (qualities, prices, quantities, welfare) of markets with different structure, and to discuss the policy implications for the food industry.

This article contributes to the existing literature pertaining to endogenous quality models in that (i) the analysis includes two stages of the marketing chain and allows for vertically integrated firms, (ii) firms are *not* assumed to have identical structure but rather they can be either vertically separated or vertically integrated, (iii) the analysis incorporates the case of decreasing returns to scale. In table 2, article II and some of the previous literature on vertical product differentiation is characterized along some important dividing lines.

In article II it is shown that if the cost of quality at primary level is fixed, and/or variable exhibiting non-constant returns to scale, firms can have a structural cost advantage due to ownership structure in addition to the high-quality advantage identified in the previous literature. In the case of a fixed cost of quality at primary level, it is shown that although IOFs charge higher prices they generate a larger consumer surplus than COOPs by marketing higher qualities. Furthermore, cooperatives generate a larger producer surplus while the market share of the high-quality good is independent of ownership structure. In the case of a variable cost of quality

Table 2: Literature on Vertical Product Differentiation

	COOPs/ Vertical integration	Non-identical firms[a]	Fix	Cost structure[b] Variable CRS	DRS
Article III	x	x	-	x	x
Amacher et al. (2005)	-	-	x	x	-
Aoki and Prusa (1996)	-	-	x	-	-
Bonnano and Haworth (1998)	-	-	-	x	-
Donnenfeld and Weber (1995)	-	-	[c]	-	-
Economides (1999)	x	-	x	-	-
Lehmann-Grube (1997)	-	-	x	-	-
Metrick and Zeckhauser (1999)	-	-	-	-	-
Motta (1993)	-	-	x	x	-
Peitz (2002)	-	-	[d]	-	-
Ronnen (1991)	-	-	x	x	-
Shaked and Sutton (1983)	-	-	-	x	-
Ueng (1997)	-	[h]	-	x	-
Wang (2003)	-	-	-	x	-

[a] Firms are considered to be identical if they incur the same cost producing the same quantity of a specific quality.
[b] Where none of the alternatives are marked, quality is assumed costless to produce. CRS and DRS are abbreviations for constant and decreasing returns to scale, respectively. [c] Donnenfeld and Weber (1995) assumes a fixed cost for entrants but sunk cost for the incumbent firms. [d] Fixed cost independent of quality. [h] Firms differ in costs.

at primary level, a cooperative firm possesses a structural cost advantage which is used to market larger quantities of higher levels of quality generating larger profits, larger consumer surplus and higher social welfare. Policy implications of the different structures are discussed. As shown in table 3 the ownership structure preferable from a policy perspective will vary depending on the policy goal specified and on the cost structure. Notable is that cooperatives for many potential policy goals represent the more beneficial ownership structure.

Table 3: Most beneficial ownership structure given some potential objectives

Policy goal: To obtain maximum	Most beneficial ownership structure if the farm level cost of quality is primarily fixed	primarily variable
Consumer surplus	Investor-owned	Cooperative
Producer surplus	Cooperative	Mixed market*
Total welfare	Inconclusive	Cooperative
Market share of high-quality good	Independent	Cooperatives
Level of high-quality good	Investor-owned	Cooperative
Market coverage	Mixed market*	Cooperative

* Mixed market refers to a market consisting of both cooperatives and investor-owned firms.

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5 Article III - Quality and Multi-product Firms

Article III examines the outcome of a multi-product game theoretic oligopoly model. Firms may be either vertically separated or vertically integrated. Specifically, the issues of specialization versus *head-to-head* competition (i.e. firms choose to produce the same qualities as its competitors), symmetric versus asymmetric equilibria and the existence of holes in the product line, i.e. firms may choose not to produce all varieties, are examined.

5.1 Multi-product firms

A firm usually has to make a trade-off between on the one hand attracting as many consumers as possible by offering a wide variety of products and on the other hand to minimize costs by specializing. A natural effect of this strategic decision, between the "completeness" of the product line and the cost efficiency, is that "holes" are usually left in the product line, i.e. not all possible qualities are produced. This may be due to a fixed cost per variety produced but even in the absence of such fixed costs it is costly for firms to produce "too many" varieties. The reason for this is that although introducing a close substitute to already existing varieties may attract new consumers it will almost surely attract consumers previously buying an already existing quality. Hence, if a firm markets a new variety similar to a variety it already produces, the firm in a sense competes with itself. As a very simple illustrative example consider the dairy industry and specifically the market for milk. Although the number of varieties has increased in recent years there could potentially be many more varieties of milk with different fat content.

The literature on vertical product differentiation initially developed along two different routes. One line of research has assumed a monopolist offering multiple qualities (see e.g., Mussa and Rosen, 1978; Gabszewics et al., 1986; Besanko et al., 1987, 1988) while another has assumed an oligopoly where each firm supplies only one quality (see e.g., Gabszewics and Thisse, 1979; Shaked and Sutton, 1982, 1983; Motta, 1993).[18]

Champasur and Rochet (1989) examined the optimal quality-price choice in a duopoly multi-product setting. They emphasize that on the one hand a wide product line is required to discriminate among heterogenous consumers while on the other hand price competition is relaxed the more differentiated the products of one firm is from the products of its competitor thus creating an incentive for each firm to differentiate its products from its competitors. They conclude that there is always a gap between the firms' product lines as the latter effect dominates. It is the assumption of price competition among homogenous products that rule out *head-to-head* competition. In the model of Champasur and Rochet (1989) it is always in a firm's interest to fill any holes in the product line, at least if the competing firm is not already offering that particular quality. Klemperer (1992) and Gilbert and Matutes (1993) in a Bertrand setting assumes a degree of product differentiation such that

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[18] See Manez and Waterson (2001) for a review of multi-product firms and horizontal as well as vertical product differentiation.

each firm can make a positive profit even when selling qualities supplied by a competitor. Gilbert and Matutes (1993) shows that while firms may want to specialize they may be trapped in a prisoners' dilemma where the only non-cooperative solution is *head-to-head* competition.

De Fraja (1996) examines the optimal quality-quantity choice in an oligopoly setting. Firms are assumed to compete in quantities rather than prices as Cournot competition between homogenous goods is often used to approximate situations characterized by oligopolistic competition less severe than price competition with perfect substitutes. Furthermore, in some industries a lag exists between production and sales, and hence prices are often used to clear the market given a fixed volume to sell.[19] Assuming a variable cost and constant returns to scale he finds that the equilibrium will be symmetric, i.e. that each firm produces the same quantities of the same qualities. Hence, firms choose *head-to-head* competition over specialization. Furthermore, he shows that while the highest quality is always produced there may be holes left in the product line.

5.2   Contributions and Conclusions of Article III

Article III examines multi-product firms within an oligopoly framework allowing for vertical integration between the primary and the secondary level of the marketing chain. Firms play a one-stage game where they simultaneously choose what qualities to produce and compete in quantities. *Constant* as well as *decreasing* returns to scale are examined. The objectives of article III are to examine under what circumstances the equilibrium is symmetric/asymmetric, when firms choose to specialize and when they choose *head-to-head* competition, under what circumstances *holes* are left in the product line, and how the equilibrium outcome in a duopoly is affected by the entry of new firms.

Article III is an extension of the article by De Fraja (1996). It contributes to the existing literature concerning vertical product differentiation and multi-product firms in that; (i) the analysis include two stages of the marketing chain, (ii) firms are allowed to be either vertically integrated or vertically separated, (iii) firms are *not a priori* assumed to have identical structure, (iv) the analysis incorporates the case of decreasing returns to scale in addition to the case of constant returns and hence goes beyond the traditional concept of "variable costs" as defined in the literature on vertical product differentiation.[20] In table 4, article III along with some of the previous literature on multi-product firms and vertical product differentiation are characterized along some important dividing lines.

The conditions for symmetric and asymmetric equilibria are identified and discussed. It is shown that *head-to-head* competition rather than specialization is a common outcome. Furthermore, it is shown that *holes* may be left in the product line although the highest quality is always produced. These findings are not re-

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[19] De Fraja (1996) also points out that in the homogenous good case, Bertrand competition would rule out *head-to-head* competition.

[20] In the literature on vertical product differentiation "variable costs" traditionally refers to constant variable and marginal costs as discussed in section 2.3.

Table 4: Literature on Vertical Product Differentiation and multi-product firms

| | Vertically integrated firms | Non-identical firms[a] | Cost structure[b] | | |
			Fix	Variable CRS	DRS
Article III	x	x	-	x	x
Besanko et al. (1988)	x	-	-	x	-
Champasur and Rochet (1989)	-	-	-	x	-
De Fraja (1996)[c]	x	-	-	x	-
Gabszewics et al. (1986)	-		-	-	-
Gilbert and Matutes (1993)	-	-	-	-	-
Lambertini (1997)	x[d]	-	x	x	-
Mussa and Rosen (1978)	-	-	x	-	-

[a] Firms are considered to be identical if they incur the same cost producing the same quantity of a specific quality.
[b] Where none of the alternatives are marked, quality is assumed costless to produce. CRS and DRS are abbreviations for constant and decreasing returns to scale, respectively. [c] De Fraja (1996) also mentions a fixed cost not dependent on the quality produced. [d] Labor managed monopolist maximizing the value added per worker.

stricted to the case of constant returns to scale. Furthermore, the effects of entry by new firms are discussed. Some of the results are summarized in table 5.

Table 5: Some of the key results emanating from article III

| | Type of technology at primary level | |
	CRS	DRS
Firms have the same structure	- symmetric equilibrium - non-specialization - potentially "incomplete" product line	- symmetric equilibrium - non-specialization - potentially "incomplete" product line
Firms have different structures	- symmetric equilibrium - non-specialization - potentially "incomplete" product line	- asymmetric equilibrium - non-specialization - potentially "incomplete" product line

6 Article IV - Asset Fixity in Hog Production

The U.S. hog production sector has undergone a dramatic structural change, from small to large scale operations, during the past decade (USDA, 1995/96-2004/05). The advent of new production technologies, increased access to international markets, and improved access to financial capital through various forms of vertical arrangements are a few of the factors that have contributed to this structural change. The transformation into larger scale operations have required greater amounts and more specialized types of capital, such as larger and more custom-designed housing

facilities, specialized types of machinery, and investments in manure management. Such inputs are typically referred to as quasi-fixed inputs because, while changes in the capital stock are feasible, there are costs associated with such an adjustment.

6.1 Investment under Uncertainty

Classical investment theory typically assumes a convex adjustment cost function dictating a smooth adjustment in the stock of quasi-fixed inputs. Investments and disinvestments are made whenever the market conditions change in order to maintain the equality between the shadow value of capital and the marginal adjustment costs. Investment rigidities may, however, be present given irregularities in the adjustment cost function. If this is the case, producers may maintain the same level of quasi-fixed inputs, consequently not adjusting their production, even though the economic situation changes.

The existence of such rigidity in the adjustment of quasi-fixed input, here referred to as asset fixity[21], is a long-standing issue in the agricultural economic literature (see e.g., Edwards, 1959; Vasavada and Chambers, 1986; Nelson et al., 1989). Several reasons for this phenomenon have been suggested and unifying the literature Abel and Eberly (1994) propose an "augmented adjustment cost function". They allow for price asymmetry, as suggested by Johnson (1956), and non-differentiability, as suggested by Hsu and Chang (1990), and show that although capital investment is a non-decreasing function of the asset's shadow price, it is not responsive to price changes if the shadow value falls within a range of inaction. The range of inaction is defined by an upper and a lower threshold and the magnitude of these thresholds are determined by the characteristics of the augmented adjustment cost function.

Given that the adjustment in capital may be characterized by a range of inaction, it is important that this aspect taken into account when modelling producers' demand for quasi-fixed input and output supply in order to better understand agricultural markets. The importance of accounting for asset fixity is further emphasized by noting that rigidities may work as entry barriers, as pointed out by Pietola and Myers (2000), and that asset fixity at the farm level may be aggravated in the presence of other frictions along the supply chain, as pointed out by Boetel et al. (2004).

6.2 Contribution and Conclusions of Article IV

The objective of article IV is to estimate aggregate U.S. hog supply explicitly accounting for the implications of possible asset fixity in the employment of quasi-fixed inputs. Specifically, it addresses the issues of investment asymmetry and the possible existence of an inaction or sluggish regime in the demand for quasi-fixed input in the U.S. hog production sector. Drawing on the theoretical work of Abel and Eberly (1994) the empirical analysis is conducted using the threshold estimation procedure developed by Hansen (1996, 1999, 2000). Quarterly data from 1970 through 2002 are used to estimate a regime-dependent investment demand equation for quasi-fixed input, using sows as a proxy.

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[21] Such rigidity is also referred to in the literature as investment rigidity, investment irreversibility and investment hysteresis.

This study contributes to the existing literature as it is the first to examine the threshold aspect of investment decisions of U.S. hog producers using an endogenous threshold estimation procedure allowing for an inaction or sluggish regime in addition to an investment and a disinvestment regimes. The results support the existence of a sluggish regime in addition to an investment and a disinvestment regime, confirming the existence of asset fixity in sow investment. The results also highlight the importance of accounting for investment rigidity when estimating hog supply and variable input demands.

While not discussed in the article, the results may have implications for quality policy. Quality assurance schemes, implying an additional cost it seems reasonable to assume, may entail additional uncertainty concerning the productivity and additional demand uncertainty if they are reasonably novel. On the other hand, quality assurance schemes may make it easier for individual firms to target certain high-quality niche markets thereby reducing uncertainty. As discussed in the introduction, the trend towards more relationship-specific vertical coordination due to the increased focus on quality, may imply that the problem of asset fixity increases over time.

7   Concluding Remarks

This thesis covers different parts of the marketing chain using several different approaches on different topics. As the conclusions of the individual articles are presented elsewhere, I will take the opportunity here to instead look ahead and sketch some ideas for future research.

Natural extensions of the more theoretical articles II and III would be to empirically test some of the hypotheses suggested by the results found. A general problem arising in doing so is the difficulty of empirically measuring quality. Most food products marketed towards consumers are either fairly homogenous, such as flour for example, or very complex, such as meats entailing multiple credence, experience and search characteristics. If the problem of measuring quality can be overcome by creating some kind of quality-index, one of the hypotheses from article II that would be interesting to test empirically is whether cooperatives do produce higher quality than investor-owned firms given decreasing returns to scale. An interesting conclusion made in article III that would be interesting to examine empirically is that processing firms tend to choose to compete head-to-head rather than to specialize, even in the presence of differences in cost structure due to different organizational structure. Another conclusion of article III that could be empirically tested is that, in an oligopoly setting, vertically separated firms will produce product lines which are at least as broad as the product lines of vertically integrated firms.

A more theoretical expansion of the duopoly model in article II would be to extend the model into an oligopoly framework with multiple firms having the possibility to adjust what qualities to produce at a surmountable cost in a repeated game. Such a dynamic game would be reasonable only if the investment cost associated with quality is not substantial. That changing the quality of the produce supplied

would be achievable at a fairly low cost may be argued to be more likely when some kind of quality assurance scheme is already in place. Even if a quality assurance scheme is already in place it would, however, probably not be reasonable to assume a low adjustment cost in the meat production if quality aspects involve quality-specific housing system due to animal welfare concerns.

Another interesting theoretical extension of articles II and III would be to expand the models, taking horizontal as well as vertical product differentiation into account. However, one drawback of game theory is that once you go beyond fairly simplistic models, the complexity quickly increases. That is for example the reason why so many game theoretic models pertaining to vertical product differentiation consider a very basic cost structure and assume a uniform distribution of consumers.

Article IV focuses on investment under uncertainty and the problem of asset fixity. While the application refers to the U.S. hog market, this problem is likely to be present in other agricultural markets as well. As pointed out in the article, the problem of asset fixity in the primary production may be worsened if there exist capacity constraints in down-stream processing firms. Hence, it would be interesting to extend the analysis to incorporate subsequent stages of the marketing chain. It would also be interesting to apply the endogenous threshold model to the Swedish market and examine the investment behavior of Swedish hog producers, especially so in the case of new and evolving animal welfare standards.

As this thesis is using different approaches and covers diverse aspects of the food marketing chain there are many more potential areas for future research that relate to the presented articles in one way or the other. However, as the above discussion indicates, the areas I find most interesting to investigate further are (i) to extend the game theoretic models so that they more closely relate to markets found in the food industry and, (ii) to empirically test some of the conclusions drawn from articles II and III.

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