

**“The Competitiveness of Agricultural Product and Input Markets:
A Review and Synthesis of Recent Research.”***

Ian M. Sheldon
Ohio State University

March 2016

* This is a draft of a paper prepared in consideration as a review article for the *Journal of Agricultural and Applied Economics*. Ian Sheldon is the Andersons Chair of Agricultural Marketing, Trade and Policy in the Department of Agricultural, Environmental, and Development Economics, Ohio State University. Phone: 614-292-2194, email: sheldon.1@osu.edu.

Abstract

This paper reviews the extant literature on competitiveness of agricultural product and input markets. While US and European researchers have tended to emphasize different stages of the agricultural and food-marketing system, their focus is the same conceptually: the extent of buyer power, although both have largely ignored the sector supplying inputs to agriculture. The key conclusion to be drawn is that there is very little robust empirical evidence for firms exerting buyer power, and that there is a lack of data concerning the nature of vertical contracts between food processing and agriculture, and also between food retailing and processing.

Keywords: agricultural and food marketing, competitiveness, buyer power

JEL Codes: L13, L42, Q13

Introduction

In the early-2000s, articles published by Sexton (2000) and McCorrison (2002) presented detailed reviews of the state of knowledge about the market structure and performance of the US and European Union (EU) agricultural and food marketing systems respectively. Specifically, both authors laid out why imperfect competition in this system should matter to agricultural economists, given increased industrialization and consolidation of that system. In describing and analyzing high levels of observed seller concentration at key stages of the US and EU agricultural and food marketing systems, both authors raised concerns about the potential impact of imperfectly competitive firms at successive stages of a vertically interrelated system, where at one end food processors procure agricultural inputs from farmers, transforming them into manufactured food products sold on to food retailers, who then market those products to final consumers.

Despite this commonality of analysis, the two articles diverged quite distinctly in terms of the competition issues that they chose to emphasize and some of the conclusions they drew. Sexton (2000) in reviewing the extant literature suggested that horizontal consolidation and vertical coordination of the US agricultural and food marketing system was driven by a focus on efficiency through exploitation of economies of scale in processing and transmission of consumer demands for higher quality food products. However, despite the empirical evidence for modest departures from competition in US food processing, he also concluded that there were legitimate social welfare concerns about the impact of imperfect competition on distributional losses to farmers and consumers. Sexton (2000) ended his review by wondering whether the views of the US Department of Agriculture Committee on Agricultural Concentration (1996) on industrialization in the agricultural and food marketing chain were too benign, and that perhaps US antitrust law was ineffective in dealing with the imbalance of market power in the system, especially as it

affected farmers facing a concentrated food processing sector downstream. Interestingly, Sexton's (2000) review said little if anything about imperfectly competitive behavior in the US food retailing sector at that time or the possible use of vertical contracts between stages of the marketing system as opposed to arms' length pricing.

By contrast, McCorrison (2002) stated very clearly upfront in his review that anti-competitive behavior in the EU agricultural and food marketing system is multi-dimensional, i.e., it is not just about measurement of the nature of horizontal competition between firms at one stage of the system or whether a limited number of processing firms can exert vertical market power over suppliers of agricultural inputs. Instead, he argued that the focus should be on a range of potentially anti-competitive practices such as food processors having to pay for access to retail shelf space (slotting allowances), the market penetration of retailers' private label products and other restraints on vertical market competition. This view of competition in the agricultural and food marketing system was driven both by perceived growing market power of retailers in the EU in the 1990s, and also concerns about how imperfect competition at successive stages of the agricultural and food marketing system might interact with vertical linkages between the stages, thereby affecting transmission of exogenous changes in the price of raw agricultural products through to prices of food products at retail.

This emphasis on increased seller concentration of food retailing and its impact on vertical competition reflected both public and regulatory concerns expressed in Europe at the end of the 1990s about the possible exercise of retailer market power over food consumers, captured in the reports of agencies such as the UK Competition Commission (2000). McCorrison (2002) concluded that focusing on the measurement of market power at the food processing stage is less relevant than recognizing the role and impact of vertical coordination in the agricultural and food

marketing chain, especially between food processors and retailers, and that analyzing the incidence of price changes requires an understanding of the degree of competition in the system as a whole.

This divergence of focus is even stronger in more recent reviews written by the same authors. Sexton (2013) in his presidential address to the Agricultural and Applied Economics Association (AAEA), and also in two jointly-authored articles, Saitone and Sexton (2012) and Crespi, Saitone and Sexton (2012), returned to the theme of his earlier review. Sexton's (2013) motivating argument is that, while analysis of imperfect competition in the US agricultural and food marketing system has historically focused on exploitation of downstream market power by the food processing and occasionally the food retailing sectors, the spotlight has very much moved to examining the extent of processor upstream buying power over US farmers.

On the one hand Sexton and his co-authors argue that concern about the exploitation of downstream market power by US food retailers has dwindled largely due to entry into the sector of discount firms such as Wal-Mart and the associated increase in retail price competition. While on the other hand, they argue that documented increases in seller concentration among processing firms purchasing raw agricultural products, and greater vertical coordination and upstream control by those same firms through use of production and marketing contracts over the past two decades, has not only caught the attention of agricultural economists but also farmers, legislators, and regulators. For example, much debate over competition-enhancing provisions in successive US Farm Bills, has focused on the inclusion of restrictions on ownership of livestock and hogs by meat-packing firms. (Crespi *et al.*, 2012; Saitone and Sexton, 2012). In this context, Sexton (2013) and associated articles have focused on a specific question: are the concerns about food processor buyer power in the US overstated because orthodox model(s) of monopsony/oligopsony

fail to capture the economic logic for observed vertical coordination between suppliers of raw agricultural products and food processors?

In his follow-up review McCorrison (2014), as well as Lloyd, McCorrison and Morgan (2015), the focus is very much a development of the earlier article, i.e., the impact of vertical coordination in the EU agricultural and food marketing chain, especially between food processors and retailers, and how imperfect competition at successive stages of the system might affect the transmission of price changes in the agricultural sector to the final consumer. This continued emphasis on price transmission and the potential buying power of EU food retailers has been driven by the differential experience of EU Member States following the world agricultural commodity price spikes of 2007-08 and 2011. As Lloyd *et al.* (2015) note, observed differences in food price inflation across the EU have resulted in considerable concern at the level of the European Commission about the functioning of and competition in the EU food marketing chain (European Competition Network, 2012). As a consequence of this McCorrison (2014) and the associated article focus on the following question: how does successive oligopoly and vertical competition in the EU food marketing chain, embodied in the use of vertical restraints such as slotting allowances, affect price transmission, and therefore food consumer welfare?

Given this background, the objective of this article is to provide a review and synthesis of what is currently known about the competitiveness of agricultural product and input markets, paying attention to literature relating to the agricultural and food marketing systems in both the US and EU. The review is broken down into five sections: first, in section 1, the structure of the food and agricultural marketing system is described, focusing on the key sectors of food processing and retailing; second, the agricultural inputs sector is discussed in section 2, with a particular focus on the relationship between the market structure and the extent of R&D in the crop

seed/biotechnology industry; third, section 3 is devoted to reviewing contributions of the new empirical industrial organization to understanding behavior of firms in the agricultural and food marketing system, with particular emphasis on what is known about exertion of market power by firms at the food processing stage; fourth, in section 4, the vertical market relationship between suppliers of raw agricultural commodities and downstream food processors, and that between upstream food processors and downstream food retailers, are set in the context of a framework for considering buyer power in the agricultural and food marketing system; finally, section 5 summarizes what is currently known about competitiveness of the agricultural and food marketing system, and draws some brief conclusions as to where future research on the system should be directed.

1. Structure of the Agricultural and Food Marketing System

The starting point for a discussion of the structure of the agricultural and food marketing system is a basic characterization of its system of vertically-related markets. In figure 1 which is an adaptation from McCorrison (2014), the marketing system consists of four stages: stage 1 covers production and marketing of key inputs to agricultural production including crop seeds, agrochemicals, fertilizers and machinery; stage 2 is agricultural production selling raw agricultural commodities downstream to food processors at stage 3; in turn food processors sell food products to the food retailing sector at stage 4 who then market final food products and other retail services to consumers. Historically, applied industrial organization studies of this system have focused mostly on increasing consolidation, especially at the food processing stage, much of the analysis describing changes in market structure through standard metrics such as seller concentration (Connor *et al.* 1985; Marion, 1986).

Although it is well understood that high levels of seller concentration do not necessarily imply abuse of market power either within any given stage (horizontal) or between stages (vertical), it is still useful to get a sense of the current market structure of the US and EU agricultural and food marketing systems, especially as it has been central to the public debate about industry consolidation. However, it should be emphasized that the key targets of public concern have been different in the US as compared to the EU: in the former, the focus has been mostly related to the secular trend towards higher seller concentration in food processing (Crespi *et al.*, 2012). In contrast, the focus in the EU has been on increased concentration in food retailing, both because it is the stage that most directly affects consumers when they purchase food, and also because of the significant decline in the number of food retailing outlets in the EU and growing presence of large food retailing chains such as Carrefour (McCorriston, 2014).

Focusing first on the US, Crespi *et al.* (2012) provide a detailed description of market structure in food processing, drawing on data from the 2007 Census of Manufactures. In table 1, 4-firm seller concentration ratios (CR4) are reported for a sample of food processing industries defined at the six-digit level of the North American Industrial Classification System (NAICS). Also included in the table, are the changes in seller concentration in these industries since 1997. High levels of seller concentration can be found in several industries, including dog and cat food manufacturing (71 percent), wet corn milling (84 percent), soybean processing (82 percent), breakfast cereal manufacturing (80 percent), and cane sugar refining (95 percent), which compare with an average CR4 of 50 percent across a sample of 47 NAICS industries. In addition, a majority of these industries have exhibited an increase in seller concentration over a ten-year period since 1997.

Of particular interest in the context of the broader public debate on increased seller concentration in the US food processing sector, Crespi *et al.* (2012) point out that the CR4s for animal slaughtering and poultry slaughtering were 59 and 46 percent respectively, which do not deviate that much from the average for food processing as a whole. However, the same authors also point out that these indices of market structure hide the extent to which these particular industries are characterized by seller concentration in the purchasing of raw agricultural inputs. They support this argument by reporting more disaggregated data on seller concentration from USDA's Grain Inspection, Packers and Stockyards Administration (GIPSA). For selected meat packing industries, the CR4 in 2007 was 80, 70, 65, 57 and 51 percent respectively for steers and heifers, sheep and lambs, hogs, broilers and turkeys, and over the period 1980 to 2010, CR4 in these meat packing industries increased on average by 69 percent, albeit the rate of increase slowing after 1995 as the rate of mergers in these industries slowed down. Crespi *et al.* (2012) also point out that due to meatpacking firms operating multiple-plants, it is also important to note that over the same time period that seller concentration has increased in the sector, the number of slaughtering facilities has fallen significantly in cattle, sheep and hogs. From 1980 to 2010, an average of 75 percent of plants in beef, pork and lamb slaughtering were closed according to the Packers and Stockyards Program. *A priori*, at the regional level, the decline in the number of meatpacking plants, in combination with increasing transport costs may have affected competition in these markets as producers are faced with fewer plants to sell to spatially.

In contrast to the US, data on the market structure of food processing in the EU is less recent in terms of time period, McCorriston (2002; 2014) reporting the same data by Cotterill (1999) from the mid-1990s. In table 2, average three-firm seller concentration ratios (CR3) in the food processing sector are reported for a sample of countries in the EU, with the average CR3 across

these countries being 64 percent. This suggests even in the mid-1990s, there were high levels of seller concentration in the EU food processing sector, although the level varied across countries. As McCorrison (2014) points out, there was also considerable variation in seller concentration across specific industries. For example, the CR3 for breakfast cereals ranged from 92 percent in Ireland to 65 percent in the UK, while baby food production ranged from 98 percent in Ireland to 54 percent in Spain. Even though these figures are rather dated, they do confirm that the EU food processing sector was already highly concentrated by the mid-1990s, and seller concentration is unlikely to have fallen given the extent of domestic and EU cross-border merger activity in the sector over the past 20 years (McCorrison, 2014).

In both the US and EU, leading food retailers have become dominant in terms of market share at the consumer end of their agricultural and food marketing systems. In the case of the US, Richards and Pofahl (2010) report a CR4 for food retailing of 48.8 percent in 2008, the largest four retailers consisting of Wal-Mart (21.3 percent), Kroger (12.6 percent), Safeway (8.1 percent) and Costco (6.8 percent), concentration having increased from a CR4 of 16.8 percent in 1992 (Sexton, 2012). Of course the US as a whole is not really the appropriate market definition for food retailing, relevant markets being much more localized given the spatial distribution of consumers and associated transport costs (Sexton, 2013). As a consequence, seller concentration levels in food retailing are much higher at the city level, average food retailing CR4s being 79 percent in 2006 for 229 metropolitan statistical areas (Sexton, 2013).

Essentially, there has been a significant change in the US food retailing landscape: in the 1980s, regional and local supermarket chains were dominant, while in the 1990s, large grocery retail chains merged or bought out other regional food retailers, and at the same time large warehouse clubs and large discount general merchandise stores expanded into food retailing.

Between 1996 and 1999, there were 385 mergers in the sector as incumbent firms were forced to compete with supercenter/discounter firms such as Wal-Mart and Costco (Richards and Patterson, 2003). Wal-Mart has emerged as an important player in food retailing since opening its first supercenter in 1988, and thereafter becoming the leading US food retailer by 2000 (Martinez, 2007). Many commentators have suggested that Wal-Mart has enforced competitive discipline in US food retailing (Richards and Pofahl, 2010; Crespi *et al.*, 2012), the empirical evidence showing that retail food prices fall when a Wal-Mart store opens in a specific geographic location (Hausman and Leibtag, 2007). Wal-Mart has also become the world's largest transnational food retailing chain, operating across 16 countries in 2008 (Wrigley and Lowe, 2010).

In the case of the EU, the average level of seller concentration in food retailing in 2004/05 was very similar to the national level of concentration in the US, with an average CR5 across the EU-15 being just above 50 percent. However, as reported by Buceviciute, Dierx and Ilzcovitz (2009), levels of seller concentration vary considerably around this average, ranging from a CR5 in 2007 for Italy of 32 percent, through France at 52 percent, the UK at 60 percent, to Denmark, Sweden and Finland at 75, 76 and 84 percent respectively. However, as McCorriston (2014) notes, newer EU members from Eastern Europe, typically have lower levels of seller concentration in food retailing, including CR5s for Bulgaria (14 percent), Poland (22 percent), and Romania (21 percent), although these levels of seller concentration have grown significantly in a short period of time. While merger activity has been significantly greater on average in the EU food processing sector over the past two decades, like the US, there was a spike in EU food retail merger activity in the mid to late-1990s (McCorriston, 2014). In addition, several leading EU food retailing chains are also transnational in structure. For example, by 2008, the French firm Carrefour and the German firm Metro were operating in 33 and 32 countries respectively (Wrigley and Lowe, 2010).

In conclusion, the agricultural and food marketing system consists of a series of vertically related stages. Virtually all of the academic and public interest has focused historically on the horizontal structure of the food processing and retailing stages, the data on seller concentration at both of stages indicating oligopolistic market structures, such that vertical market structure is one of successive oligopoly, with the well-known potential for double-marginalization (both stages mark-up prices above marginal cost) and its associated inefficiencies (double deadweight losses), as well as the potential effect on price transmission through the chain.

2. Agricultural Inputs: Market Structure and R&D

In contrast to food processing and retailing, there has been considerably less emphasis in public debate on the documented increase in global seller concentration of the sector supplying inputs to agriculture, especially in crop seeds and agrochemicals. McCorrison (2002) presented a short discussion of the industries upstream from agriculture, noting that they appeared oligopolistic in structure, drawing specific attention to increased concentration of patent ownership in the crop seed sector, especially over traits for those seeds that had been genetically modified (GM). Interestingly McCorrison's (2014) follow-up review has no further discussion of the inputs sector – one can speculate that this was either due to the fact that no GM crops are currently grown in the EU, and/or that the public policy focus in Europe has been almost entirely on price transmission and the perceived market power of food retailers. Surprisingly, there is also no mention of this sector in either of Sexton's reviews (2000; 2012), although it does get some coverage in Saitone and Sexton (2012), where there is a short discussion concerning the small number of firms responsible for developing and patenting GM traits in seeds, and the implications this might have for competition and incentives to innovate among other firms in the crop seed sector.

Despite the apparent low level of interest in the sector supplying inputs to agriculture a detailed survey was recently published by the Economic Research Service (ERS) of the US Department of Agriculture (USDA) highlighting changes in its global market structure, along with extensive data on the extent of R&D expenditures in each part of the sector (Fuglie *et al.*, 2011). In terms of its overall size, the value of supplies of key agricultural inputs by firms in the private sector stood at \$355 billion in 2006. Breaking this down, 60 percent of the value of these sales were accounted for by bulk inputs such as fertilizers and animal feed, neither of which participate extensively in conducting R&D. Of the remaining input sales, 21 percent were accounted for by farm machinery, 15 percent the combined sales of agrochemicals and crop seeds, and 4 percent for animal health and breeding inputs. Over time, Fuglie *et al.* (2011) report that only the farm machinery and crop seed industries have grown significantly in real terms since 1994, and only five industries, agrochemicals, crop seed and traits, animal health, farm machinery, and animal genetics, have been characterized by significant R&D.

In terms of market structure, by the end of the last decade, the largest four firms accounted for at least 50 percent of global market sales in each of these sectors, with seller concentration reaching 53, 54, 51, 50, and 56 percent respectively in agrochemicals, crop seed and traits, animal health, farm machinery and animal genetics by the end of the 2000s. Importantly, over the period 1994-2009, growth in global seller concentration was most rapid in the crop seed industry, where the share of sales of the largest four firms more than doubled between 1994 and 2009. At the same time, R&D intensity, measured by the ratio of R&D expenditure to sales, was highest over the same period for the crop seed industry, growing significantly between 1994 and 2000. By 2006, private sector firms spent \$1.2 billion in crop seed R&D, accounting for 50 percent of all R&D expenditure on food and agriculture. This growth of R&D expenditure in the crop seed sector, and

in particular the development of GM traits, in combination with increased seller concentration in the sector, has caught the attention of economists, policymakers and the public.

Since the introduction of GM crops in the mid-1990s, considerable concern has been expressed about GM food by a wide number of groups, including farmers, consumer groups, food retailers and governments (Sheldon, 2002). While the discussion has been dominated by food safety and environmental issues relating to GM crops/foods, some of the early public opposition to agricultural biotechnology was based on the concern that a few large firms would exercise control over the global food supply (Harhoff, Régibeau and Rockett, 2001). Related to this was the concern that firms in the crop seed/biotechnology sector would not develop products beneficial to society, rather there would be systematic biases in the types of GM crops that private firms would select for development.

These concerns have not diminished over time, for example, in 2009 the US Department of Justice and USDA organized a series of joint public workshops exploring issues of competition in agriculture (US Department of Justice, 2012). The public comments submitted in support of these workshops raised concerns of anticompetitive practices and “excessively” high levels of concentration across a variety of agriculture-related industries with many focusing specifically on the seed industry and agricultural biotechnology firms. A group of fourteen state attorney generals were one group raising concerns of concentration in the crop seed industry citing that “increased vertical integration and acquisitions may have raised the bar for entry so high that entry into the trait market is difficult, or nearly impossible” (Munson, London, and Lindeback, 2010). One of the primary concerns regarding concentration in the seed industry is not solely the levels of market concentration as measured by sales, but rather the concentration in seed traits and germplasm. (Hubbard, 2009).

The concerns of farmers and consumers about the firms supplying and developing GM crops might be dismissed on the grounds that they simply represent the typical fears of the former about other actors in the food marketing chain, and that consumer concerns are those of a small minority with a strong anti-corporate bias. However, the increase in seller concentration in the crop seed/biotechnology sector has already resulted in serious analysis by some observers of the industry. While there may be perfectly legitimate reasons for an industry becoming concentrated, there is a concern that there will not only be a static welfare loss associated with increased seller concentration, but that firms will also abuse their market dominance by engaging in anti-competitive practices (Saitone and Sexton, 2012). For example, Harhoff *et al.* (2001) argue that the integration of crop seed and agrochemical firms may have biased the types of GM crops introduced by the sector. In addition, business contracts such as tie-in contracts between GM seeds and complementary products such as herbicides may be exclusionary in nature and therefore grounds for antitrust scrutiny.

The breadth of the debate about biotechnology and GM crops/food also creates a dilemma for the regulator (Harhoff *et al.*, 2001). On the one hand, increased rigor of the regulatory approval process, notably in the EU, has partly been a response to the concerns of consumers and NGOs about the safety and environmental impact of GM crops. On the other hand, tougher regulation of GM crop approval may create a barrier to entry, affecting seller concentration in two ways: first, large firms with extensive experience of similar regulatory processes will initially own a larger share of approved products, although this “expertise effect” will eventually be dissipated over time; second, costly approval procedures increase sunk costs, and therefore reduce the number of firms actively developing GM products for regulatory approval, an effect that will persist over time.

These concerns about the industry revolve around two well-known arguments from the industrial-organization literature: first, what determines market structure; and second, to what extent is there a causal link between market structure and the extent and nature of innovation? In the case of agricultural biotechnology, as noted above, there is evidence for extensive consolidation in the sector both in terms of both patent and firm ownership (Harhoff *et al.*, 2001; Graff, Rausser and Small, 2003; Pray, Oehmke, and Naseem, 2005; King and Schimmelpfennig, 2005; Brennan, Pray, Naseem and Oehmke, 2005; Marco and Rausser, 2008; Moschini, 2010; Fuglie *et al.*, 2011). For example, King and Schimmelpfennig (2005) report that since 1998, just six firms, Dow, DuPont, Monsanto from the US, and BASF, Bayer, and Syngenta from Europe, have accounted for over 80 percent of GM crop trials for release in the US.

Importantly, these same six multinational firms also have a significant share in the global agrochemicals sector, accounting for 63 percent of global sales in 2010 (Fuglie *et al.*, 2011). High seller concentration in this sector is the end result of consolidation due to mergers, acquisitions and the exit of firms, along with the fact that the industry is very capital-intensive, which favors an industry structure of a few large firms (Fuglie *et al.*, 2011). At the same time, the relationship between crop seed and agrochemicals appears critical for these “big 6” firms for two reasons: first, there is a complementarity between crop seeds engineered to be tolerant to agrochemicals such as herbicides; second there was a need for firms to diversify into biotechnology and crop seed research as pest resistant traits were developed and began to compete with agrochemicals.

Private sector agricultural R&D spending is also dominated by the “big six” crop seed and agrochemicals firms, with Bayer, Syngenta and Monsanto estimated to collectively account for \$2.5 billion of R&D investment in 2007 (Fuglie *et al.*, 2011). Not surprisingly, the dominance of these firms in terms of market share and R&D expenditures shows up in their collective share of

intellectual property rights relating to seed traits. By 2002, the same six firms accounted for over 40 percent of private-sector agricultural biotechnology-patents issued in the US. Much of this concentration of biotechnology patent ownership has been due to extensive merger and acquisition activity in the sector. Pray *et al.* (2005) report a flurry of mergers and acquisitions between 1994 and 2000 in the five major GM crops in the US, corn, cotton, potatoes, soybeans and tomatoes, with a peak of 22 mergers in 2000. This process of consolidation appears also to have had a significant impact on the concentration of patent ownership in both the US and EU, where the six-firm concentration ratio for patents rose from 36 to 50 percent, and from 32 to 53 percent respectively (Harhoff *et al.*, 2001). The levels of observed market concentration are even higher when the focus shifts to products approved for inclusion in food, the top three firms, Monsanto, AgroEvo (absorbed in a merger with Rhône-Poulenc Agro to form Aventis in 2000), and Novartis (absorbed in a merger with Astra-Zeneca to form Syngenta in 2000) accounting for 66 percent of approvals by the end of the 1990s (Harhoff *et al.*, 2001).

Such concentration ratios are well over the levels that typically trigger concern by the antitrust authorities about the impact of mergers and acquisitions on market structure. In addition, some analysts have also begun to ask whether such an increase in seller concentration has a negative or positive impact on the degree of innovation in agricultural biotechnology. For example, Brennan *et al.* (2005) argue that the leading biotechnology firms have the *ability* to decrease total industry investment in research and development (R&D) because of the concentration of patent ownership. They also argue though that it is ambiguous whether the same firms have an *incentive* to reduce their innovatory efforts. Counter to this, the intensity of R&D expenditures in the biotechnology sector is clearly very high. Over the period 1996-2000, the ratio of R&D expenditures to product sales for US biotechnology companies averaged 71.4 percent, far exceeding the levels in industries

such as drugs and medicines, where the ratio of R&D expenditures to sales was 10.5 percent over the same period (Lavoie, 2004).

While it is clear that the structure of the crop seed/biotechnology sector has changed in the past decade, and that there may be some connection between market structure and innovation, modern industrial organization no longer subscribes to the view of early researchers such as Bain (1956) that market structure is determined exogenously by factors such as economies of scale and other barriers to entry, which in turn has a direct impact on the rate of innovation (Kamien and Schwartz, 1982). Instead the direction of causation debate that once raged over whether industries with high concentration generate more R&D activity or that industries in which firms conduct a good deal of R&D tend to become more concentrated, has been replaced with the widespread acceptance of the argument that in fact concentration and R&D intensity are both endogenous variables simultaneously determined within an equilibrium system (Dasgupta and Stiglitz, 1980; Sutton, 1998). This is supported by the fact that there is no empirical consensus in the literature as to the form of the relationship, if any, between R&D intensity and seller concentration (Cohen and Levin, 1989).

In Sutton's (1996) view, the mixed empirical results on the correlation between R&D intensity and seller concentration are not that surprising. Specifically he suggests any link between R&D intensity and seller concentration involves a "bounds" constraint, which will not be captured in a reduced-form regression specification across a sample of industries. To fix the basic idea of Sutton's approach, assume initially that firms in an industry sell a homogeneous product, and to do this they have to incur an exogenous sunk cost of F_0 , which might be thought of as the cost of acquiring a plant of minimum efficient scale, or the necessary technology to undertake production, after which they compete in price. It turns out that the equilibrium market structure C is a function

of the size of the market S relative to sunk costs F_0 and the intensity of price competition. In the case of Bertrand-Nash competition, the market can only sustain one firm in equilibrium, as multiple entry drives price down to marginal cost, firms making a net loss of F_0 in equilibrium. Nested in this case is the perfectly contestable market result of Baumol, Panzar and Willig (1982), where sunk costs $F_0 = 0$, and a continuum of equilibria exist, i.e., two or more firms enter, price equaling marginal cost.

In the case of Cournot-Nash competition, market structure becomes more fragmented as market size increases relative to sunk costs. Specifically, the number of firms entering in equilibrium will be equivalent to $N = \sqrt{S/F_0}$ (Sutton, 1991). Essentially, market concentration C will fall with the size of the market, given a specific level of sunk costs F_0 . Importantly, if firms are not recovering their sunk costs, it cannot be an equilibrium market structure, i.e., there will either have to be consolidation by acquisition or merger, or there will be exit of firms as they are unwilling to incur additional fixed costs of replacing their plant as it becomes obsolete.

Alternatively, if it is assumed that firms are able to horizontally differentiate their products exogenous sunk costs now relate to producing a specific variety and price competition is mitigated in equilibrium. This results in the relationship between market structure and size being a lower *bound* to equilibrium seller concentration, as there is a possibility of multiple equilibria, due to the fact that, either different firms will enter each sub-market, the same firms may enter all sub-markets, or firms occupy several niche markets.

Now suppose that firms can vertically differentiate their products in the sense that each product has a single quality attribute u which can be enhanced through R&D outlays. All consumers have the same tastes for higher quality, and consumers' marginal utility is increasing in u . Firms still incur initial sunk costs of F_0 , but they now choose a level of u at an additional

sunk cost $F(u)$ before competing in price. This setting allows for the possibility that the link between increased market size S and structure C is broken. Specifically, competitive escalation of $F(u)$ raises the equilibrium level of sunk costs $\{F_0 + F(u)\}$ as S increases, offsetting any tendency toward market fragmentation, i.e., R&D is an endogenous barrier to entry. If, however there are very rapidly diminishing returns to R&D in terms of consumer response to higher quality, then market fragmentation may still occur as S increases, and R&D is an exogenous barrier to entry.

In figure 2, the market size-seller concentration relationship is plotted for two different values of initial sunk costs, F_0^1 and F_0^2 where the locus rr traces out the points at which there is a switch from the no-R&D to an R&D regime, defined by where if N firms have no R&D, it is just profitable for one firm to deviate. Two comments can be made: first, increases in market size do not lead to indefinite decreases in seller concentration; second, the market size-seller concentration relationship is not necessarily monotonic. In other words, R&D is not an exogenous barrier to entry as in the traditional literature, whereby the cost of R&D merely shifts the negative relationship between seller concentration and market size. Instead, low sunk costs F_0^1 are initially associated with falling seller concentration as the size of the market increases, and then seller concentration increases. This follows from the fact that R&D only becomes profitable when the market reaches a certain size, which itself varies with the level of seller concentration along rr , i.e., a lower value of F_0 implies that the switch-point will be at lower level of seller concentration. In addition, once in the R&D regime, increases in the market size result in increases in R&D expenditure, i.e., market structure becomes independent of the initial sunk costs, and low sunk cost only permits a low degree of seller concentration over a specific range. Finally, if the market is at point X , it will require a discrete increase in R&D expenditures to get up to the higher equilibrium schedule F_0^2 .

Casual empiricism suggests that evolution of market structure in the crop-seed-biotechnology sector may fit this type of “bounds” model. Initially, in the 1980s, the sector was populated by a large set of small dedicated start-up firms incurring the sunk costs of doing basic research, F_0^1 (Lavoie and Sheldon, 2000). Then in the 1990s, the opportunity arose to tailor the genetic structure of crops, which required firms in the industry to take advantage of complementarities between three types of intellectual assets, relating to plant genetic transformation, genes, and elite germ plasm, driving up industry sunk costs to F_0^2 . As a result, there was rapid consolidation via acquisition of start-up firms as the major life science firms attempted to avoid the additional transactions costs of acquiring these assets via arms’ length licensing arrangements (Graff, Rausser and Small, 2003), i.e., equilibrium C changes from X to Y . Finally, we can speculate that this also coincided with growth in the size of the market for GM crops as farmers in both North and South America rapidly adopted several key GM crops, causing biotechnology firms to incur additional, endogenous sunk costs of R&D, $F^2(u)$, equilibrium market structure moving from Y to Y' .

While the above story seems plausible, it is important to understand that the model makes a key simplifying assumption – a firm’s R&D spans all of the products it offers within the industry. Consider instead the case where firms engage in R&D with the objective of improving the attributes of the various products they offer. An initial equilibrium might be characterized by a fragmented industry where all firms have small market share with low R&D outlays. However, there may be a situation where a firm(s) finds it profitable to outspend other firms and capture a larger market share. Sutton (1997; 1998) argues that whether a firm(s) can outspend their rivals and still make sufficient profits to cover their R&D outlays will depend on an escalation parameter α , the value of which will depend on the pattern of technology and tastes, and the nature of price competition in the industry.

More specifically, the effectiveness of an escalation strategy depends on the success of R&D outlays in raising consumers' willingness to pay for the firm's products within a sub-market. It also depends on supply and demand linkages between different R&D trajectories and different sub-markets. Where these linkages are strong due to economies of scope in R&D and/or a high degree of substitution in demand, α will be high, while it is low with no economies of scope in R&D and a low degree of substitution across sub-markets.

Following Anderson and Sheldon (2015), assume that there are regional variations in the demand for specific crop seed traits, such as herbicide tolerance or insecticide resistance, and that these regional variations create geographically distinct sub-markets. This assumption corresponds with the empirical findings of Shi, Chavas, and Stiegert (2010) and Stiegert, Shi, and Chavas (2011) of spatial price differentiation in GM corn and implies that the crop seed/biotechnology industry is characterized by horizontal product differentiation. Also assume that farmers value higher quality products such that a firm competes within each sub-market primarily via vertically differentiating the quality of its seed traits.

Firm-level sales are defined for firm i in sub-market m as Π_{im} , and total industry sales are defined as $\Pi_m = \sum_{i \in m} \Pi_{im}$, i.e., the size of the sub-market S . Similarly, R&D expenditure is also defined at the firm F_{im} and sub-market $F_m = \sum_{i \in m} F_{im}$ levels respectively. The degree of market segmentation, or product heterogeneity is defined as $h_m \in [0,1]$ the share of industry sales in sub-market m accounted for by the largest product category l such that:

$$h_m = \max_l \frac{\Pi_{lm}}{\Pi_m}, \quad (1)$$

where $h_m = 1$ corresponds to a sub-market in which only a single product is offered.

Drawing on Sutton (1998), the lower bound to the single firm seller concentration ratio C_{1m} for the quality-leading firm in sub-market m can be stated as:

$$C_{1m} = \frac{\hat{\Pi}_m}{\Pi_m} \geq \alpha(\sigma, \beta) \cdot h_m, \quad (2)$$

where α is some constant for a given set of parameter values (σ, β) , σ is a parameter capturing consumer preferences and product market substitutability, and β is a parameter capturing the elasticity of R&D expenditures. $\hat{\Pi}_m$ are sales for the quality-leading firm in sub-market m . The value of α depends upon industry technology, product market competition, and consumer preferences and signifies the extent that a firm can escalate product quality via R&D investment and capture market share from rivals. Equation (2) implies that the lower bound to seller market concentration is independent of the size of the market in industries with endogenous fixed costs.

Sutton (1998) also notes that an equivalent expression for the lower bound to R&D-intensity \hat{P}_m for the quality-leading firm can be defined as:

$$\hat{P}_m = \frac{\hat{F}_m}{\hat{\Pi}_m} \geq \alpha(\sigma, \beta) \cdot h_m - \frac{F_0}{\Pi_m}, \quad (3)$$

where F_0 are the sunk costs associated with entering a sub-market, and \hat{F}_m are sunk R&D costs. Equation (3) implies that the R&D-to-sales ratio for the largest firm shares the same lower bound as the single firm concentration ratio as the size of the market becomes large, i.e., $\Pi_m \rightarrow \infty$. For finitely-sized markets, the lower bound to R&D intensity is increasing in the size of the market as the largest firms respond to these increases with an escalation of R&D expenditures.

From this more general theory, predictions about R&D intensity and market structure can be derived. If R&D outlays are ineffective in raising willingness to pay for a firm's products, R&D

intensity will necessarily be low. Consequently if we observe a high R&D to sales ratio, it implies that R&D outlays are effective. Seller concentration will then be determined by the strength of the linkages between sub-markets, i.e., it will tend to be high where the linkages are strong, making an escalation strategy profitable, and the h index will tend to be high. With weak linkages on the demand and supply side, even if R&D outlays are effective, seller concentration will be low, as will the h index. As a result, a joint restriction can be placed on the observable parameters: in an industry with a high R&D to sales ratio, seller concentration C should increase with h . Alternatively, an industry with a low R&D to sales ratio will converge to a fragmented market structure independent of h . In addition, if sunk costs increase, seller concentration will increase irrespective of R&D intensity, but with low R&D intensity, this increase in concentration will be eroded over time as the market grows.

In the case of high R&D intensity, the impact of an increase in sunk costs on seller concentration has to be separated out from the effects of escalation in R&D outlays. Returning to the stylized facts of the crop seed/biotechnology industry described in figure 2, the increase in sunk costs was the initial mechanism for the sector to become more concentrated in the 1990s as start-up firms were acquired by larger life-science companies, but the complementarities between the different intellectual property rights they acquired, along with the willingness of a growing number of farmers to purchase GM crops, resulted in an R&D escalation strategy that has led to further increases in seller concentration in the crop seed-biotechnology sector.

What is clear though from this analysis is that assuming a direct correlation between R&D intensity and seller concentration in the crop seed/biotechnology industry may be misleading both in terms of understanding the evolution of the sector's market structure, as well in terms of drawing normative conclusions about the impact of market structure on innovation in the sector.

Nonetheless, it is still an open question as to the long-run consequences for social welfare of the crop seed/biotechnology sector being so concentrated in terms of market share and patent ownership. Interestingly, this sector has drawn the attention of the US antitrust authorities in the past decade. Specifically, in 2009 the Department of Justice initiated an investigation into the possibility that Monsanto was breaking antitrust rules, Monsanto's rivals, including DuPont and Pioneer Hi-Bred, alleging that the firm had used its licensing agreements to prevent other companies from combining their own technologies with Monsanto's Roundup Ready genes. However, the inquiry ended in 2012 without any enforcement action being taken by the Department of Justice.

3. New Industrial Organization Analysis of the Agricultural and Food Marketing System

In order to think through the potential welfare impact of market failure due to exploitation of oligopoly power, Sexton (2000) outlined a prototypical new industrial organization (IO) approach to modeling the agricultural and food marketing system, drawing on advances in applied game theory and empirical analysis conducted under the auspices of the so-called new empirical industrial organization (NEIO). Essentially, Sexton (2000) laid out a simple vertical market model where an integrated processing-retailing sector purchases raw product from an upstream agricultural sector, undertakes some processing activities, and then sells a homogeneous final food product downstream to consumers at retail. Assuming a representative processor-retailer purchasing the raw product at arms' length operating under a fixed proportions-constant cost returns to scale technology, Sexton (2000) derives a standard first-order condition for the firm:

$$p^r \left(1 - \frac{\lambda}{\eta} \right) = p^f \left(1 - \frac{\theta}{\varepsilon} \right). \quad (4)$$

In equilibrium, mark-up of the retail price, p^r , over marginal cost (the Lerner index) is conditioned on a downstream market conduct parameter (conjectural elasticity) capturing the extent of processor-retailer exploitation of oligopoly market power, λ , and the inverse price-elasticity of demand for the final good at retail, η ; while mark-down of the raw product price, p^f , below its marginal value product is conditioned on an upstream market conduct parameter (conjectural elasticity) capturing processor exploitation of oligopsony power, θ , and the inverse supply elasticity of supply from the agricultural sector, ε . Specifically, the indices of market power, $\lambda \in [0,1]$ and $\theta \in [0,1]$, can capture the range from competitive input and output markets, $\lambda = 0, \theta = 0$, to monopoly/monopsony or perfect collusion in output/input markets, $\lambda = 1, \theta = 1$. If a fixed number of symmetric processor-retailer firms are assumed, and farm supply and retail demand functions are treated as linear (or double-log), the vertical model can easily be solved for equilibrium farm and retail prices, farm and retail outputs as functions of the conjectural and price elasticities, and the agricultural sector's share of final product revenue under perfect competition.

While the model is subject to the well-merited theoretical criticism that it uses a static framework, conjectural variations, to capture dynamic interaction between processor-retailers in their upstream and downstream markets, as Sexton (2000) noted it can capture a variety of horizontal market structures at various stages of the food and agricultural marketing chain, and perhaps most importantly, by focusing on the possibility of both processor-retailer oligopsony and oligopoly power, it minimizes the risk of the researcher understating the extent of market power and/or attributing observed market distortions to the incorrect type of market power.

The model also has the advantage that it can be used for empirical analysis, assuming estimates of the price and conjectural elasticities are available. In particular, the basic structure of Sexton's (2000) framework is very similar to what formed the modeling basis of applied research

of industry behavior in the 1980s under the rubric of the NEIO, characterized by efforts to estimate the extent of imperfect competition in single industries. The latter grew out of a dissatisfaction with the structure-conduct-performance (SCP) paradigm, pioneered by Bain (1951), whereby a one-way causal relationship was posited from market structure (seller concentration) to conduct to performance in a specific industry. Typically in cross-sectional empirical research, average accounting profits Π_i in the i^{th} industry were regressed on seller concentration S_i in that industry:

$$\Pi_i = \alpha_i + \beta S_i, \quad (5)$$

a positive coefficient on market structure being taken to mean that higher seller concentration facilitated collusion among firms, and therefore higher industry profits, β_i representing all other factors affecting industry profitability (Geroski, 1988). Up to the mid-1980s, most studies of the food industry typically followed the SCP approach, e.g., Connor *et al.* (1985), a positive correlation being found consistently between seller concentration and industry profits (Sexton and Lavoie, 2001). However, starting with Schroeter's (1988) analysis of beef-packing, the emphasis in the agricultural economics literature began to shift to NEIO-type studies drawing on the methodologies for estimating market conduct described in articles by Appelbaum (1982) and Bresnahan (1982).

Development of the NEIO methodology grew out of significant criticisms of the SCP approach (Schmalensee, 1989): Demsetz (1973) questioned the view that profits in concentrated industries reflect collusive behavior as opposed to differential efficiency, while Fisher and McGowan (1993) criticized SCP studies for using accounting measures of profitability to infer market power. Perhaps most seriously, Clarke and Davis (1982), in extending Cowling and Waterson's (1976) efforts to provide a theoretical underpinning to SCP models, showed that all variables in such models were logically endogenous, making it impossible to infer any direction

of causality between market structure and performance. In contrast, the NEIO drew on models of imperfectly competitive profit-maximizing firms to guide specification, estimation, and testing of structural time-series econometric models of industry behavior (Bresnahan, 1989).

In this context, Sexton (2000) asked an important question: what had been learned at the time of writing about the extent of market power in food processing? Sexton noted that up to that point, NEIO studies of food processor behavior, especially in the US meat and poultry processing sector, had generally found some statistical evidence for market power, although the measured departures from perfect competition were actually rather small. A subsequent survey of NEIO studies in the agricultural economics literature by Sheldon and Sperling (2003) confirmed Sexton's (2000) finding, and made the following observations: first, the majority of studies concerned the US food industry; second, the estimates of market power and the Lerner index varied widely across industries, and that the value of the Lerner index depended not only on the value of the market power parameter, but also the estimate price elasticity; third the US meat marketing system had been subject to most analysis; and fourth, analysis of food retailing had received little attention in terms of this methodology.

As Sexton (2000), and subsequently others have noted, including Sexton and Lavoie (2001), Sheldon and Sperling (2003), Kaiser and Suzuki (2006), and Perloff, Karp and Golan (2007), key issues arose with the use of the NEIO methodology. These issues included, *inter alia*, the lack of a dynamic oligopoly framework in the majority of studies, the modeling of the food processing technology (fixed vs. variable proportions), poorly defined product markets, specific *ex ante* choices of functional forms for the demand and supply functions, and processing technology, and a failure to account for economies of scale.

These and other criticisms of the NEIO methodology may partially explain the relative decline in its popularity among applied IO researchers. However, in conducting the current review, it was clear that of the NEIO-type studies undertaken since 2000, several have made efforts to address some of these issues, while others have adopted new/adapted NEIO-type methodologies, e.g., dynamic interaction (Richards, Patterson, and Acharya, 2001 – US potato processing; Hunnicutt and Aadland, 2003 – beef packing; Katchova, Sheldon and Miranda, 2005 – US potato processing; Scokai, Soregaroli and Moro, 2013 – Italian cheese retailing), and different/extended NEIO-type methodologies (Alvarez, Fidalgo, Sexton and Zhang, 2000 – Spanish milk processing; Crespi, Gao, and Peterson, 2005 – US rice milling; Reimer, 2004 – US breakfast cereals; Raper, Love and Shumway, 2007 – US cigarette manufacturing; Mérel, 2009 – French cheese marketing; Cakir and Balagtas, 2012 – US fluid milk marketing; Hovahannisyan and Gould, 2012 – US milk retailing). Nevertheless, with a few exceptions, the majority of these more recent NEIO studies have again found only modest departures from perfect competition in the industries studied.

In his follow-up review, Sexton (2013) again concludes that despite the concerns of US farmers, legislators, regulators and agricultural economists, empirical research conducted under the NEIO rubric, and especially that relating to the US meat and poultry processing, has found only modest departures from competitive pricing behavior, a conclusion also drawn by the US Government Accountability Office (2009) in a report conducted and written at the behest of Congress. In addition, the deadweight losses (the Harberger triangle) from exercise of market power are small and typically exceeded by efficiency gains from exploitation of economies of scale, e.g., Alston, Sexton and Zhang (1997), and Lopez and Lirón-España (2003).

This leaves one wondering whether new IO analysis of the agricultural and food marketing system actually has any substantive relevance to policymaking. Sexton (2000; 2013) answers this

pretty emphatically in both review articles: first, if the agricultural and food marketing chain is characterized by successive oligopoly, the deadweight losses become quite large, and therefore of consequence – an argument laid out in detail in Sexton *et al.* (2007); and, second, as is well-known from other sub-fields in economics, even if the deadweight loss triangles are inconsequential – the so-called “tyranny of the triangles” (The Economist, July 1994) – the distributional consequences of market distortions are much greater quantitatively. As Sexton (2013) points out, relative to competition, any food processing firm(s) marking up price over their marginal cost(s), which include(s) the raw agricultural commodity price, earn(s) a rectangle of monopoly profits, the height of which gets larger the greater the price wedge, and, therefore, the greater the redistribution through reductions in producer and consumer surplus. Nevertheless, having argued that some key welfare-economic conclusions can be drawn from new IO analysis of the agricultural and food marketing system, Sexton (2013) raises a critical question: does this homogeneous good - oligopsony/oligopoly workhorse model, which has been used in both theoretical and applied research, actually fit modern agricultural procurement markets in the US, where there has been an increased focus on food product quality and also extensive vertical coordination between the agricultural and processing sectors?

McCorriston (2014) essentially asks the same question, albeit in the EU context and with an emphasis on the vertical relationship between food processors and retailers. He draws a similar conclusion to Sexton (2013) about the findings of the NEIO methodology: despite there being high observed levels of seller concentration in the food processing sector, there are only modest departures from the competitive benchmark in this sector. While he recognizes that this may be due to data limitations or inappropriate modeling choices, most critically he suggests it is not processor seller power that matters in the EU agricultural and food marketing system, but rather

retailer buyer power exercised through vertical contractual relationships with upstream suppliers which are not adequately captured in typical NEIO models.

Therefore, while Sexton (2002; 2013) and McCorrison (2002; 2014) diverge in terms of focus - food processor vertical coordination with the agricultural sector versus food retailer vertical coordination with the food processing sector - they are essentially emphasizing the same general issue: what is the nature of buyer power in the agricultural and food marketing system, how does it affect economic efficiency and distribution of surplus in the system, and what are the welfare consequences of such vertical market competition?

4. Buyer Power in the Agricultural and Food Marketing System

Framework

In order to analyze the economics of buyer power in the agricultural and food marketing system, it is useful to draw on a conceptual framework due to Chen (2007), who defines buyer power as:

“...the ability of a buyer to reduce the price profitably below a supplier’s normal selling price, or more generally the ability to obtain terms more favorable than a supplier’s normal trade terms...” (Chen, p.19).

From this definition, it is possible to pin down two types of downstream market power contingent on whether or not upstream suppliers have market power. If there is competition among suppliers upstream, as is the case with agriculture, and the normal selling price would be the competitive price, downstream buyer power is due to monopsony/oligopsony power. On the other hand, if the upstream market is oligopolistic, as is the case with food processing, and the normal selling price would be in excess of the competitive price, downstream buyer power arises from the exercise of countervailing power. As Chen (2007) notes, these two types of buying power are

quite distinct in their effects on economic welfare, and hence the way in which they should be viewed in the context of antitrust analysis.

In terms of economic efficiency, the loss due to exercise of monopsony/oligopsony power is well-understood. The quantity of the good purchased from upstream suppliers is less than what is socially optimal, reducing the price paid below the competitive price, thereby generating a deadweight loss. Importantly, this deadweight loss occurs irrespective of the nature of competition at the downstream stage, the only impact of downstream competition being the position of the derived demand curve for the upstream good. This inefficiency result is due to the fact that transactions between downstream and upstream firms in a standard monopsony/oligopsony model are based on linear pricing, a problem that disappears if efficient non-linear pricing contracts can be implemented, whereby the foregone profit implied by the deadweight loss can be captured. However, even if such efficient contracts can be written, the next stage in the marketing chain will not benefit from the removal of the monopsony/oligopsony distortion, higher prices paid to upstream suppliers being passed through to the next stage by the downstream buyer.

Countervailing buying power, long ignored since the term was introduced into the economics literature by Galbraith (1952), has generated considerable interest among economists since the mid-1990s as retailing became more concentrated and discount retailers such as Wal-Mart established significant market share. With countervailing buyer power, the effects on welfare depend quite crucially on the nature of competition downstream, and the nature of contracts that downstream firms are able to implement with upstream firms. For example, analysis by von Ungern-Sternberg (1996) and Dobson and Waterson (1997) shows that consolidation of downstream buyers may have two opposing effects on prices downstream: on the one hand, fewer downstream firms results in countervailing power, driving down the price that an upstream

monopoly/oligopoly can charge, on the other hand, consolidation downstream may result in firms increasing their mark-ups over marginal cost, pushing up downstream prices. Which effect dominates will depend on how intense competition is at the downstream stage. Other studies show that while increased consolidation downstream may result in lower downstream prices, it does not necessarily increase efficiency downstream if a dominant firm increases their market share at the expense of a competitive fringe (Chen, 2003). In addition, countervailing power downstream is more likely to result in lower downstream prices if transactions between downstream and upstream firms occur via linear pricing, whereas non-linear pricing allows contracts whereby upstream and downstream firms share their joint profits, without there being a reduction in the downstream price (Inderst and Shaffer, 2004).

Given the distinction between buyer power that results from either monopsony/oligopsony power, or countervailing power, it is interesting to return to Sexton (2013) and McCorrison (2014), placing their reviews in the context of the orthodox view in industrial organization of vertical market control (see for example, Tirole, 1988). The prototypical vertical market is one where there is successive monopoly between two stages, upstream processing and downstream retailing, and there is a vertical externality. The best known example of such an externality is the problem of double-marginalization: at the processing stage, a monopolist marks up the wholesale price over marginal cost, which is passed through at arms' length under linear pricing to a monopolistic retailer who then marks up the retail price over the wholesale price. The vertical externality arises because the downstream retailer fails to take account of the upstream processor's marginal profit when setting their price, resulting in downstream consumption of the intermediate good produced upstream being too low, and aggregate profit of the vertical system being lower than it would be under vertical integration.

Alternatively, it is argued that the upstream processor has an incentive to impose a vertical restraint on the downstream retailer thereby eliminating the vertical externality (Katz, 1989). The standard example of such a restraint is non-linear pricing, specifically a two-part tariff, i.e., the upstream processor implements a contract consisting of a wholesale price equal to their marginal costs and a franchise fee equal to the vertical system's profit. Such a contract allows the upstream sector to realize the profits of downstream vertical integration by making the downstream sector the residual claimant on any marginal profit in the system, i.e., they are given the correct incentive to set the monopolistic price at retail, in other words the upstream processor is principal and the downstream processor is agent. Alternatively, the upstream processor can charge a monopoly price at wholesale, and impose resale-price maintenance whereby the downstream price is set equal to the wholesale price, the upstream processor capturing all the vertical profits. Essentially, elimination of double marginalization is unambiguously welfare increasing, retail consumers facing a lower price.

While this textbook view of vertical market control may not have been an unreasonable characterization of the agricultural and food marketing system prior to the 1980s, it ignores the current reality whereby the specific location of buyer power essentially determines who is principal and who is agent at any point in the system. First, the textbook model completely ignores the vertical externality identified by Chen (2007): firms at the food processing stage can either exercise monopsony/oligopsony power over their agricultural input suppliers, or they may choose to implement non-linear price contracts with those suppliers in order maximize the aggregate profits of this vertical market linkage. Second, with consolidation of food retailing, and the potential for the retailing sector to exercise countervailing power, it is no longer obvious that the upstream food processing sector is the principal in this vertical market linkage.

Food Processor Buyer Power

Focusing on Chen's (2007) first definition of buyer power: if this were a true characterization of the relationship between suppliers of raw agricultural commodities and downstream food processors, market transactions would all be through spot markets, and there should be some empirical evidence for the exertion of monopsony/oligopsony power. As noted in the previous section, NEIO studies of US food processing have found only modest departures from perfectly competitive pricing, and in the case of meatpacking, there is considerable empirical support for the view that the actual buying behavior of downstream food processors is driven not by exertion of market power, but instead by realization economies of scale and the need to operate processing plants at full capacity (MacDonald and Ollinger, 2000). In addition, food processing firms are meeting increased demands for quality from downstream food retailers, who are in turn responding to consumer willingness to pay for a broad range of attributes in the foods they consume (Sexton, 2013). As a consequence, food processors have an incentive to enter into vertical contracts that ensure sufficient plant throughput of uniform and high quality inputs, thereby maintaining processing plant-level profitability (MacDonald and McBride, 2009).

The latter point has been extensively documented in the literature – since the 1980s, there has been a significant decline in the use of spot markets across a range of agricultural commodities, and a significant increase in vertical coordination through contractual arrangements between upstream suppliers of raw agricultural commodities and downstream food processing. MacDonald (2015), using USDA's Agricultural Resource Management (ARMS) data set for 2013, reports that by 2011, 40 percent of the value of US agricultural commodity production was governed by contracts compared to 28 percent in 1991, although this share did fall to 35 percent by 2013. The extent of contracting does vary quite a bit across commodity-type, MacDonald (2015) reporting

that by 2013, the share of production under contract ranged from 22 percent for all crops to 52 percent for all livestock, but within all crops, the share varied from 13 percent for wheat to 57 percent for peanuts, and within all livestock, the share varied from 32 percent for cattle to 74 and 84 percent for hogs and poultry respectively.

Much of the public concern about contracting has concerned the livestock sector where vertical coordination is typically conducted through production contracts. For example, in the broiler industry, producers sink costs into specialized housing and equipment and provide labor, while poultry processing firms, provide key inputs such as chicks, feed, veterinary services and management guidance. Producers deliver finished birds to processing plants, and they are paid on the basis of how well they performed in transforming chicks and feed into broiler meat. MacDonald (2015) reports that in 2013, such contracts accounted for \$58 billion worth of US agricultural production, with \$48 billion in poultry and hogs.

Importantly, production contracts typically bind upstream producers to either a specific or limited number of downstream processors for multiple production periods due to investment in specific assets such as production units, and because of scale economies in downstream processing. As Wu (2006) notes, relationship-specific investments in upstream production facilities create quasi-rents, the difference between the profit a producer can make within a contractual relationship and the next best use of those assets. Bargaining over and appropriation of quasi-rents by downstream food processors, and hence the risk to the upstream supplier of a “hold-up” is at the heart of concerns over buyer power, and which should be treated as distinct from the exertion of textbook monopsony/oligopsony power (MacDonald, 2015).

Sexton (2013) and Crespi *et al.* (2012) argue strongly that downstream processors do not have an incentive to exert monopsony/oligopsony power over suppliers of raw agricultural

commodities. This follows from the fact that the processors have themselves sunk investment into large scale, location-specific processing plants committed to supplying a specific product to the downstream food retailing sector. As a consequence, driving their input prices below their marginal value product is short-sighted, generating not only the traditional deadweight loss triangles, but also running the risk of pushing upstream suppliers out of business as the rate of return on their specific investment falls below the competitive level. Downstream food processors will in fact seek contracts in order to guarantee a stable supply of high-quality raw agricultural commodities and minimize transactions costs. As Crespi *et al.* (2012) indicate in a footnote, the connection between the transaction cost benefits of vertical coordination, and firm/relationship specific assets, was originally made by Williamson (1986), and has been noted in the agricultural context by several researchers, including, *inter alia*, Goodhue (2000), Wu (2006; 2014).

What Sexton (2013) and Crespi *et al.* (2012) are essentially arguing is that downstream food processors will write contracts with upstream suppliers to avoid the long-run consequences of the vertical externality noted by Chen (2007), i.e., they will offer upstream suppliers a non-linear contract. Following Crespi *et al.* (2012), suppose the per unit surplus to a transaction between a downstream food processor i and an upstream supplier j is, $S_{ij} = P_i^w - c_i - c_j - T_{ij}$, where P_i^w is the wholesale price charged to downstream food retailers, c_i and c_j are downstream and upstream variable production costs respectively, and T_{ij} are the downstream processing firm's transactions costs, which include contract monitoring, enforcement and other agency costs that cannot be contracted on. Given this, the downstream processor will offer the upstream supplier a non-linear price consisting of, $P_{ij}^u = c_j + \delta S_{ij}$, i.e., a two-part tariff that covers the upstream supplier's variable costs plus a share of the vertical market surplus $0 \leq \delta \leq 1$. As Sexton (2013) notes, if upstream

suppliers sell to competitive downstream firms, $\alpha = 1$, upstream firms earning a return on their fixed investment c_j^f , i.e., orthodox producer surplus. In principle, in the contracting case, the downstream processor only has to offer a contract that covers the upstream variable costs c_j , with $\delta = 0$, assuming that the upstream supplier has no alternative outlet. This has the structure of a standard principal-agent problem, where the downstream food processor (the principal) has the ability to make take-it-or-leave-it contracts to the upstream supplier of the raw agricultural commodity (the agent). Essentially, the contract as described satisfies the agent's participation constraint.

In a dynamic setting, such a contract is likely to be inefficient due to the fact that if the upstream firm makes no return on their fixed investment c_j^f in the long run, they will be forced to exit the industry. In turn, this would result in sub-optimal use of capacity by the downstream food processor, and/or the transactions costs of seeking alternative suppliers of high-quality raw agricultural commodities. Sexton (2013), and Crespi *et al.* (2012) argue that as a consequence, in a long run setting, upstream suppliers will be offered a portion of the available vertical surplus, $0 < \delta^* \leq 1$, such that $P_{ij}^u \geq c_j^f$. In other words, downstream processing firms have an incentive to internalize the vertical externality that would be generated by exploitation of their buyer power.

Wu (2006; 2014) suggests that this characterization of long run vertical coordination is rooted in the notion of relational contracts (Levin, 2003). Wu (2014) defines relational contracts as incomplete contracts that govern contract performance via informal incentives, which are self-enforced via a repeated game. In a simple contracting setting: suppose an upstream supplier j and downstream processor i sign a contract to trade a unit of the raw agricultural commodity, and during the production stage, the upstream supplier can choose to either invest or not invest in some

action that will ensure higher quality of the agricultural commodity and thereby raise the wholesale price P_i^w the downstream food processor can charge. Based on this, the downstream processor can choose either to pay or not pay the upstream supplier a bonus. Assuming the investment and bonus actions are observable but not contractible, in a one-shot game, the equilibrium is one where the upstream supplier does not invest and the downstream processor offers no bonus.

If this game is repeated indefinitely, however, and there is a sufficiently high discount rate, the upstream supplier has an incentive to invest as the downstream food processor will credibly promise to pay bonus payments, i.e., a relational contract is established. Wu (2006) also shows in this setting, the downstream food processor also has an incentive to invest in relationship-specific assets in order to increase their payoff at wholesale. This is a relationship-specific asset due to that fact that the additional payoff to the downstream food processor only exists when it cooperates with the existing upstream supplier. Of course parties to such a contract are not wholly immune to opportunism – for example, the downstream processing firm may heavily discount the future, reverting to the short run optimum of not offering a bonus. Crespi *et al.* (2012) argue that this will only occur in cases of extreme buyer financial distress, i.e., their discount rate would be low.

Where does this leave analysis of perceived buyer power in the contracting relationship between upstream suppliers of raw agricultural commodities and downstream food processors? As Wu (2014) notes, buyer power has not yet been incorporated into typical models of contracting, so it is not clear exactly how one would pin down exploitation of such power in any empirical analysis. However, MacDonald and Wu (2014) have conducted some experimental economic analysis of varying the level of competition in markets where multiple buyers make take-it-or-leave-it offers to multiple sellers. Their results indicate that with increased market concentration among downstream processors, upstream suppliers are more willing to accept contracts that allow

buyers more discretion. Specifically, downstream processors offer contracts with two-part tariffs that have a lower fixed payment and higher bonus payments, the contracts offering greater performance incentives to upstream suppliers, but at the same time reducing buyer contracting (agency) costs.

This finding suggest that there will be two opposing effects of increased concentration in downstream food processing: on the one hand, downstream food processors exert greater buyer power in vertical contracting, i.e., they make the terms of contracts tougher for upstream suppliers, but the reduction in their agency costs works in the opposite direction as downstream processors increase their purchases of raw agricultural commodities. In other words, increased food processing concentration in combination with widespread relational contracting might actually result in the deadweight losses from buyer power being mitigated. Wu (2014) suggests this as a potential explanation for the apparent paradox of continued public concern about increased seller concentration in downstream food processing at the same time as the lack of any significant empirical evidence for the exploitation of monopsony/oligopsony power.

Food Retailer Buyer Power

(a) Vertical Restraints

The focus here turns to the use of vertical restraints by the downstream food retailing sector. Apart from the simple two-part tariff and resale price maintenance contract described earlier, conventional vertical restraints cover a wide range of activities, including exclusive dealing and exclusive territories, which are contractual provisions restricting a retailer to carrying only one processor's brand, and the geographical area of sales for that brand; full-line forcing which relates to a retailer having to carry the complete range of a processor's products and the related activities of tie-in sales and commodity bundling whereby the sale of one product is conditioned on the

retailer buying some other product. McCorriston and Sheldon (1997) found that in the US food processing/retailing sector many of these vertical restraints were the subject of antitrust decisions over the period 1972-1991, exclusive territories being the most common.

The standard argument in favor of vertical restraints is that without them intensive competition between downstream retailers can either result in an inefficient level of pre-retail services (Matthewson and Winter, 1984; Rey and Tirole, 1986), or excessive post-sale quality differentiation (Bolton and Bonnano, 1988). However, other arguments suggest that the efficiency enhancing effects of such restraints ignores their potential effect on firm behavior at the upstream processing and downstream retailing stages of the marketing chain (Rey and Stiglitz, 1988; Innes and Hamilton, 2009).

To illustrate the argument, consider a simple result due to Bonnano and Vickers (1988): suppose two upstream processors sell a differentiated product to a downstream retailing sector consisting of two firms, and at both stages firms compete in price. Also assume that there is exclusive dealing, i.e., each upstream processor delegates just one of the retailers to sell their branded product. Suppose the initial contract consists of each upstream firm selling its product at a wholesale price equal to marginal cost, franchise fees being set equal to zero. Under such a contract, neither retailer can credibly raise price beyond marginal cost, i.e., the Bertrand-Nash equilibrium. As a consequence, such a contract fails to maximize vertical profits due to inter-brand competition. Alternatively, suppose each upstream processor commits to raising its wholesale price above marginal cost, which they are able to do because of their exclusive dealing arrangements. This in turn allows retailers downstream to credibly raise their prices, upstream processors capturing the additional retailing profits via franchise fees. In other words, exclusive

dealing in conjunction with a two-part tariff, while removing the vertical externality of inter-brand competition can actually reduce consumer welfare.

While the above result is logically consistent, it is very sensitive to the assumption that the upstream processor(s) (principal) is able to make take-it-or-leave offers to the downstream retailer(s) (agent), ignoring the possibility that downstream retailers are able to bargain in their favor over setting contract terms due to their countervailing power. Following Shaffer (1991), suppose an upstream processing sector sells homogeneous products to a downstream retailing duopoly differentiated by characteristics such as location, range of goods and services etc. Each upstream processor sets a wholesale price, and then each retailer chooses an upstream processor as their supplier and sets a retail price.

The key difference to Bonnano and Vickers (1988) is that there is competition between processors for retail shelf-space, and in the absence of non-linear pricing, vertical profits will not be maximized. With linear pricing no upstream processor can set a wholesale price above marginal cost as they will be undercut by other processors, and neither retailer can raise price above marginal cost as they will be undercut by the other retailer. Alternatively, a two-part tariff can be offered where the wholesale price is marked up above marginal cost along with a negative franchise fee paid by the upstream processor(s) to the downstream retailer(s). The negative franchise fee compensates downstream retailers for the higher wholesale price, but at the same time in paying the higher wholesale price, competition is lessened at retail, feeding back into higher retail profits. Essentially, this is the same outcome as Bonnano and Vickers (1988), except that it is downstream retailers who appropriate the vertical profits. In the context of Chen's (2007) discussion, the latter result highlights two key points: first, countervailing power at retail may have a significant impact on the nature of vertical coordination between upstream and downstream firms, and second,

countervailing power at retail is not necessarily in the interest of consumer welfare, even if a vertical externality is removed by a vertical restraint.

The extensive use of negative franchise fees, or slotting allowances as they are more commonly known, is at the heart of the debate about increased buyer power by the food retailing sector. Innes and Hamilton (2013) report that their use is pervasive in US food retailing, fees taking various forms, including among others: new product introduction fees, and pay-to-stay fees on existing stocks. Other fees include: firms producing established products pay “facial allowances” for better shelf-positioning, end-aisle displays requiring “street money” from upstream firms, and contributions by upstream processors to “market development funds” (Shaffer, 2005). In the case of the UK, the Competition Commission (2000) reported that 40 percent of upstream suppliers had to pay slotting allowances to food retailers.

Slotting allowances have proven controversial, attracting the attention of the US Federal Trade Commission on two occasions (2001; 2003), and with upstream processors expressing the view that they differentially effect large versus small firms, and may therefore be anti-competitive (Bloom, Gundlach and Cannon, 2000). Specifically, small processing firms argue that paying for retail shelf-space puts them at a disadvantage to large processors who can afford to pay them, i.e., slotting allowances can result in vertical foreclosure, (Shaffer, 2005). This negative view of slotting allowances runs counter to the argument that they might be welfare-enhancing. For new food products, payment of slotting allowances provides a credible signal of whether a product will succeed or fail, i.e., they constitute a screening device (Kelly, 1991; Chu, 1992; Lariviere and Padmanabham, 1997; Desiraju, 2001; Richards and Patterson, 2004; DeVuyst, 2005). In the case of all food products, slotting allowances provide food retailers with a means of allocating scarce shelf-space (Sullivan, 1997).

Since Shaffer's (1991) seminal article, several authors, drawing on different market structure assumptions, have all shown that slotting allowances may facilitate market control, and are therefore welfare-reducing. Shaffer (2005) describes a set up where a dominant upstream processor and competitive fringe compete for retail shelf space by selling differentiated products A and B respectively. The dominant firm makes a take-it-or-leave two-part tariff consisting of a wholesale price and slotting fee, while retailers either accept the contract and carry the dominant firm's product A or reject it and carry product B supplied by the competitive fringe. This is designed to capture the idea that smaller processors in the competitive fringe are unable to get their product B on to retailer shelves due to the exclusionary nature of slotting allowances. Shaffer (2005) finds that the dominant firm is more likely to induce exclusion of the competitive fringe when products A and B are more substitutable.

Innes and Hamilton (2006; 2009) model how slotting allowances can be used in a multi-product retailing environment to facilitate cross-market control by a dominant upstream processor of a single product. In Innes and Hamilton (2006), they assume a similar horizontal market structure upstream to Shaffer (2005), but downstream there is a duopoly selling the processed products A and B in a spatially differentiated, multi-product retail market. Here the dominant upstream processor offers a contract to retailers that consists of a monopoly wholesale price for product A and a requirement that slotting allowances be imposed on the competitive fringe product B. The effect of slotting allowances is to reduce supply of the competitive fringe, and raise the monopoly profits of the dominant upstream processor, despite retailer competition, where the additional monopoly rents are essentially extracted from fringe consumers. In other words, slotting allowances act like auction prices paid by fringe processors to be the retailer's second brand.

A similar market structure at the processing and retailing stages is also assumed in Innes and Hamilton (2009), but in this case the requirement that slotting allowances be imposed on the competitive fringe is ruled out – either because of antitrust rules, or the behavior of retailers cannot be monitored by the dominant upstream firm. Instead the dominant upstream processor chooses a vertical contract combining a wholesale price below marginal cost with a franchise fee paid by the retailers, and minimum resale price maintenance for its own product A. In turn this will elicit a demand by downstream retailers for payment of slotting allowances by upstream suppliers in exchange for wholesale prices of product B being set above marginal cost. If minimum resale price maintenance is deemed illegal by antitrust rules, the upstream dominant firm will increase its wholesale price for product A due to the slotting allowance having raised the wholesale price of product B. In other words, slotting allowances charged to the competitive fringe results in higher retail prices for both goods.

A problem with all of these results is that other than the possibility of scarce shelf-space, retailers are not really exercising any countervailing power, rather it is a dominant upstream processor using vertical restraints as a means to exert market power. An exception to this is a recent article by Innes and Hamilton (2013) where they assume it is retailers that exercise their countervailing power through slotting allowances in a manner more similar to Shaffer's (1991) original result. A retailing duopoly is assumed to compete for consumers spatially, as well as through the variety of products on their shelves. Each retailer selects a number of varieties to stock and offers a non-linear price to the upstream supplier of each variety, consisting of a wholesale price and a slotting allowance, and then retailers compete in price. In the absence of slotting allowances, a retailer choosing more varieties will prompt the other retailer to lower prices in order to make up for lost consumer traffic through their store, which in turn will result in fewer varieties

actually being offered in equilibrium. With slotting allowances, retailers are able to commit to paying higher wholesale prices, as in Shaffer (1991), and this frees up retailers to increase the number of varieties they are able to offer consumers. Consequently, there is a welfare trade-off: higher retail prices versus greater product variety.

In many ways, the latter article probably does the best job of characterizing the current nature and structure of food retailing. In addition, it highlights Chen's (2007) observation that the likely welfare impact of retailer countervailing power over upstream suppliers will actually depend on the nature of competition at retail. However, actually assessing vertical restraints empirically is difficult due to lack of data on wholesale prices, and as yet only a limited number of articles have managed to generate any meaningful results, notably Berto Villas-Boas (2007) and Bonnet and Dubois (2010) who examine the US yogurt and French bottled water markets respectively.

The approach of these studies is essentially to use alternative models of vertical coordination between upstream processors and downstream retailers in order to establish whether or not vertical contracting relationships are being used to avoid the double-marginalization problem. For example, using demand estimates, Berto Villas-Boas (2007) computes the price-cost margins for US yogurt processors and retailers implied by different models of vertical coordination, and then compares these with price-cost margins from direct estimates of cost. Her results indicate that double-marginalization is being avoided in the sector, processors pricing at marginal cost, and profit maximizing prices being set by retailers. Similarly, Bonnet and Dubois (2010) compute price-cost margins for both linear pricing and two-part tariff contracts with or without resale price maintenance, their results indicating that processors in the French bottled water sector use non-linear pricing with resale price maintenance.

While the recent empirical analysis of vertical coordination is encouraging, it does not shed much light on the impact of slotting allowances and the exercise of buying power by food retailers. For example, Berto Villas-Boas' (2007) results are consistent with non-linear pricing by processors via two-part tariffs, except that in the US yogurt market, positive franchise fees are either very small or non-existent. She interprets this to imply that food retailers have bargaining power, driving down the wholesale price of yogurt, but without detailed data on fixed fees (positive or negative), she is unable to formally identify what type of vertical contract is driving her results, and how retailers are exercising their countervailing power.

(b) Private Label Products

An interesting aside in Innes and Hamilton's (2009) discussion of vertical restraints is the possibility that the dominant firm selling brand A can be thought of as the producer of a national brand, while product B produced by the competitive fringe upstream might be a food retailer's private label product. As noted by McCorrison (2014), the growth of private labels and their market penetration has become an important feature of how food retailers in both the US and EU compete horizontally with each other as well as how they compete vertically with national brand food processors. McCorrison (2014) reports that private labels account for 15 percent of retail sales in North America, and 23 percent in the EU, the level of penetration varying widely across EU Member States and product categories. For example, Bergès-Sennou, Bontems, and Réquillart (2004) find that in 2001, the share of retail sales accounted for by private label products, ranged from 13 percent in Italy, through 15 percent in the US to 41 percent in the UK, and seemed to be correlated with the extent of retail seller concentration. In the case of product categories, and comparing frozen food with non-alcoholic beverages respectively, Bergès-Sennou *et al.* (2004)

found for 2002 that the share of retail sales for private label products ranged from 17 and 10 percent for Italy, through 15 and 29 percent for the US, to 45 and 36 percent for the UK.

Most of the theoretical research on the impact of private labels has focused on the vertical dimension of private label products and whether or not competition between them and national brands results in higher or lower consumer prices. As Bergès-Sennou *et al.* (2004) note, the typical model in the literature has the prototypical vertical market structure outlined earlier, i.e., an upstream food processor sells a high-quality national brand to a downstream food retailer, the problem of double-marginalization arising. If the food retailer introduces a lower-quality private-label product into the market, this limits the market power of the upstream processor, driving down the wholesale price of the national brand, consumer surplus increasing due to removal of double-marginalization, assuming the cost of producing the private label product is not too high, and that it is sold at marginal cost by a competitive fringe of upstream food processors.

A key assumption affecting results in the literature relates to the production costs for private label products and competing national brands. Mills (1995) assumed that these costs are the same, his results being driven by the quality level of the private label product. Specifically, if the private label reaches a certain quality level, the firm producing the national brand has an incentive to lower its wholesale price in order to deter the retailer selling the private label product, but as private label quality increases, the firm producing the national brand accommodates the private label product, lowering the wholesale price. Consumers benefit from introduction of the private label product as it drives down the retail price of the national brand.

In contrast, Bontems, Monier and Réquillart (1999) assume that the marginal costs of producing private label products differ from the national brand, and costs increase in quality. If the private label product is of low quality, the producer of the national brand cannot prevent entry

of the private label product, the wholesale price of the national brand falls, and the retailer sells both products. As private label quality increases though, even though it gets more competitive with the national brand, it induces a cost increase, which may result in the wholesale price of the national brand increasing. If the national brand price rises enough though, it may exit the market especially if consumers have a low willingness to pay for quality. For intermediate levels of private label quality, the firm producing the national brand can set a limit wholesale price to deter sales of the private label product, the increasing cost of producing the private label making limit pricing easier. For high levels of private label quality, the national brand recovers its monopoly position as the private label product is not competitive.

While the retail price effects of private labels may differ, it is clear that their introduction may increase the countervailing power of retailers over upstream processors selling national brands. This raises an interesting question: might upstream processors be able to respond to the threat of private labels by using other vertical restraints, and if so what is the effect on retail prices? Gabrielsen and Sjørgard (2007) address this in a setting where consumers are split into two groups: those who are loyal to a national brand, and those who are opportunistic and therefore willing to switch to the private label product. The upstream producer of the national brand now has to select a strategy in response to the threat of a private label product being introduced by a retailer. They could choose to offer an exclusive dealing contract with a retailer, where it offers the national brand at a lower wholesale price which would benefit consumers. Alternatively, they could choose not to offer an exclusive dealing contract, but instead either compete for the opportunistic consumers by lowering the wholesale price of the national brand or charge a higher wholesale price to loyal consumers who have price-inelastic demand, the latter strategy being more likely when the share of loyal consumers is large. Importantly, this particular vertical market structure

can generate the result that wholesale and hence retail prices of national brands may either fall or rise in the presence of private label brands.

Based on the available theoretical literature, the introduction of private label products by food retailers in both the US and EU confers countervailing power on food retailers, but the impact on consumer prices is very sensitive to the quality of private label products relative to national brands, the costs of raising the private label quality, and the willingness of consumers to pay for higher quality national brands. On balance though, the empirical research on the impact of private label products indicates that it is associated with national brand prices rising. For example, Cotterill, Putsis and Dhar (2000), using cross-sectional US data for 143 product categories in 57 geographic markets, found that private label and national brand prices tend to be higher when the retail market is concentrated, and share of the national brand is high. Ward *et al.* (2002), using monthly time-series data for 34 products in the US, found that an increase in the market share of private labels is associated with an increase (or no change) in the price of national brands, a fall in the price (or no change) of private label products, and a negative impact on average prices or no change. Finally, Bontemps, Orozco, and Réquillart (2008), using a sample of 218 French products over the period 1998-2001, find that there is a positive relationship between private label product development and national brand prices, the effect being stronger when the private label product is a closer substitute in terms of quality for the national brand.

In conclusion, like the vertical restraints literature, the analysis of private label products is characterized by models with quite different underlying assumptions, generating different predictions about their impact on consumer prices. However, unlike the empirical literature on vertical restraints, which is constrained by the lack of data on two-part tariffs, i.e., wholesale prices and fixed fees, the empirical results for private labels seem quite consistent. Nevertheless, as

McCorriston (2014) points out, the empirical research on private label products is of a reduced form, such that it is difficult to choose between alternative theoretical explanations that might be consistent with the data. Second, the focus of both theoretical and empirical research is entirely on the effect of private label introduction on national brand prices, with nothing said about how it affects horizontal competition across retailers.

Price Transmission and Vertical Market Structure

A key focus of McCorriston (2014) and Lloyd *et al.* (2015) is how competition in the agricultural and food marketing chain might affect transmission of changes in upstream agricultural commodity prices through to final consumer prices. Following McCorriston (2002), assume an aggregate food processing/retailing sector producing a homogeneous good with firms setting output to maximize profits. Transmission of a change in the price of a raw agricultural commodity will be conditioned on two variables: change in the aggregate mark-up of the oligopolistic processing/retailing sector and the change in their costs. If the aggregate mark-up is zero, the extent of price transmission will depend only on the change in costs, the share of those costs in processing/retailing cost function and the nature of the processing/retailing technology. If the mark-up is positive, market power will influence the degree of price transmission, the extent being dependent on how the aggregate mark-up adjusts to the change in costs and the nature of the demand function. Specifically, if the demand function is not too convex there will be under-shifting of the change in price of the raw agricultural commodity through to the retail price, i.e., there is less than perfect pass-through, the food processing/retailing sector absorbing some of the increase in costs.

This under-shifting result is well-known from both the public and international economics literature, and several studies have found empirical evidence for it, including: Bettendorf and

Verboven (2000) – the Dutch coffee industry, Delipalla and O’Donnell (2001) – the European cigarette industry, Hellerstein (2008) – the global branded beer industry, and Nakamura and Zerom (2010), the US coffee sector. However, it should be noted that the under-shifting result can be overturned either if demand for a single product is sufficiently convex (Stern, 1987; Anderson, de Palma, and Kreider, 2001), or if there are multiple products being sold by the processor/retailer stage (Hamilton, 2009). The latter result occurs when the downstream sector responds to an increase in inputs costs by placing less retail products on the market, thereby lessening retail competition, resulting in over-shifting of the input cost increase, a result confirmed empirically for the US breakfast cereal market by Richards and Hamilton (2011).

The simple model also ignores two questions that matter in the current context: how is price-transmission affected by the presence of buyer power in the agricultural and food marketing system, and is price transmission affected by its vertical market structure? In terms of the former, Wedegebriel (2004) has shown that if the food processing/retailing sector is assumed to have monopsony/oligopsony power over upstream suppliers of the agricultural commodity, the extent of price transmission also depends on the extent to which the mark-down of the input price changes, as well as the nature of the input supply function. Specifically, if the markdown increases due following the change in input prices, this will offset any tendency for the mark-up at retail to narrow, and as a result, it may be quite difficult to be precise about whether it is buyer or seller power that is driving the extent of price transmission.

In terms of vertical market structure, the analysis presented also ignores the possible effect that successive oligopoly at the food processing and food retailing stages may have on price transmission. McCorrison and Sheldon (1996) have shown that the degree of price transmission is lower for a two-stage marketing system consisting of upstream processing and downstream

retailing stages as compared to an aggregate processing/retailing stage. Given arms' length pricing and linear demand at retail, the extent to which there is less than perfect pass-through depends on the fact that each oligopolistic stage will change their mark-up in response to the change in upstream costs: at the food processing stage, the change in mark-up is a function of both horizontal competition at that stage, and the slope of their derived demand function, which in turn is a function of horizontal competition at the retailing stage; downstream at the food retailing stage, the change in their mark-up is a function of the degree of pass-through the upstream processor of the input price change, and horizontal competition at retailing.

The latter result is essentially due to the problem of double-marginalization in the vertical marketing chain. However, as this section has highlighted, vertical contracting matters, and should be accounted for in any analysis of price transmission. In the case of contracting between upstream input suppliers and downstream food processors, if contracting removes, or at least partially removes the incentive for exertion of monopsony/oligopsony power by the processor, transmission of any increase in the price of the agricultural commodity will again be a function of horizontal competition at that stage, and the slope of their derived demand curve. In turn, the latter depends on both horizontal competition at retailing and the structure of any vertical restraints between the processing and retailing stages. If a vertical contract results in removal of a mark-up at one or other stage, this will increase price transmission. Alternatively, if a vertical restraint results in either wholesale and/or retail mark-ups changing, this may lower price transmission.

The earlier discussion of the empirical analysis of vertical restraints suggest it is going to be challenging to figure out precisely how vertical restraints might affect the degree of price transmission. Recent empirical analyses indicate some progress is being made in this area, drawing on the methodology of Berto Villas-Boas (2007) and Bonnet and Dubois (2010). Bonnet

and Réquillart (2013) find that the most likely vertical model is one where there are two-part tariffs and resale price maintenance, and that upstream cost changes are over-shifted to consumers of soft drinks in France. Bonnet *et al.* (2013) find that for the German coffee sector, two-part tariffs in combination with resale price maintenance increase the degree of pass-through compared to linear pricing.

5. Summary and Conclusions

This article was motivated by earlier reviews by Sexton (2000; 2013) and McCorrison (2002; 2014) of what is currently known about the competitiveness of the US and European agricultural and food marketing systems respectively. The common characteristic of both sets of reviews is each author highlights the key structural changes in the agricultural and food marketing systems that have occurred over the past three decades, such that it can clearly be described as a system of vertically inter-connected sectors, where food processing and food retailing can be described as a successive oligopoly.

The reviews are also similar in terms of their both ignoring the structure of the agricultural inputs sector and its interaction with R&D performance, other than a short section in McCorrison (2002). This is somewhat surprising, especially as regards the crop seed/biotechnology industry, although in the case of the EU this may be due to the fact that no GM crops are currently grown there, the public policy focus having been almost entirely on food safety and labeling of GM foods. In light of what is presented in section 2 of the current article though, understanding the evolution of market structure, the dynamics of R&D expenditure, and ownership of intellectual property rights in the crop seed/biotechnology industry, has potentially important implications for both the antitrust authorities, as well as the ability (or otherwise) of private agricultural R&D in this sector

to meet future food security challenges, given declining growth rates in agricultural productivity, an issue recently identified by researchers such as Alston and Pardey (2014).

The key to both Sexton (2013) and McCorrison (2014) is their highlighting the economics of buyer power in the agricultural and food marketing system, but they clearly diverge in terms of their emphasis: Sexton (2013) focuses on food processor vertical coordination with the agricultural sector, while McCorrison (2014) focuses on food retailer vertical coordination with the food processing sector. This is likely driven by divergent US and EU public and policymaker concerns about the precise location of market power in the agricultural and food marketing system, the former being dominated by the view that US food processors have buyer power over their suppliers, the latter that EU food retailers have buyer power over food processors.

However, Sexton (2013) and McCorrison (2014) do agree on a key conceptual problem: the empirical results presented in NEIO-type analysis of the agricultural and food marketing system finds little empirical evidence for exertion of buyer power in either the US or EU, a conclusion that is supported in the review presented in section 3 of this article. This may of course be due to technical issues with the methodology itself and/or lack of necessary data, but it is more likely due to the fact that vertical coordination between downstream food processors and suppliers of raw agricultural commodities is characterized by extensive use of contracts designed to internalize the inefficiencies of using spot markets, and vertical coordination between upstream food processors and downstream food retailers is characterized by the use of vertical restraints designed to resolve the problem of double-marginalization.

These possibilities were extensively reviewed in section 4 of this article, the overall conclusion being twofold: first, while there is an extensive body of contract theory focusing on agency costs and incentives, it has yet to rigorously incorporate downstream processor buyer

power, and data constraints make it difficult to conduct any robust empirical analysis of contracting; and, second, the body of research on vertical markets is very rich in different models of the impact of various vertical restraints such as slotting allowances, and how to capture countervailing power of retailers, but these models have so far proven rather hard to evaluate in terms of the vertical restraints actually being used, due to lack of data on wholesale prices and the terms of vertical contracts. In addition, in the case of private label products, while there has been quite a bit of empirical analysis of their impact on national brand prices in both the US and EU, the empirical models are not tied to any specific theoretical model.

Finally, while it may be difficult to draw any definitive conclusions about the competitiveness of any specific stage in the agricultural and food marketing system, it may be possible to assess its overall performance in terms of the transmission of price changes from the agricultural sector to the final consumer. While this issue merits a thorough review of its own, a connection can be drawn between the extent of pass-through of upstream price changes to downstream consumers, the potential for imperfect competition downstream, and the nature of vertical contracting in the system. However, what is currently not fully understood, and what future research should probably focus on, is the extent to which price transmission in the food marketing system is affected by both vertical contracting between agricultural suppliers and downstream food processors, and vertical restraints between food processors and retailers,.

References

- Alston, J.M. and P.G. Pardey (2014). "Agriculture in the Global Economy", *Journal of Economic Perspectives* 28: 121-146.
- Alston, J.M., R.J. Sexton, and M. Zhang (1997). "Imperfect Competition, Functional Forms, and the Size and Distribution of Research Benefits", *Agricultural Economics* 21: 155-172.
- Alvarez, A.M., E.G. Fidalgo, R.J. Sexton, and M. Zhang (2000). "Oligopsony Power with Uniform Spatial Pricing: Theory and Application to Milk Processing in Spain", *European Review of Agricultural Economics* 27: 347-364.
- Anderson, S.P. A. de Palma, and B. Kreider (2001). "Tax Incidence in Differentiated Product Oligopoly", *Journal of Public Economics* 81: 173-192.
- Anderson, B.C. and I.M. Sheldon (2015). "Endogenous R&D Investment and Market Structure: A Cased Study of the Agricultural Biotechnology Sector", unpublished working paper, Columbus, OH: Ohio State University.
- Appelbaum, E. (1982). "The Estimation of the Degree of Oligopoly Power", *Journal of Econometrics* 19: 287-299.
- Bain, J.S. (1951). "Relation of Profit Rate to Industry Concentration: American Manufacturing", *Quarterly Journal of Economics* 65: 293-324.
- Bain, J.S. 1956. *Barriers to New Competition*. Cambridge, MA: Harvard University Press.
- Baumol W.J., J.C. Panzar, and R.D. Willig (1982). *Contestable Markets and the Theory of Market Structure*. San Diego, CA: Harcourt Brace Jovanovich.
- Bergès-Sennou, F., P. Bontems, and V. Réquillart (2004). "Economics of Private Labels: A Survey of Literature", *Journal of Agricultural and Food Industrial Organization* 2:1037-1062.
- Berto Villas-Boas, S. (2007). "Vertical Relationships between Manufacturers and Retailers: Inference with Limited Data", *Review of Economic Studies* 74: 625-652.
- Bettendorf, L. and F. Verboven (2000). "Incomplete Transmission of Coffee Bean Prices: Evidence from the Netherlands", *European Review of Agricultural Economics* 27: 1-16.
- Bloom, P.N., G.T. Gundlach, and J.P. Cannon (2000). "Slotting Allowances and Fees: Schools of Thought and the Views of Practicing Managers", *Journal of Marketing* 64: 92-108.
- Bolton, P. and G. Bonnano (1988). "Vertical Restraints in a Model of Vertical Differentiation", *Quarterly Journal of Economics* 103: 555-570.
- Bonnano, G. and J. Vickers (1988). "Vertical Separation", *Journal of Industrial Economics* 36: 257-265.
- Bonnet, C. and P. Dubois (2010). "Inference on Vertical Contracts between Manufacturers and Retailers Allowing for Nonlinear Pricing and Resale Price Maintenance", *Rand Journal of Economics* 41: 139-164.
- Bonnet, C. and V. Réquillart (2013). "Impact of Cost Shocks on Consumer Prices in Vertically-Related Markets: The Case of the French Soft Drink Market", *American Journal of Agricultural Economics* 95: 1088-1108.
- Bonnet, C., P. Dubois, S. B. Villas Boas, and D. Klapper (2013). "Empirical Evidence on the Role of Nonlinear Wholesale Pricing and Vertical Restraints on Cost Pass-Through", *Review of Economic Studies* 95: 500-515.
- Bontems, C., V. Orozco, and V. Réquillart (2008). "Private Labels, National Brands and Food Prices", *Review of Industrial Organization* 33: 1-22.

- Brennan, M., C. Pray, A. Naseem, and J.F. Oehmke (2005). "An Innovation Market Approach to Analyzing Impacts of Mergers and Acquisitions in the Plant Biotechnology Industry." *AgBioForum* 8: 89-99.
- Bresnahan, T.F. (1982). "The Oligopoly Solution Concept is identified", *Economics Letters* 10: 87-92.
- Bresnahan, T.F. (1989). "Empirical Studies of Industries with Market Power." In *Handbook of Industrial Organization*, R. Schmalensee and R. Willig (Eds.). Amsterdam: North-Holland.
- Buceviciute, L., A. Dierx, and F. Ilzkovitz (2009). "The Functioning of the Food Supply Chain and Its Effect on Food Prices in the European Union." Occasional Paper 47, Brussels: European Commission.
- Cakir, M. and J.V. Balagtas (2012). "Estimating Market Power of U.S. Dairy Cooperatives in the Fluid Milk Market", *American Journal of Agricultural Economics* 94: 647-658.
- Chen, Z. (2003). "Dominant Retailers and Countervailing Hypothesis", *Rand Journal of Economics* 34: 612-625.
- Chen, Z. (2007). "Buyer Power: Economic Theory and Antitrust Policy", *Research in Law and Economics* 22: 17-40.
- Chu, W. (1992). "Demand Signaling and Screening in Channels of Distribution", *Marketing Science* 11: 327-347.
- Clarke, R. and S.W. Davies (1982). "Market Structure and Price-Cost Margins", *Economica* 49: 277-287.
- Connor, J.M., R.T. Rogers, B.W. Marion, and W.F. Mueller (1985). *The Food Manufacturing Industries: Structure, Strategies, Performance, and Policies*. Lexington, MA: Lexington Books.
- Cotterill, R.W. (1999). "Continuing Concentration in Food Industries Globally: Strategic Challenges to an Unstable Status Quo", Research Report 49, Storrs, CT: Food Policy Research Center, University of Connecticut.
- Cotterill, R.W., W.P. Putsis, and R. Dhar (2000). "Assessing the Competitive Interaction between Private Labels and National Brands", *Journal of Business* 73: 109-137.
- Cowling, K. and M. Waterson (1976). "Price-Cost Margins and Market Structure", *Economica* 43: 267-74.
- Crespi, J.M., Z. Gao, and H. H. Peterson (2005). "A Simple Test of Oligopsony Behavior with Application to Rice Milling", *Journal of Agricultural and Food Industrial Organization* 3: 1117-1134
- Crespi, J.M., T.L. Saitone, and R.J. Sexton (2012). "Competition in the U.S. Farm Products Markets: Do Long-Run Incentives Trump Short-Run Market Power?" *Applied Economic Perspectives and Policy* 34: 669-695.
- Dasgupta, P. and J. Stiglitz (1980). "Industrial Structure and the Nature of Innovative Activity", *Economic Journal* 90:266-293.
- Delipalla, S. and O. O'Donnell (2001). "Estimating Tax Incidence, Market Power and Market Conduct: The European Cigarette Industry", *International Journal of Industrial Organization* 19: 885-908.
- Demsetz, H. (1973). "Industry Structure, Market Rivalry, and Public Policy", *Journal of Law and Economics* 16: 1-9.
- Desiraju, R. (2001). "New Product Introductions, Slotting Allowances and Retailer Discretion", *Journal of Retailing* 77: 335-358.

- DeVuyst, C.S. (2005). "Demand Screening with Slotting Allowances and Failure Fees", *Journal of Agricultural and Food Industrial Organization* 3: 1076-1093.
- Dobson, P.W. and M. Waterson (1997). "Countervailing Power and Consumer Prices", *Economic Journal* 107: 418-430.
- The Economist (1994). "The Tyranny of Triangles" July 16.
- European Competition Network (2012). "ECN Activities in the Food Sector: Report on Competition Law Enforcement and Market Monitoring Activities by European Competition Authorities in the Food Sector." Brussels: ECN.
- Fisher, F.M. and J.J. McGowan (1983). "On the Misuse of Accounting Rates of Return to Infer Monopoly Profits", *American Economic Review* 73: 82-97.
- Fuglie, K.O., P.W. Hiesey, J.L. King, C.E. Prey, K. Day-Rubinstein, D. Schimmelpfennig, S.L. Wang, and R. Karmarkar-Deshmukh (2011). "Research Investments and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide." Economic Research Report 130, Washington DC: Economic Research Service, USDA
- Gabrielsen, T.S. and L. Sørsgard (2007). "Private Labels, Price Rivalry, and Public Policy", *European Economic Review* 51: 403-424.
- Galbraith, J.K. (1952). *American Capitalism: The Concept of Countervailing Power*. New York: Houghton Mifflin.
- Geroski, P.A. (1988). "In Pursuit of Monopoly Power: Recent Quantitative Work in Industrial Economics", *Journal of Applied Econometrics* 3: 107-123.
- Goodhue, R.E. (2000). "Broiler Production Contracts as a Multi-Agent Problem: Common Risk, Incentives and Heterogeneity", *American Journal of Agricultural Economics* 82: 606-622.
- Graff, G.D., G.C. Rausser, and A.A. Small (2003). "Agricultural Biotechnology's Complementary Intellectual Assets", *Review of Economics and Statistics* 85: 349-363.
- Hamilton, S.F. (2009). "Excise Taxes with Multiproduct Transactions", *American Economic Review* 99: 458-471.
- Harhoff, D., P. Régibeau, and K. Rockett (2001). "Some Simple Economics of GM Food", *Economic Policy* 265-299.
- Hausmann, J. and E. Leibtag (2007). "Consumer Benefits from Increased Competition in Shopping Outlets: Measuring the Effect of Wal-Mart", *Journal of Applied Econometrics* 22: 1157-1177.
- Hellerstein, R. (2008). "Who Bears the Cost of a Change in the Exchange Rate? Pass-through Accounting for the Case of Beer", *Journal of International Economics* 76: 14-32.
- Hovahannisyan, V. and B.W. Gould (2012). "A Structural Model of the Analysis of Retail Market Power: The Case of Fluid Milk", *American Journal of Agricultural Economics* 94: 67-79.
- Hubbard, K. (2009). "Out of Hand: Farmers Face the Consequences of a Consolidated Seed Industry", Farmer to Farmer Campaign on Genetic Engineering, Washington DC: National Family Farm Coalition.
- Hunnicut, L. and D. Aadland (2003). "Inventory Constraints in a Dynamic Model of Imperfect Competition: An Application to Beef Packing", *Journal of Agricultural and Food Industrial Organization* 1: 1023-47.
- Inderst, R. and G. Shaffer (2004). "Retail Mergers, Buyer Power and Product Variety", *Economic Journal* 117: 45-67.
- Innes, R. and S.F. Hamilton (2006). "Naked Slotting Fees for Vertical Control of Multi-Product Retail Markets", *International Journal of Industrial Organization* 24: 303-318.
- Innes, R. and S.F. Hamilton (2009). "Vertical Restraints and Horizontal Control", *Rand Journal of Economics* 40: 120-143.

- Innes, R. and S.F. Hamilton (2013). "Slotting Allowances under Supermarket Oligopoly", *American Journal of Agricultural Economics* 95: 1216-1222.
- Kaiser, H.M. and N. Suzuki (2006). *New Empirical Industrial Organization and the Food System*. New York: Peter Lang.
- Kamien, M.I., and N. L. Schwartz 1982. *Market Structure and Innovation*. Cambridge: Cambridge University Press.
- Katchova, A.L., I.M. Sheldon, and M.J. Miranda (2005). "A Dynamic Model of Oligopoly and Oligopsony in the U.S. Potato Processing Industry", *Agribusiness* 21: 409-428.
- Katz, M. (1989). "Vertical Contractual Relations." In *Handbook of Industrial Organization*, R. Schmalensee and R. Willig (Eds.). Amsterdam: North-Holland.
- Kelly, K. (1991). "Antitrust Analysis of Grocery Slotting Allowances: The Procompetitive Case", *Journal of Public Policy and Marketing* 10: 187-198.
- King, J.L. and D. Schimmelpfennig (2005). "Mergers, Acquisitions, and Stocks of Agricultural Biotechnology Intellectual Property", *AgBioForum* 8: 83-88.
- Lariviere, M.A. and V. Padmanabhan (1997). "Slotting Allowances and New Product Introductions", *Marketing Science* 16: 122-28.
- Lavoie, B.F. (2004). "Real Options and the Management of R&D Investment: An Analysis of Comparative Advantage, Market Structure, and Industry Dynamics in Biotechnology", unpublished PhD Dissertation, Columbus, OH: Ohio State University.
- Lavoie, B.F. and I.M. Sheldon (2000). "The Source of Comparative Advantage in the Biotechnology Industry: A Real Options Approach", *Agribusiness: An International Journal* 16: 56-67.
- Levin, J. (2003). "Relational Incentive Contracts", *American Economic Review* 93: 835-857.
- Lloyd, T.A., S. McCorriston, and C.W. Morgan (2015). "Experience of Food Inflation across the EU." In *Food Price Dynamics and Price Adjustment in the EU*, S. McCorriston (Ed.). Oxford: Oxford University Press.
- Lopez, R.A. and C. Lirón-España (2003). "Social Welfare and the Market Power-Efficiency Tradeoff in U.S. Food Processing: A Note", *Journal of Agricultural and Food Industrial Organization* 1: 1007-1017.
- MacDonald, J.M. (2015). "Trends in Agricultural Contracts", *Choices* 30.
- MacDonald, J.M. and W. McBride (2009). "The Transformation of the U.S. Livestock Agriculture: Scale, Efficiency, and Risks." Economic Information Bulletin 43, Washington DC: Economic Research Service, USDA.
- MacDonald, J.M. and M.E. Ollinger (2000). "Scale Economies and Consolidation in Hog Slaughter", *American Journal of Agricultural Economics* 82: 334-346.
- MacDonald, J.M. and S.Y. Wu (2014). "Market Competition and Contracting Outcomes: Theory and Experimental Evidence", unpublished working paper, West Lafayette, IN: Purdue University.
- Marco, A.C. and G.C. Rausser (2008). "The Role of Patent Rights in Mergers: Consolidation in Plant Biotechnology", *American Journal of Agricultural Economics* 89: 133-151
- Marion, B.W. (1985). *The Organization and Performance of the U.S. Food System*. Lexington, MA: Lexington Books.
- Martinez, S.W. (2007). "The U.S. Food System: Recent Developments, 1997-2006." Economic Research Report 42, Washington DC: Economic Research Service, USDA.
- Matthewson, G. and R. Winter (1984). "An Economic Theory of Vertical Restraints", *Rand Journal of Economics* 15: 27-38.

- McCorriston, S. (2002). "Why Should Imperfect Competition Matter to Agricultural Economists?" *European Review of Agricultural Economics* 29: 349-372.
- McCorriston, S. (2014). "Background Note." In *Competition Issues in the Food Chain Industry*. Paris: OECD.
- McCorriston, S. and I.M. Sheldon (1996). "Trade Policy in Vertically Related Markets", *Oxford Economic Papers* 48: 664-672.
- McCorriston, S. and I.M. Sheldon (1997). "Vertical Restraints and Competition Policy in the US and UK Food Marketing Systems", *Agribusiness* 15: 27-38
- Mérel, P.R. (2009). "Measuring Market Power in the French Comté Cheese Market", *European Review of Agricultural Economics* 36: 31-51.
- Mills, D.E. (1995). "Why Retailers Sell Private Labels", *Journal of Economics and Management Strategy* 4: 509-528.
- Moschini, G. (2010). "Competition Issue in the Seed Industry and the Role of Intellectual Property", *Choices*: 25.
- Munson, C., S. London, and L. Lindebak (2010). "Comments Regarding Competition in the Agriculture Industry." Comments submitted for the USDA and US Department of Justice Competition in the Agriculture Industry Workshops, Washington DC: USDA and US Department of Justice.
- Nakamura, E. and D. Zerom (2010). "Accounting for Incomplete Pass-Through", *Review of Economic Studies* 77: 1192-1230.
- Perloff, J.M., L.S. Karp, and A. Golan (2007). *Estimating Market Power and Strategies*. Cambridge: Cambridge University Press.
- Pray, C., J.F. Oehmke, and A. Naseem (2005). "Innovation and Dynamic Efficiency in Plant Biotechnology: An Introduction to the Researchable Issues", *AgBioForum* 8: 83-88.
- Raper, K.C., H.A. Love, and C.R. Shumway (2007). "Distinguishing the Source of Market Power", *American Journal of Agricultural Economics* 89: 78-90.
- Reimer, J.J. (2004). "Market Conduct in the U.S. Ready-to-eat Cereal Industry", *Journal of Agricultural and Food Industrial Organization* 2: 1075-1104.
- Rey, P. and J.E. Stiglitz (1988). "Vertical Restraints and Producers' Competition", *European Economic Review* 32: 561-568.
- Rey, P. and J. Tirole (1986). "The Logic of Vertical Restraints", *American Economic Review* 76: 921-939.
- Richards, T.J. and S.F. Hamilton (2011). "Variety and Cost Pass-Through among Supermarket Retailers", paper presented at EAAE Congress, Zurich, Switzerland.
- Richards, T.J. and P.M. Patterson (2003). "Competition in Fresh Produce Markets: An Empirical Analysis of Marketing Channel Performance." Contractors and Cooperators Report 1, Washington DC: Economic Research Service, USDA.
- Richards, T.J. and P.M. Patterson (2004). "Slotting Allowances as Real Options: An Alternative Explanation", *Journal of Business* 77: 675-696.
- Richards, T.J., P.M. Patterson, and R.N. Acharya (2001). "Price Behavior in a Dynamic Oligopsony: Washington Processing Potatoes" *American Journal of Agricultural Economics* 83: 259-271.
- Richards, T.J. and G. Pofahl (2010). "Pricing Power by Supermarket Retailers: A Ghost in the Machine", *Choices* 25.
- Saitone, T.L. and R.J. Sexton (2012). "Market Structure and Competition in the U.S. Food Industries: Implications for the 2012 Farm Bill." In *American Boondoggle: Fixing the Farm*

- Bill Content*, V. Smith and B. Goodwin (Eds.). Washington DC: American Enterprise Institute.
- Schmalensee, R. (1989). "Inter-Industry Studies of Structure and Performance." In *Handbook of Industrial Organization*, R. Schmalensee and R. Willig (Eds.). Amsterdam: North-Holland.
- Schroeter, J.R. (1988). "Estimating the Degree of Market Power in the Beef Packing Industry", *Review of Economics and Statistics* 70: 158-162.
- Scokai, P., C. Soregaroli, and D. Moro (2013). "Estimating Market Power by Retailers in a Dynamic Framework: the Italian PDO Cheese Market", *Journal of Agricultural Economics* 64: 33-53.
- Sexton, R.J. (2000). "Industrialization and Consolidation in the U.S. Food Sector: Implications for Competition and Welfare", *American Journal of Agricultural Economics* 82: 1087-1104.
- Sexton, R.J. (2013). "Market Power, Misconceptions, and Modern Agricultural Markets", *American Journal of Agricultural Economics* 95: 209-219.
- Sexton, R.J. and N. Lavoie (2001). "Food Processing and Distribution: An Industrial Organization Approach". In *Handbook of Agricultural Economics*, B. Gardner and G.C. Rausser (Eds.). Amsterdam: North-Holland.
- Sexton, R.J., I.M. Sheldon, S. McCorriston, and H. Wang (2007). "Agricultural Trade Liberalization and Economic Development: The Role of Downstream Market Power", *Agricultural Economics* 36: 253-270.
- Shaffer, G. (1991). "Slotting Allowances and Resale Price Maintenance: A Comparison of Facilitating Practices", *Rand Journal of Economics* 22: 120-35.
- Shaffer, G. (2005). "Slotting Allowances and Optimal Product Variety", *Advances in Economic Analysis and Policy* 5: 1083-1118.
- Sheldon, I.M. (2002). "Regulation of Biotechnology: Will We Ever 'Freely' Trade GMOs?" *European Review of Agricultural Economics* 29: 155-176.
- Sheldon, I.M. and R. Sperling (2003). "Estimating the Extent of Imperfect Competition in the Food Industry: What have we learned?" *Journal of Agricultural Economics* 51: 89-109.
- Shi, G., J.P. Chavas, and K. Stiegert (2010). "An Analysis of the Pricing of Traits in the U.S. Corn Seed Market", *American Journal of Agricultural Economics* 92: 1324-1338.
- Stern, N.H. (1987). "The Effects of Taxation, Price Control and Government Contracts in Oligopoly and Monopolistic Competition", *Journal of Public Economics* 32: 133-158.
- Stiegert, K., G. Shi, and J.P. Chavas (2011). "Spatial Pricing of Genetically Modified Hybrid Corn Seeds." In *Genetically Modified Food and Global Welfare: Frontiers of Economics and Globalization*, C. Carter, G.C. Moschini, and I.M. Sheldon, (Eds.). New Milford, CT: Emerald Books.
- Sullivan, M.W. (1997). "Slotting Allowances and the Market for New Products", *Journal of Law and Economics* 40: 461-493.
- Sutton, J. (1991). *Sunk Costs and Market Structure*, Cambridge, MA: MIT Press.
- Sutton, J. (1996). "Technology and Market Structure", *European Economic Review* 40: 511-530.
- Sutton, J. (1997). "One Smart Agent", *Rand Journal of Economics* 28: 605-628.
- Sutton, J. (1998). *Technology and Market Structure*, Cambridge, MA: MIT Press.
- Tirole, J. (1988). *Theory of Industrial Organization*, Cambridge, MA: MIT Press.
- UK Competition Commission (2000). *Supermarkets: A Report on the Supply of Groceries from Multiple Stores in the United Kingdom Cm 4842*, London: TSO.
- US Government Accountability Office (2009). "Concentration in Agriculture." GAO-09-746R, Washington DC: Government Accountability Office.

- USDA Agriculture Committee on Agricultural Concentration (1996). "Concentration in Agriculture: A Report of the USDA Advisory Committee on Agricultural Concentration." Washington DC: Agricultural Marketing Service, USDA.
- US Department of Justice (2012) "Voices from the Workshops on Agriculture and Antitrust Enforcement in our 21st Century Economy and Thoughts on the Way Forward." Washington DC: U.S. Department of Justice.
- US Federal Trade Commission (2001). "Report on the Federal Trade Commission Workshop on Slotting Allowances and other Marketing Practices in the Grocery Industry." Washington DC: US Federal Trade Commission.
- US Federal Trade Commission (2003). "Slotting Allowances in the Retail Grocery Industry." Washington DC: US Federal Trade Commission.
- von Ungern-Sternberg, T. (1996). "Countervailing Power Revisited", *International Journal of Industrial Organization* 14: 507-520.
- Ward, M.B., J.P. Shimshack, J.M. Perloff, and J.M. Harris (2002). "Effects of Private-Label Invasion in Food Industries", *American Journal of Agricultural Economics* 84: 961-973.
- Wedegabriel, H.T. (2004). "Imperfect Price Transmission: Is Market Power Really to Blame", *Journal of Agricultural Economics* 55: 101-114.
- Williamson, O.E. (1986). "Vertical Integration and Related Variations on a Transactions-Cost Economics Theme." In *New Developments in the Analysis of Market Structure*, J. Stiglitz and F. Matthewson (Eds.). London: Macmillan.
- Wrigley, N. and M. Lowe (2010). "The Globalization of Trade in Retail Services." Commissioned Report, Paris: OECD.
- Wu, S.Y. (2006). "Contract Theory and Agricultural Policy Analysis: A Discussion and Survey of Recent Developments", *Australian Journal of Agricultural and Resource Economics* 50: 490-509.
- Wu, S.Y. (2014). "Adapting Contract Theory to Fit Contract Farming", *American Journal of Agricultural Economics* 96: 1241-1256.

Table 1: Seller Concentration: US Food Processing Industries

Industry	CR4 – 2007 (%)	Change in CR4 – 1997-2007 (%)
Dog and cat food manufacturing	71	22
Wet corn milling	84	17
Soybean processing	82	2
Breakfast cereal manufacturing	80	-3
Cane sugar refining	95	-4
Chocolate manufacturing	59	-26
Frozen fruit, juice, and vegetable manufacturing	41	20
Fruit and vegetable canning	24	-2
Ice cream and frozen dessert manufacturing	53	63
Animal slaughtering	59	4
Meat processed from carcasses	28	37
Poultry processing	46	13
Seafood canning	58	124
Commercial bakeries	37	-5
Cookie and cracker manufacturing	69	16
Dry pasta manufacturing	63	10
Coffee and tea manufacturing	43	-18
Average across 6-digit NAICS	50	13

Source: Crespi *et al.* (2012)

Table 2: Average Seller Concentration in EU Food Processing – mid-1990s

Country	Average CR3 (%)
Denmark	69
Finland	79
France	63
Germany	55
Italy	67
Ireland	89
Spain	61
Sweden	69
UK	56

Source: Cotterill (1999)

Figure 1: Market Structure – Agriculture and Food Marketing System

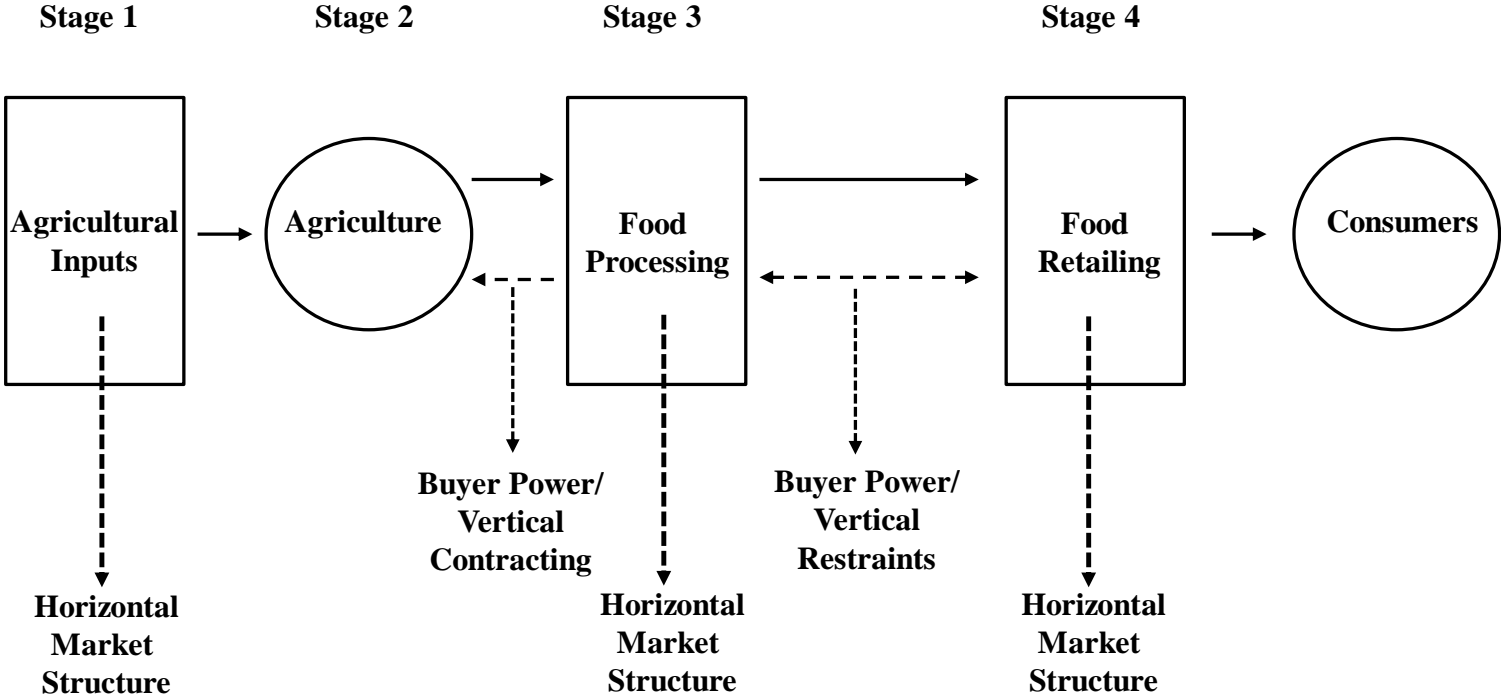


Figure 2: Market Structure, Sunk Costs and R&D in Biotechnology Industry

