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THE COMPETITIVENESS OF AGRICULTURAL PRODUCT AND INPUT MARKETS: A REVIEW AND SYNTHESIS OF RECENT RESEARCH

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Abstract. This article reviews literature on competitiveness of agricultural product and input markets. Although researchers in the United States and Europe emphasize different stages of the agricultural and food marketing system, their focus is similar: extent of buyer power, although both have largely ignored the sector supplying inputs to agriculture. The key conclusion is that there is little robust empirical evidence for food processing firms exerting buyer power, and there are limited data concerning vertical contracts between food processing and agriculture, but there is a small body of evidence concerning food retailer behavior and vertical coordination between food retailing and processing.

Keywords. Agricultural and food marketing, competitiveness, buyer power

JEL Classifications: L13, L42, Q13

1. Introduction

In the early 2000s, articles published by Sexton (2000) and McCorriston (2002) presented detailed reviews of the state of knowledge about the market structure and performance of the U.S. 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 U.S. 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.

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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 U.S. 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 U.S. 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 U.S. Department of Agriculture (USDA), Committee on Agricultural Concentration (1996) on industrialization in the agricultural and food marketing chain were too benign, and that perhaps U.S. 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 U.S. food retailing sector at that time or the possible use of vertical contracts between stages of the marketing system as opposed to arm's length pricing.

By contrast, McCorriston (2002) stated very clearly up-front in his review that anticompetitive behavior in the EU agricultural and food marketing system is multidimensional; that is, 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 anticompetitive 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 coordination. This view of competition in the agricultural and food marketing system was driven both by the perceived growing market power of retailers in the EU in the 1990s and 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 coordination 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). McCorriston (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 nature of competition in the system as a whole—that is, *competition* between firms at a specific stage (horizontal) and *coordination* between different stages (vertical), where horizontal competition and vertical coordination are also interdependent.

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, and also in two jointly authored articles (Crespi, Saitone, and Sexton, 2012; Saitone and Sexton, 2012), returned to the theme of his earlier review. Sexton's (2013) motivating argument is that, although analysis of imperfect competition in the U.S. 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 U.S. farmers.

On the one hand, Sexton and his coauthors argue that concern about the exploitation of downstream market power by U.S. food retailers has dwindled largely because of entry into the sector of discount firms such as Walmart and the associated increase in retail price competition. Although, 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, have caught the attention of not only agricultural economists but also farmers, legislators, and regulators. For example, much debate over competition-enhancing provisions in successive U.S. farm bills has focused on the inclusion of restrictions on ownership of livestock and hogs by meatpacking firms (Crespi, Saitone, and Sexton, 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 United States 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 McCorriston (2014), as well as Lloyd, McCorriston, and Morgan (2015), the focus is very much a development of the earlier article—that is, 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 2007–2008 and 2011. As Lloyd, McCorriston, and Morgan (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, McCorriston (2014) and the associated article focus on the following question: How does successive oligopoly and vertical coordination 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 United States and the EU. The review is broken down into four sections. First, in Section 2, what is currently known about the structure of the food and agricultural marketing system is described, focusing on the key sectors of agricultural input supply, food processing and retailing. Second, 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 both the food processing and retailing stages. Third, in Section 4, vertical market coordination between suppliers of raw agricultural commodities and downstream food processors, and that between upstream food processors and downstream food retailers, is 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.

2. Structure of the Agricultural and Food Marketing System

2.1. Stages in the 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 McCorriston (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, which then markets final food products and other retail services to consumers. Historically, applied industrial organization (IO) studies of this system have focused mostly on increasing consolidation, especially at the food processing stage, with much of the analysis describing changes in market structure through

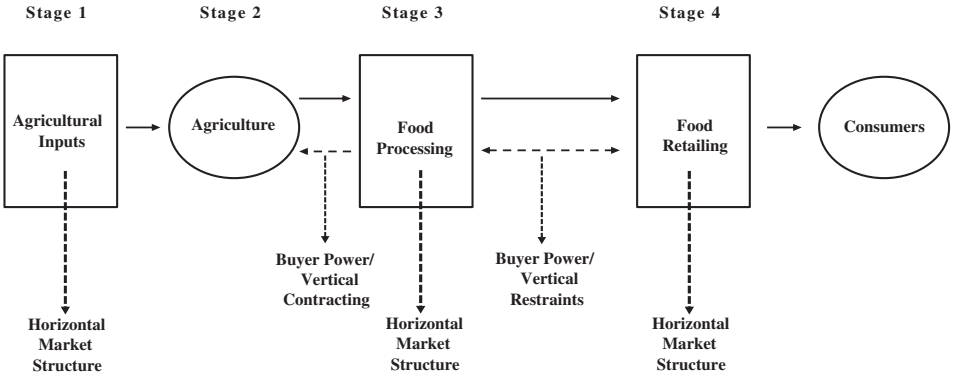

Figure 1. Market Structure, Agriculture and Food Marketing System (source: adapted from McCorriston [2014])

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 (Tirole, 2015), either within any given stage or in coordination between stages, it is still useful to get a sense of the current market structure of the U.S. and EU agricultural and food marketing systems. Apart from being a set of stylized facts in virtually all applied work in the field, description of market structure has been very central to the U.S. and EU public debate concerning consolidation in their respective food marketing systems (e.g., Organisation for Economic Co-operation and Development [OECD], 2014; UK Competition Commission, 2008; U.S. Department of Justice, 2012). Also, the U.S. and EU antitrust authorities continue to consider metrics such as market share and seller concentration when analyzing specific industries, most notably in merger investigations (e.g., see their respective merger guidelines; European Commission, 2013; U.S. Department of Justice and Federal Trade Commission, 2010).

However, it should be emphasized that although the U.S. and EU antitrust authorities both focus on anticompetitive behavior throughout the food chain (OECD, 2014), the key targets of popular public concern have typically been different in the United States as compared with the EU: in the former, the focus has been mostly related to the secular trend toward higher seller concentration in food processing (Crespi, Saitone, and Sexton, 2012), especially as it relates to suppliers of raw agricultural commodities. 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).

2.2. *Agricultural Inputs*

Unlike 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. McCorriston (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, McCorriston's (2014) follow-up review has no further discussion of the inputs sector—one can speculate that this was either because of 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, 2013), 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 by these authors in the sector supplying inputs to agriculture, a detailed survey was recently published by the Economic Research Service of the USDA highlighting changes in its global market structure, along with extensive data on the extent of research and development (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 US$355 billion in 2006. Breaking this down, 60% of the value of these sales was accounted for by bulk inputs such as fertilizers and animal feed, neither of which participates extensively in conducting R & D. Of the remaining input sales, 21% were accounted for by farm machinery; 15%, the combined sales of agrochemicals and crop seeds; and 4%, 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% of global market sales in each of these sectors, with seller concentration reaching 53%, 54%, 51%, 50%, and 56%, 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 US$1.2 billion in crop seed R & D, accounting for 50% of all R & D expenditure on food and agriculture.

The growth of R & D expenditure in the crop seed sector, and in particular the development of GM traits, in combination with extensive consolidation in terms of both patent and firm ownership, has caught the attention of several economists (e.g., Graff, Rausser, and Small, 2003; Harhoff, Régibeau, and Rockett, 2001; King and Schimmelpfennig, 2005; Marco and Rausser, 2008). King and Schimmelpfennig (2005) report that since 1998, just six firms (Dow, DuPont, and Monsanto from the United States; BASF, Bayer, and Syngenta from Europe) have accounted for more than 80% of GM crop trials for release in the United States. Importantly, these same six multinational firms also have a significant share in the global agrochemicals sector, accounting for 63% of global sales in 2010 (Fuglie et al., 2011). High seller concentration in the latter sector is the end result of consolidation because of 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 six" firms—there is a complementarity between crop seeds engineered to be tolerant to agrochemicals such as herbicides, and 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 US$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 more than 40% of private-sector agricultural biotechnology patents issued in the United States. Much of this concentration of biotechnology patent ownership has been because of extensive merger and acquisition activity in the sector. Pray, Oehmke, and Naseem (2005) report a flurry of mergers and acquisitions between 1994 and 2000 in the five major GM crops in the United States (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 United States and EU, where the six-firm concentration ratio for patents rose from 36% to 50% and from 32% to 53%, respectively (Harhoff, Régibeau, and Rockett, 2001). The levels of observed market concentration are even higher when the focus shifts to products approved for inclusion in food, with 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

Table 1. Seller Concentration: U.S. 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 six-digit NAICS	50	13

Note: CR4, four-firm seller concentration ratio; NAICS, North American Industrial Classification System.
Source: Crespi, Saitone, and Sexton (2012).

Syngenta in 2000)—accounting for 66% of approvals by the end of the 1990s (Harhoff, Régibeau, and Rockett, 2001).

Such concentration ratios are well over the levels that typically trigger concern about the impact of mergers and acquisitions on market structure, and the sector has already drawn the attention of the U.S. antitrust authorities in the past decade. In 2009, the U.S. Department of Justice initiated an investigation into the possibility that Monsanto was breaking antitrust rules, with 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 U.S. Department of Justice.

2.3. Food Processing and Retailing

Focusing first on the United States, Crespi, Saitone, and Sexton (2012) provide a detailed description of market structure in food processing, drawing on data from the 2007 Census of Manufactures. In Table 1, four-firm seller concentration ratios (CR4s) 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%), wet corn milling (84%), soybean processing 82%), breakfast cereal manufacturing (80%), and cane sugar refining (95%), which compare with an average CR4 of 50% across a sample of 47 NAICS industries. In addition, a majority of these industries have exhibited an increase in seller concentration over a 10-year period since 1997.

Of particular interest in the context of the broader public debate on increased seller concentration in the U.S. food processing sector, Crespi, Saitone, and Sexton (2012) point out that the CR4s for animal slaughtering and poultry slaughtering were 59% and 46%, 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 the USDA's Grain Inspection, Packers and Stockyards Administration. For selected meatpacking industries, the CR4 in 2007 was 80%, 70%, 65%, 57%, and 51%, respectively, for steers and heifers, sheep and lambs, hogs, broilers, and turkeys, and over the period 1980 to 2010, the CR4 in these meatpacking industries increased on average by 69%, albeit the rate of increase slowing after 1995 as the rate of mergers in these industries slowed down. Crespi, Saitone, and Sexton (2012) also point out that because of meatpacking firms operating multiple plants, and at the same time 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% 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 United States, data on the market structure of food processing in the EU are less recent in terms of time period, with McCorriston (2002, 2014) reporting the same data by Cotterill (1999) from the mid-1990s. In Table 2, average three-firm seller concentration ratios (CR3s) in the food processing sector are reported for a sample of countries in the EU, with the average CR3 across these countries being 64%. This suggests that 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 McCorriston (2014) points out, there was also considerable variation in seller concentration across specific industries. For example, the CR3 for breakfast cereals ranged from 92% in Ireland to 65% in the United Kingdom, while baby food production ranged from 98% in Ireland to 54% 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

Table 2. Average Seller Concentration in European Union Food Processing, Mid-1990s

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

Note: CR3, three-firm seller concentration ratio.
Source: Cotterill (1999).

given the extent of domestic and EU cross-border merger activity in the sector over the past 20 years (McCorriston, 2014).

In both the United States and the 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 United States, Richards and Pofahl (2010) report a CR4 for food retailing of 48.8% in 2008, the largest four retailers consisting of Walmart (21.3%), Kroger (12.6%), Safeway (8.1%), and Costco (6.8%), concentration having increased from a CR4 of 16.8% in 1992 (Sexton, 2013). Of course, the United States 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, the average food retailing CR4 being 79% in 2006 for 229 metropolitan statistical areas (Sexton, 2013).

Essentially, there have been several significant changes in the U.S. food retailing landscape: in the 1980s, regional and local supermarket chains were dominant, whereas 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 Walmart and Costco (Richards and Patterson, 2003). These developments have not been driven by economies of scale in food retailing (Ellickson, 2016; Richards and Hamilton, 2013). Instead, Ellickson (2007) argues that supermarkets have had to compete for customers through offering a wider variety of products in their stores, requiring fixed investment in distribution. In order to gain a larger market share, more stores have to be built, escalating fixed costs and discouraging entry of other firms. Using store-level data for 1998, Ellickson (2007) found that U.S. food retailing had a two-tiered structure: a small number of firms capturing

the majority of sales, competing with an expanding fringe of stores offering a narrower variety of products.

Walmart emerged as an important player in U.S. food retailing after opening its first supercenter in 1988, thereafter becoming the leading U.S. food retailer by 2000 (Martinez, 2007). Following its market entry, Walmart has, on average, opened 100 supercenters a year and currently operates in excess of 3,200 stores, while at the same time seller concentration in food retailing has increased at the national level, along with the development of several national chains (Ellickson, 2016). Many commentators have suggested that Walmart has enforced competitive discipline in U.S. food retailing (Crespi, Saitone, and Sexton, 2012; Ellickson, 2016; Richards and Pofahl, 2010), the empirical evidence showing that retail food prices fall when a Walmart store opens in a specific geographic location (Hausmann and Leibtag, 2007). However, although Walmart has also become the world's largest transnational food retailing chain, operating across 16 countries in 2008 (Wrigley and Lowe, 2010), it is a much less dominant player in Europe compared with firms such as Carrefour and Aldi. Over the past few years, its rate of growth has slowed down, the company announcing the closure of 269 stores worldwide in 2016 (Heller, 2016).

More recent evidence suggests that U.S. food retailing may already be undergoing further structural change. Traditional food retailers are now finding it harder to follow a strategy of product variety expansion, given competitive pressure on their margins from discounters such as Walmart and Aldi and the increasing incentive to focus on a narrower range of high-quality fresh unpackaged foods (Watson, 2016). In addition, online food retailing is expected to grow more rapidly over the next decade compared with traditional food retailing. Richards, Hamilton, and Empen (2015) report that online food sales in the United States, which stood at US$13 billion in 2010, are forecast to grow to more than US$100 billion by 2019, accounting for 12% of total food sales. Amazon and Walmart are already competing in this market segment, although Walmart has been much slower in adapting, only recently purchasing the start-up firm Jet in order to try to catch up with Amazon (Neate, 2016). However, online food retailing is already more developed in the United Kingdom than in the United States, with 6% of grocery purchases being through that channel in 2012 as compared with 0.5% in the United States, with the major supermarket chains, Tesco, Asda, Sainsbury's, and Waitrose, all offering online purchasing and delivery (Richards, Hamilton, and Allender, 2016).

In the case of the EU, the average level of seller concentration in food retailing in 2004/2005 was very similar to the national level of concentration in the United States, with an average five-firm seller concentration ratio (CR5) across the EU-15 being just above 50%. However, as reported by Bukeviciute, Dierx, and Ilzkovitz (2009), levels of seller concentration vary considerably around this average, ranging from a CR5 in 2007 for Italy of 32% to France at 52%, the United Kingdom at 60%, and Denmark, Sweden, and Finland at 75%,

76%, and 84%, respectively. 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%), Poland (22%), and Romania (21%), though these levels of seller concentration have grown significantly in a short period of time. Although merger activity has been significantly greater on average in the EU food processing sector over the past two decades, like the United States, 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). Discounters such as Aldi and Lidl are also becoming more important in Europe, although this varies considerably across countries, where at one extreme, they had a 44% market share in Germany compared with a 4% market share in the United Kingdom in 2007 (Bukeviciute, Dierx, and Ilzkovitz, 2009).

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 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.

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

In order to think through the potential welfare impact of market failure because of exploitation of oligopoly power, Sexton (2000) outlined a prototypical new 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 arm's length operating under a fixed proportions–constant cost returns to scale technology, Sexton (2000) derives a standard first-order condition for the firm:

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

In equilibrium, markup 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; whereas markdown 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.

Although 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 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 ith industry were regressed on seller concentration S_i in that industry:

$$\Pi_i = \alpha_i + \beta S_i, \tag{2}$$

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, and Fisher and McGowan (1983) criticized SCP studies for using accounting measures of profitability to infer market power. Perhaps most seriously, Clarke and Davies (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 U.S. 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, that the majority of studies concerned the U.S. food processing sector; second, that 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 on the estimated price elasticity; third, that the U.S. meat marketing system had been subject to most analysis; and fourth, that 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, whereas others have adopted new/adapted NEIO-type methodologies, for example, dynamic interaction (beef packing: Hunnicutt and Aadland, 2003; U.S. potato processing: Katchova, Sheldon, and Miranda, 2005; U.S. potato processing: Richards, Patterson, and Acharya, 2001; Italian cheese retailing: Scokai, Soregaroli, and Moro, 2013), and different/extended NEIO-type methodologies (Spanish milk processing: Alvarez et al., 2000; U.S. fluid milk marketing: Cakir and Balagtas, 2012; U.S. rice milling: Crespi, Gao, and Peterson, 2005; U.S. milk retailing: Hovahannisyan and Gould, 2012; French cheese marketing: Mérel, 2009; U.S. cigarette manufacturing: Raper, Love, and Shumway, 2007; U.S. breakfast cereals: Reimer, 2004). 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 U.S. farmers, legislators, regulators, and agricultural economists, empirical research conducted under the NEIO rubric, and especially that relating to the U.S. meat and poultry processing, has found only modest departures from competitive pricing behavior, a conclusion also drawn by the U.S. 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, 1999; 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 policy making. 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 subfields in economics, even if the deadweight loss triangles are inconsequential—the so-called "tyranny of the triangles" (*Economist*, 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 United States, 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 vertical coordination 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. Although he recognizes that this may be because of data limitations or inappropriate modeling choices, most critically he suggests it is not food processor seller power that matters in the EU agricultural and food marketing system, but rather the multiproduct nature of food retailing and retailer buyer power exercised through vertical contractual relationships with upstream firms are not adequately captured in typical NEIO models.

Interestingly, Sheldon and Sperling (2003) in their earlier review also concluded that NEIO models needed to account for the multiproduct nature of food processing and retailing. At the time of writing, Nevo's (1998, 2001) methodology was an exception to the rule in focusing on a differentiated food product (breakfast cereal). In the intervening period, Nevo's (1998) analytical approach, and variations on it, has become the "workhorse" for examining both horizontal competition in food processing and retailing and also vertical relationships between food processors and retailers. Although discussion of the latter is delayed until later in this article, it is useful at this point to describe the approach and its early application to food processing.

The NEIO methodology pioneered by Bresnahan (1982) and Appelbaum (1982) focused on homogeneous product industries, extension to differentiated products being limited by the difficulty of estimating demand and then solving out for the conjectural elasticities. To get around this problem, Nevo (1998) proposed the following approach: first, aggregate demand for $j = 1, \ldots J$ varieties of a differentiated product is estimated using the discrete demand methodology suggested by Berry, Levinsohn and Pakes (1995); second, assuming a Bertrand-Nash equilibrium in prices, the profit-maximizing conditions of the firms selling the J varieties are derived, implying price-cost margins for each variety; third, a pricing equation is derived where price is a function of marginal cost and the markup; and fourth, using estimates of the parameters for the demand equation, price-cost margins are calculated without observing marginal costs and where the margins can be separated into three specific sources (single-product differentiation, multiproduct firm pricing, and potential price collusion). Nevo (2001) applied this methodology to the U.S. ready-to-eat breakfast cereals industry, his results indicating that despite high price-cost margins, prices in the industry were consistent with multiproduct firms playing a Bertrand-Nash game in prices rather than colluding over price.

What is important about this methodology is that it provides a robust framework for analyzing the behavior of multiproduct firms in the current food marketing system and is likely a better approach than the typical NEIO model historically applied to food processing. Nevertheless, it was perhaps not unreasonable for many earlier NEIO studies to have focused on estimating market power in a homogeneous product setting such as beef and poultry processing.

In conclusion, although Sexton (2000, 2013) and McCorriston (2002, 2014) both raise legitimate questions about the usefulness of the NEIO approach to analyzing horizontal competition and vertical coordination in the food marketing system, they clearly diverge in terms of focus—food processor vertical coordination with the agricultural sector versus food retailer vertical coordination with the food processing sector. Having said that, they are essentially emphasizing the same general issues: 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 coordination?

4. Buyer Power in the Agricultural and Food Marketing System

4.1. 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 attributable to Chen (2007, p. 19), 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."

From this definition, it is possible to pin down two types of downstream market power contingent on whether 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 because of 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 viewed in the context of antitrust analysis.

In terms of economic efficiency, the loss because of 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 because of 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 nonlinear 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 Walmart 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 markups 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 although increased consolidation downstream may result in lower downstream prices, it does not necessarily increase efficiency downstream if a dominant firm increases it 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 nonlinear pricing allows contracts whereby upstream and downstream firms share their joint profits, without there being a reduction in the downstream price (Inderst and Shaffer, 2007).

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 McCorriston (2014), placing their reviews in the context of the orthodox view in IO of vertical market control (see, e.g., 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 arm's 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 its 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 nonlinear pricing, specifically a two-part tariff; that is, the upstream processor implements a contract consisting of a wholesale price equal to its 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; that is, they are given the correct incentive to set the monopolistic price at retail, or 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.

Although 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 choose to implement nonlinear 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.

4.2. 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 U.S. 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 realizing 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 the USDA's Agricultural Resource Management data set for 2013, reports that by 2011, 40% of the value of U.S. agricultural commodity production was governed by contracts compared with 28% in 1991, although this share did fall to 35% 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% for all crops to 52% for all livestock, but within all crops, the share varied from 13% for wheat to 57% for peanuts, and within all livestock, the share varied from 32% for cattle to 74% and 84% 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 US$58 billion worth of U.S. agricultural production, with US$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 because of 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 "holdup," is at the heart of concerns over

buyer power and should be treated as distinct from the exertion of textbook monopsony/oligopsony power (MacDonald, 2015).

Sexton (2013) and Crespi, Saitone, and Sexton (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 shortsighted, not only generating 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, Saitone, and Sexton (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) and Wu (2006, 2014).

What Sexton (2013) and Crespi, Saitone, and Sexton (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); that is, they will offer upstream suppliers a nonlinear contract. Following Crespi, Saitone, and Sexton (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} is 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 nonlinear 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 because of the fact that if the upstream firm makes no return on its fixed investment c_j^f in the long run, it will be forced to exit the industry. In turn, this would result in suboptimal 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, Saitone, and Sexton (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 that the downstream food processor has an incentive to invest in relationship-specific assets in order to increase its payoff at wholesale. This is a relationship-specific asset because of 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, Saitone, and Sexton (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.

4.3. Food Retailer Buyer Power

4.3.1. 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 geographic area of sales for that brand, and 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. It is important to note that detailed analysis of such constraints is not purely a theoretical exercise. McCorriston and Sheldon (1997) found that in the U.S. 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. It should also be noted that in response to both economic and legal arguments, many vertical restraints, including resale price maintenance, are no longer treated as "per se" illegal under U.S. antitrust rules but instead are evaluated on a "rule of reason" basis, making them presumptively legal (Sokol, 2014; Tirole, 2015).

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 preretail services (Matthewson and Winter, 1984; Rey and Tirole, 1986) or excessive postsale 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 (Innes and Hamilton, 2009; Rey and Stiglitz, 1988).

To illustrate the argument, consider a simple result derived by 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 because of interbrand 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 interbrand competition, can actually reduce consumer welfare.

Although the previously discussed 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-it offers to the downstream retailer(s) (agent), ignoring the possibility that downstream retailers are able to bargain in their favor over setting contract terms because of 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, and so forth. Each upstream processor sets a wholesale price, and then each retailer chooses an upstream processor as its 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 nonlinear pricing, vertical profits will not be maximized. With linear pricing, no upstream processor can set a wholesale price above marginal cost as it will be undercut by other processors, and neither can any retailer raise price above marginal cost as they will be undercut by other retailers. 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, has been 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 U.S. 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 paying "facing 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).

Recent estimates suggest that in the United States, such fees increased from US$1 billion in the 1990s to US$18 billion in 2015 (*Economist*, 2015). However, it should be noted they are not uniformly charged by the major U.S. food retailers—Kroger and Safeway do use slotting allowances, but Walmart does not (Stoffel, 2013), although it does receive other payments (*Economist*, 2015). In the case of the United Kingdom, the UK Competition Commission (2000) reported that 40% of upstream suppliers had to pay slotting allowances to food retailers, and anecdotal evidence suggests that the four largest UK food retailers now receive more in such fees than they make in operating profits, as firms respond to competition from discounters such as Aldi and Lidl (*Economist*, 2015).

Slotting allowances have proved controversial, attracting the attention of the U.S. Federal Trade Commission on two occasions (2001, 2003), although its recent review of guidelines on complying with the Robinson-Patman Act simply required suppliers to offer the same fees to all retailers (*Economist*, 2015). Typically, upstream processors have expressed the view that they differentially effect large versus small firms and may therefore be anticompetitive (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; that is, 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; that is, it constitutes a screening device (Chu, 1992; Desiraju, 2001;

DeVuyst, 2005; Kelly, 1991; Lariviere and Padmanabham, 1997; Richards and Patterson, 2004). 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-it two-part tariff consisting of a wholesale price and slotting fee, and 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 onto retailer shelves because of 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 multiproduct 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, multiproduct 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 because 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 because of the slotting allowance having raised the wholesale price of product B. In other words, slotting

allowances charged to the competitive fringe result 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 actually 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) in which 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 nonlinear 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 its 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.

4.3.2. 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, whereas product B produced by the competitive fringe upstream might be a food retailer's private-label product. As noted by McCorriston (2014), the growth of private labels and their market penetration has become an important feature of how food retailers in both the United States and the EU compete horizontally with each other, as well as how they compete vertically with national brand food processors. McCorriston (2014) reports that private labels account for 15% of retail sales in North America and 23% 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% in Italy to 15% in the United States and 41% in the United Kingdom, and it seemed to be correlated with the extent of retail seller concentration. In the case of product categories, and comparing frozen food with nonalcoholic beverages, respectively, Bergès-Sennou, Bontems, and Réquillart (2004) found for 2002 that the share of retail sales for private-label products ranged from 17% and 10% for Italy to 15% and 29% for the United States and 45% and 36% for the United Kingdom.

Most of the theoretical research on the impact of private labels has focused on the vertical dimension of private-label products and whether competition

between them and national brands results in higher or lower consumer prices. As Bergès-Sennou, Bontems, and Réquillart (2004) note, the typical model in the literature has the prototypical vertical market structure outlined earlier—that is, 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 because of 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, Bontemps, Monier-Dilhan, and Réquillart (1999) assume that the marginal costs of producing private-label products differ from the national brand, and marginal costs increase in product 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.

Although 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 Sørgard (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. It 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, it 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.

4.3.3. Evaluating Vertical Coordination

Actually assessing vertical coordination empirically is difficult because of lack of data on wholesale prices, and as yet, only a limited number of articles have managed to generate any meaningful results, notably Villas-Boas (2007), Rennhoff (2008), Bonnet and Dubois (2010), and Bonnet and Bouamra-Mechemache (2016) who examine the U.S. yogurt, U.S. ketchup, French bottled water, and French fluid milk markets, respectively. Extending the workhorse empirical methodology pioneered by Berry, Levinsohn, Pakes (1995) and Nevo (2001) to a vertical market setting, and drawing on earlier work by, inter alia, Sudhir (2001), Villas-Boas and Zhao (2005), and Hellerstein (2008), 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 vertical contracting relationships are being used to avoid the double-marginalization problem.

Using demand estimates from a discrete choice demand formulation, and allowing for branded and private-label yogurt products, Villas-Boas (2007) computes the price-cost margins for U.S. 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, with processors pricing at marginal cost and profit-maximizing prices being set by retailers. Using a similar methodology, and again allowing for branded and private-label bottled water, 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 nonlinear pricing with resale price maintenance, even though the latter vertical restraint is actually illegal in France.

Although this empirical analysis of vertical coordination is encouraging, it does not shed much light on the impact of slotting allowances and/or the exercise of buying power by food retailers. For example, Villas-Boas's (2007) results are

consistent with nonlinear pricing by processors via two-part tariffs, except that in the U.S. yogurt market, positive franchise fees are either very small or nonexistent. 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. Rennhoff (2008), using a similar methodology, develops a vertical market model with two-part tariffs, where processors do not hold total bargaining power, thereby allowing for negative franchise fees. Importantly, he is able to infer the level of the fees by tying them to in-store promotion decisions by retailers in the U.S. ketchup sector, his estimates suggesting an average weekly fee of US$1.60 per bottle of ketchup. Overall, Rennhoff (2008) concludes that negative franchise fees result in loss of aggregate economic welfare, an increase in retailer profits being outweighed by a decrease in processor profits and consumer surplus.

By contrast, Richards and Hamilton (2013) have recently cast doubt on the viability of retailers paying high wholesale prices and accepting slotting allowances, focusing on the network effects that arise from two-sided demand for shelf space in supermarkets. In their model, food retailers are multiproduct platforms connecting food processors with consumers. Based on earlier empirical research (Richards and Hamilton, 2006), they argue that because consumers value a variety of food products, they also value supermarket platforms that attract a range of branded food products. At the same time, food processors benefit from supplying supermarket platforms that attract a large number of consumers. As a consequence, both consumers and food processors are willing to pay for access to the platform, jointly determining retail and wholesale margins.

Key to how the total margin is shared between processor and retailer are both direct and indirect effects. The former depends on the relative value consumers and food processors place on the size of the platform (Armstrong, 2006), whereas the latter depends on indirect network effects on the pricing power of food processors and retailers. In a multiproduct framework, an increase in the number of varieties drives down total margins because of increased price competition (Hamilton and Richards, 2009), but at the same time, increased variety increases consumer demand within a retail location, generating indirect network effects, thereby raising retail margins at the expense of wholesale margins. Basically, there is a network externality whereby all food processors benefit from a new variety being added to a retailer's range. However, although consumers are able to internalize this externality because of their utility increasing in product variety, retailers extract increased rents from consumer willingness to pay for more variety, while food processors fail to recognize the externality they generate from adding an extra product at the margin. As a consequence, retailers internalize indirect network effects by increasing their retail margins. Richards and Hamilton (2013) use demand estimates from a Berry, Levinsohn, and Pakes (1995)–type model to solve out for retail choices concerning variety and price;

their empirical results for six supermarkets in Visalia, California, indicate that as variety increases, retailers have an incentive to raise retail margins, while food processors accept lower wholesale margins in competing for the higher retail margins. Richards and Hamilton (2013) argue that their results provide an explanation for the emergence of Walmart as a supermarket platform in the United States.

The possibility that retailers may be able to exert bargaining power over processors is also explicitly tested for by Bonnet and Bouamra-Mechemache (2016), who draw on the methodology of Draganska, Klapper, and Villas-Boas (2010) to model wholesale price as the outcome of a Nash bargaining game between processors and retailers in the French fluid milk market. Their approach involves using estimates from a discrete choice demand model to recover retail margins as per Nevo (2001), from which they are able to estimate the relative bargaining power of processors versus retailers, given exogenous cost variables for fluid milk products. From the estimates of retail margins and bargaining power parameters, Bonnet and Bouamra-Mechemache (2016) are able to infer wholesale margins and hence total fluid milk margins. Their results indicate that processor margins exceed retailer margins for organic milk as compared with conventional milk, and that retailer bargaining power is still lower even when they sell private-label milk. In the case of conventional milk, retailers have greater bargaining power, although it varies by retailer and brand pair.

Turning to the impact of private labels, the literature outlined previously suggests that the introduction of private-label products by food retailers in both the United States and the 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 U.S. 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 United States, 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, found 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.

Unlike the existing empirical literature on vertical restraints, which is constrained by the lack of data on two-part tariffs, 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.

Finally, even though online food retailing is at an early stage of development, Richards, Hamilton, and Allender (2016) use online price data for the major UK supermarket chains, in order to examine the impact of product variety on consumer search costs and retail price dispersion. Multiproduct food retail environments generate two opposing effects for consumers: on the one hand, breadth of variety may raise search costs, and on the other hand, there may be a better matching of food products with consumer preferences, which lowers search costs. As a consequence, the link between product variety and search costs may allow food retailers to exert market power.

The literature is currently unclear on what effect search costs will have on equilibrium retail prices, although many of the models presented focus only on a single-product environment. Recent articles assuming a multiproduct setting suggest that there will be a positive correlation between retail prices, which runs counter the prediction of negative retail price correlation where retailers follow a low-price strategy on some products in order to get consumers into the store, after which they raise the price of the remaining products (McAfee, 1995). Zhou (2014) shows that retail prices will fall with greater variety because higher search costs in a multiproduct world are mitigated by the potential economies of scope involved in searching; that is, retailers are able to sell more varieties to a searching consumer by reducing all retail prices. A similar complementarity argument is put forward by Rhodes (2015), who argues multiproduct retailers will charge lower prices in order to attract consumers into their store who are more price sensitive. Richards, Hamilton, and Allender (2016) find empirical support for the latter prediction that online food retail prices are negatively correlated (i.e., search in an online multiproduct setting is different from the typical single-product setting that has been typically evaluated).

4.4. Price Transmission and Vertical Market Structure

A key focus of McCorriston (2014) and Lloyd, McCorriston, and Morgan (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 markup of the oligopolistic processing/retailing sector and the change

in their costs. If the aggregate markup 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 markup is positive, market power will influence the degree of price transmission, the extent being dependent on how the aggregate markup 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 undershifting of the change in price of the raw agricultural commodity through to the retail price—that is, there is less than perfect pass-through, the food processing/retailing sector absorbing some of the increase in costs.

This undershifting result is well known from both the public and international economics literature, and several studies have found empirical evidence for it (Dutch coffee industry: Bettendorf and Verboven, 2000; European cigarette industry: Delipalla and O'Donnell, 2001; global branded beer industry: Hellerstein, 2008; U.S. coffee sector: Nakamura and Zerom, 2010). However, it should be noted that the undershifting result can be overturned either if demand for a single product is sufficiently convex (Anderson, de Palma, and Kreider, 2001; Stern, 1987) 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 fewer retail products on the market, thereby lessening retail competition, resulting in overshifting of the input cost increase, a result confirmed empirically for the U.S. breakfast cereal market by Richards and Hamilton (2015), using a variation of the Berry, Levinsohn, and Pakes (1995)/Nevo (2001) methodology.

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, Weldegebriel (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 markdown of the input price changes, as well as the nature of the input supply function. Specifically, if the markdown increases following the change in input prices, this will offset any tendency for the markup 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. McCorriston 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 with an aggregate processing/retailing stage. Given arm's-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 its markup in response to the change in upstream costs: at the food processing stage, the change in markup 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 markup is a function of the degree of pass-through by the upstream processor of the input price change and horizontal competition at retailing.

The latter result is essentially because of 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 the 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 markup at one or other stage, this will increase price transmission. Alternatively, if a vertical restraint results in either wholesale and/or retail markups changing, this may lower price transmission.

The previous discussion of the empirical analysis of vertical restraints suggests 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 Villas-Boas (2007) and Bonnet and Dubois (2010). Bonnet and Réquillart (2013) find that the most likely vertical model is one in which there are two-part tariffs and resale price maintenance, and that upstream cost changes are overshifted 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 with linear pricing.

In addition to generating evidence for the use of vertical restraints, this methodology has also been used to draw inferences about the impact of volatility in commodity prices on the exercise of market power in a vertical market structure. Richards, Allender, and Hamilton (2012) analyze the U.S. potato and fluid milk sectors, their results indicating that for potatoes, wholesale and retail market power decreases (increases) with rising (falling) commodity prices, while for fluid milk, market power declines with an increase in the commodity price but does not change significantly when the commodity price falls. They interpret this result in the context of multiproduct retailing, whereby fluid milk is treated as a loss leader by supermarkets whatever the cost of the commodity in order to attract consumers into the store but then extract rents from those consumers on other products such as potatoes.

5. Summary and Conclusions

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

The reviews are also similar in terms of ignoring the structure of the agricultural inputs sector, other than a short section in McCorriston (2002). This is somewhat surprising, especially as regards the crop seed/biotechnology industry, although in the case of the EU this may be because of 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 3 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 the antitrust authorities that bears further analysis.

The key to both Sexton (2013) and McCorriston (2014) is their highlighting 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, whereas McCorrriston (2014) focuses on food retailer vertical coordination with the food processing sector. This is driven in part by divergent U.S. and EU popular public concerns about the precise location of market power in the agricultural and food marketing system, the former being dominated by the view that U.S. food processors have buyer power over their suppliers, the latter that EU food retailers have buyer power over food processors as well as concerns about the nature of price transmission in the food marketing system.

However, Sexton (2013) and McCorriston (2014) do agree on a key conceptual problem: NEIO-type analysis of the agricultural and food marketing system finds little empirical evidence for exertion of buyer power in either the United States or the EU, a conclusion that is supported in the review presented in Section 3 of this article. This may of course be because of technical issues with the methodology itself and/or lack of necessary data, but it is more likely because of 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 through vertical restraints designed to resolve the problem of double marginalization. Neither characteristic is adequately

captured in typical NEIO models focusing on single homogenous products transformed/sold through the vertical marketing system, the approach ignoring the impact of multiproduct/multibrand food processing and food retailing on vertical coordination and the potential feedback to suppliers of agricultural inputs.

Analysis of vertical coordination is reviewed in detail in Section 4 of this article, the overall conclusion being twofold: first, although there is an extensive body of contract theory focusing on agency costs and incentives, it has yet to rigorously incorporate downstream processer 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 now very rich in different models of the impact of various vertical restraints such as slotting allowances and how to capture countervailing power of retailers. Although these models are potentially hard to evaluate, because of lack of data on wholesale prices, some real progress has been made empirically in pinning down the structure of vertical contracts, through adoption/adaptation of the multiproduct approach originally pioneered by Berry, Levinsohn, and Pakes (1995) and Nevo (1998). In addition, the advent of online retailing holds out the possibility of gaining new insights into the impact of multiproduct strategies by retailers and its interaction with consumer search.

Finally, although 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. Although 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.

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