Since the financial and food price crises of 2007, market instability has been a topic of major concern to agricultural economists and policy professionals. This volume provides an overview of the key issues surrounding food prices volatility, focusing primarily on drivers, long-term implications of volatility and its impacts on food chains and consumers.

The book explores which factors and drivers are volatility-increasing and which others are price level-increasing, and whether these two distinctive effects can be identified and measured. It considers the extent to which increasing instability affects agents in the value chain, as well as the actual impacts on the most vulnerable households in the EU and in selected developing countries. It also analyses which policies are more effective to avert and mitigate the effects of instability.

Developed from the work of the European-based ULYSSES project, the book synthesises the most recent literature on the topic and presents the views of practitioners, businesses, NGOs and farmers’ organisations. It draws policy responses and recommendations for policy makers at both European and international levels.

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FOOD & AGRICULTURE / ECONOMICS / ENVIRONMENT & SUSTAINABILITY
Chapter 6
A review of the effects of contextual factors on price volatility transmission in food supply chains

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1 Introduction

Global agricultural prices have experienced an increasing degree of volatility in the last decade (FAO et al., 2011). Prices rose sharply in 2006 and 2007, reaching peak levels in the second half of 2007 for some products and in the second half of 2008 for others, and then plummeted sharply in the second half of 2008 to rise sharply back in 2011 (FAO et al., 2011). Demand-increasing factors, such as economic growth, shifting dietary patterns in developing countries and growth of the biofuel industry, and factors related to the structure of agricultural markets, such as the weak transfer of market price signals to farmers, are attributed to the recent rise in food price volatility (Rabobank, 2011). While there is no generally accepted definition of price volatility (Serra and Zilberman, 2013), it is commonly agreed that price volatility is characterized by price changes that are unpredictable and unanticipated in nature (Piot-Lepetit, 2011; FAO et al., 2011; Serra and Zilberman, 2013; Rabobank, 2011). Price changes along a well-established trend reflecting market fundamentals and with known cyclical patterns are less a matter of concern (FAO et al., 2011) and are not defined as price volatility.

The impacts of price volatility extend to all actors in the food supply chain. Price volatility implies larger risks to farmers, who may react by reducing output supply and investments in productive inputs (Seal and Shonkwiler, 1987; Rezitis and Stavropoulos, 2009; Sckokai and Moro, 2009; Piot-Lepetit, 2011; Tangermann, 2011; Taya, 2012). Furthermore, agricultural input price volatility exposes the downstream sector of food supply chains to sourcing uncertainties, forcing food and agricultural companies to alter their sourcing strategies as a coping mechanism (Rabobank, 2011). On the other end of food supply chains, unexpected increases in prices pose food security risks, particularly to consumers who spend a large share of their income on food items (Hernandez et al., 2011). These chain-wide implications of food price volatility stress the importance of investigating the mechanism by which price volatility transmits along the chain.

Curbing price volatility transmissions in food chains requires an understanding of the factors that affect these transmissions. One point worth noting is the distinction between price transmissions and price volatility transmissions.
The transmission of prices in levels along the chain is necessary for a market to operate efficiently (Chavas and Mehta, 2004), for the maximization of producers’ and consumers’ welfares, and for an effective transmission of policy induced price measures (Meyer and von Cramon-Taubadel, 2004; Vavra and Goodwin, 2005; Ben-Kaabia and Gil, 2007). On the other hand, price volatility transmission entails the transmission of risks due to unpredictable price changes from one market to another (Apergis and Rezitis, 2003), and this transmission should be minimized. This highlights a potential conflict between market measures intended to improve price transmissions and those intended to reduce price volatility transmissions. In this regard, identification of the factors affecting each type of transmission can help design policy measures or risk management tools that can achieve higher price transmissions as well as lower volatility transmissions. This chapter gives an overview of the factors that affect price volatility transmissions and price transmissions in food supply chains. This is achieved through a review of the literature on price transmission and price volatility transmission.

This chapter proceeds in section 2 with a discussion of differences in the definition of price transmission and price volatility transmission. This is followed by a review of the factors affecting price volatility transmissions in section 3 and a review of those that affect price transmissions in section 4. Section 5 briefly compares the factors identified in sections 3 and 4 and concludes the chapter.

2 Price transmission and price volatility transmission: definitions

Price transmission and price volatility transmission are similar in that they both deal with price linkages along the chain. However, whereas price transmission refers to the linkages between the conditional mean prices, price volatility transmission refers to the linkages between the conditional variance of prices (Natcher and Weaver, 1999). Price transmission deals more generally with the relationship between the predictable “portions” of prices, whereas price volatility transmission deals with the relationship between the unpredictable portions of prices. Price volatility transmission is also defined as the degree to which price uncertainty in one market affects price uncertainty in other markets (Apergis and Rezitis, 2003).

If price volatilities are fully and instantaneously transmitted along the chain, one would expect a near to unity correlation between price volatilities at different market levels (Serra, 2011). It can be the case that the predictable portion of prices is perfectly transmitted, whereas the unpredictable portion is not. Figure 6.1 illustrates a situation that implies a perfect price transmission in levels and an imperfect price volatility transmission for a chain consisting of a farm and retail sector of an unprocessed agricultural food product (to allow direct comparison of the degree of price transmission). Farm and retail price predictions can be made based on market fundamentals such as past prices, the degree of market competition, and demand and supply conditions.
Factors on price volatility transmission

Figure 6.1 shows that the predictable portion or the conditional means of farm and retail prices follow each other both in the short and long run. This indicates that price transmission in levels is perfect. However, the graph on actual prices shows that farm prices deviate more often from the mean values than the retail prices do. This implies that farm prices are less predictable than retail prices, and that the farm price unpredictability does not translate into unpredictable retail prices. This implies imperfect price volatility transmission from farm to retail, even though causality cannot be directly inferred from the figure.

3 Factors affecting food price volatility transmission

Table 6.1 provides a summary of studies that investigated price volatility transmission in food supply chains. The data in Table 6.1 follows from the literature review by Assefa et al. (2013) and Assefa et al. (2015). The overview of studies shows that price volatility transmission is bidirectional. The factors that the authors suggested as having an effect on the degree of transmissions are reported in the last column of Table 6.1. No formal tests of such effects are conducted, however, in any of the reported studies. The suggested factors can be categorized as farm-level and retail-level factors. Each category is briefly discussed next.

3.1 Farm-level factors

The nature of farm production, inelastic farm-level demand, farm input cost share, and contracts fall into the category of farm-level factors. While the first two factors can explain the higher level of farm price volatility relative to the retail stage, the latter two factors can explain the level of volatility transmissions across these two chain stages. According to Apergis and Rezitis (2003) and
<table>
<thead>
<tr>
<th>Authors (date)</th>
<th>Countries</th>
<th>Products</th>
<th>Chain stages</th>
<th>Sample period</th>
<th>Transmission of volatility detected</th>
<th>Direction of detected volatility transmission</th>
<th>Factors affecting volatility transmissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buguk et al. (2003)</td>
<td>US</td>
<td>Catfish</td>
<td>Feed – farm – wholesale – retail</td>
<td>1980–2000</td>
<td>Yes</td>
<td>From feed to farm; From wholesale to farm; From farm to wholesale</td>
<td>Market power</td>
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<td>Apergis and Rezitis (2003)</td>
<td>Greece</td>
<td>Agricultural products</td>
<td>Agricultural input – agricultural output – retail</td>
<td>1985–1999</td>
<td>Yes</td>
<td>From feed to farm; From consumer to farm</td>
<td>• Contracts • Nature of agricultural production • Inelastic farm-level demand</td>
</tr>
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<td>Rezitis (2012)</td>
<td>Greece</td>
<td>Lamb, beef, pork, poultry</td>
<td>Farm – retail</td>
<td>1988–2000</td>
<td>Yes</td>
<td>From farm to consumer; From consumer to farm</td>
<td>None</td>
</tr>
<tr>
<td>Zheng et al. (2008)</td>
<td>US</td>
<td>45 retail food items</td>
<td>Retail</td>
<td>1980–2004</td>
<td>Yes</td>
<td>From farm to retail</td>
<td>• Market power • Farm input cost share</td>
</tr>
<tr>
<td>Mehta and Chavas (2008)</td>
<td>Brazil–US</td>
<td>Coffee</td>
<td>Farm (Brazil) – wholesale (US) – retail (US)</td>
<td>1975–2002</td>
<td>Yes</td>
<td>N/A</td>
<td>None</td>
</tr>
<tr>
<td>Authors (date)</td>
<td>Country</td>
<td>Products</td>
<td>Chain stages</td>
<td>Sample period</td>
<td>Transmission of volatility detected</td>
<td>Direction of detected volatility</td>
<td>Factors affecting volatility transmissions</td>
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<tr>
<td>Buguk et al. (2003)</td>
<td>US</td>
<td>Catfish</td>
<td>Feed – farm – wholesale – retail</td>
<td>1980–2000</td>
<td>Yes</td>
<td>From feed to farm; From wholesale to farm; From farm to wholesale</td>
<td>Market power</td>
</tr>
<tr>
<td>Apergis and Rezitis (2003)</td>
<td>Greece</td>
<td>Agricultural products</td>
<td>Agricultural input – agricultural output – retail</td>
<td>1985–1999</td>
<td>Yes</td>
<td>From feed to farm; From consumer to farm</td>
<td>• Nature of agricultural production; • Inelastic farm-level demand</td>
</tr>
<tr>
<td>Rezitis (2012)</td>
<td>Greece</td>
<td>Lamb, beef, pork, poultry</td>
<td>Farm – retail</td>
<td>1988–2000</td>
<td>Yes</td>
<td>From farm to consumer; From consumer to farm</td>
<td>N/A</td>
</tr>
<tr>
<td>Chavas and Mehta (2004)</td>
<td>US</td>
<td>Butter</td>
<td>Wholesale – retail</td>
<td>1980–2011</td>
<td>N/A</td>
<td>None</td>
<td>N/A</td>
</tr>
<tr>
<td>Zheng et al. (2008)</td>
<td>US</td>
<td>45 retail food items</td>
<td>Retail</td>
<td>1980–2004</td>
<td>Yes</td>
<td>From farm to retail</td>
<td>Market power; Farm input cost share</td>
</tr>
<tr>
<td>Mehta and Chavas (2008)</td>
<td>Brazil–US</td>
<td>Coffee Farm (Brazil) – wholesale (US) – retail (US)</td>
<td>1975–2002</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Uchezuba et al. (2010)</td>
<td>South Africa</td>
<td>Boiler</td>
<td>Farm – retail</td>
<td>2000–2008</td>
<td>Yes</td>
<td>From farm to retail</td>
<td>Market power</td>
</tr>
<tr>
<td>Serra (2011)</td>
<td>Spain</td>
<td>Beef</td>
<td>Farm – retail</td>
<td>1996–2005</td>
<td>Mixed</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Alexandri (2011)</td>
<td>Romania</td>
<td>Agricultural price indices</td>
<td>Farm – retail</td>
<td>2006–2010</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Rezitis and Stravapoulaus (2011)</td>
<td>Greece</td>
<td>Broiler</td>
<td>Farm – retail</td>
<td>1993–2009</td>
<td>No</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Rezitis (2012)</td>
<td>Greece</td>
<td>Beef, lamb, pork, poultry</td>
<td>Farm – retail</td>
<td>1993–2008</td>
<td>Yes</td>
<td>N/A</td>
<td>None</td>
</tr>
<tr>
<td>Khiyavi et al. (2012)</td>
<td>Iran</td>
<td>Poultry</td>
<td>Feed – farm – retail</td>
<td>1997–2010</td>
<td>Yes</td>
<td>From feed to farm; From retail to farm</td>
<td>• Contracts; • Nature of agricultural production; • Inelastic farm-level demand</td>
</tr>
</tbody>
</table>

1Not applicable
Khiyavi et al. (2012), farmers cannot quickly respond to market price signals due to time lags in farm production. This in turn leads to farm prices being more volatile than wholesale and retail prices. The other factor causing a mismatch between farm and downstream stage price volatility is the inelasticity of farm-level demand compared to consumer demand. This implies that an oversupply at the farm level is not proportionately matched by an increase in retail demand, causing farm prices to drop further.

Contracts are argued by Khan and Helmers (1997), Apergis and Rezitis (2003), and Khiyavi et al. (2012) to reduce volatility transmissions in the chain. According to Khan and Helmers (1997), contract production helped to reduce the transmission of corn price volatility to beef and poultry prices. On the other hand, Apergis and Rezitis (2003) argue that, although farmers have a contract for their inputs, their output prices can be affected by price shocks coming from output markets if they do not enter into price-fixing contracts for their outputs. Khiyavi et al. (2012) argue that the sensitivity of agricultural outputs to agricultural input and retail price volatilities would be reduced if farmers had used contracts for their inputs and outputs. Finally, the low share of farm inputs in retail prices is argued to be responsible for the low responsiveness of retail prices to the volatility of farm prices (Zheng et al., 2008).

### 3.2 Retail-level factors

A commonly mentioned reason for the low transmission of price volatility through the supply chain is actors’ market power, and retail market power in particular (Buguk et al., 2003; Zheng et al., 2008; Uchezuba et al., 2010; Serra, 2011; Rezitis and Stavropoulos, 2011). Retail market concentration is argued to cause consumer prices to be irresponsive to the volatility of farm prices. According to Serra (2011), retailers use their market power to transmit farm price volatility in calmer periods (periods with limited news on bovine spongiform encephalopathy [BSE] crisis), but do not transmit in turbulent times (when news of BSE cases is widespread). Marketing strategies of retailers also reduce the transmission of farm price volatility to consumers (Alexandri, 2011). According to Alexandri, retailers keep consumer prices rigid due to consumers’ sensitivity to frequent price changes. Buguk et al. (2003) argues on the other hand that even farmer market power can reduce volatility transmissions in the chain. They argue that farmers organized in cooperatives can use their market power to asymmetrically transmit input price shocks to the next stage.

### 4 Factors affecting food price transmission

Table 6.2 summarizes the main factors affecting price transmission (in levels). It should be noted that although the list of the reviewed studies is not exhaustive, it provides the key factors affecting price transmission. In contrast to the price volatility transmission literature, the price transmission literature has
<table>
<thead>
<tr>
<th>Author (Date)</th>
<th>Country</th>
<th>Product</th>
<th>Chain stages</th>
<th>Sample period</th>
<th>Asymmetry detected?</th>
<th>Factors affecting price transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reagan and Weitzman (1982)¹</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td>Yes</td>
<td>Adjustment costs</td>
</tr>
<tr>
<td>Mankiw (1985)¹</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td>Yes</td>
<td>Adjustment costs</td>
</tr>
<tr>
<td>Schroeter et al. (1996)</td>
<td>EU</td>
<td>Banana</td>
<td>Wholesale – retail</td>
<td>N/A²</td>
<td>Yes</td>
<td>Number of stages in the chain and market power</td>
</tr>
<tr>
<td>Azzam (1999)¹</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td>Yes</td>
<td>Market power and adjustment costs</td>
</tr>
<tr>
<td>Mc Corriston et al. (2001)¹</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td>Asymmetry not studied</td>
<td>Market power and processing technology in food industry</td>
</tr>
</tbody>
</table>

¹Indicates theoretical paper
²Not applicable. Simulations are made.
³Studies focusing on the retail stage study retail price rigidity using scanner data
theoretically and/or empirically tested for the effects of the factors mentioned in the table on the level of price transmission. Another distinction between these two streams of literature is that a focus of the price transmission literature has been the detection of asymmetries in price transmissions. Table 6.2 also indicates whether the reviewed studies detected transmission asymmetries. The commonly mentioned factors affecting price transmissions are briefly discussed next.

4.1 Market power

As Table 6.2 indicates, market power is an important factor determining the degree of price transmission. Market power often results in asymmetric price transmission, whereby actors transmit input price increases more than price decreases. Market power also results in output price rigidity, in which the output price does not react to both input price increases and decreases. Such abuse of market power is mainly reported in downstream stages of the food supply chain (wholesaler and retail), which are more concentrated than the farm sector. Besides their large number and the homogeneous nature of their products, the inability of farmers to easily control supply weakens their bargaining position vis-à-vis the buyers. According to Acharya et al. (2011), retailers exercise more market power during periods with excess farm production than when supply is in shortage. Market power also helps the downstream sector secure a constant or a higher margin in times of market crises. For instance, Lloyd et al. (2006) show that the BSE crisis had a differential impact on producer and retail prices, and therefore on farm–retail margins. In the absence of market power, the crisis would have had the same impact on the two prices and therefore should not have had an impact on the farm–retail margin.

Some authors, on the other hand, argue that market power does not always reduce price transmission through the chain. By considering the case of retailers that compete with competitors within their vicinity, Azzam (1999) suggests that retail prices are more flexible when retailers have market power than when they are in vigorous competition. He also shows that positive asymmetric price transmission occurs whether firms have market power or not. Weaver et al. (1989) support the view that market power as measured by concentration increases the transmission of upstream price changes. They assert that increased concentration increases the efficiency of firms and reduces the need for firms to postpone the transmission of upstream price decreases. As put by Azzam (1999, p. 997), “the temptation to secure such cost savings may have overwhelmed the incentives for oligopolistic output restrictions”.

4.2 Adjustment costs

Price adjustment cost at the retail stage is the second commonly mentioned factor affecting price transmission in the chain. Adjustment costs are also labelled as
repricing costs or menu costs, and they refer to any costs incurred in repricing decisions. According to Miller and Hayenga (2001), retailers do not respond to high-frequency/temporary price changes because of the high cost of adjusting inventories and other costs involved in changing prices. According to Azzam (1999), retailers change prices only when the extra profit from repricing is greater than the cost incurred to reprice. These costs include the time of relabelling products and the goodwill lost because of frequent repricing. Adjustment costs not only cause rigidity in output prices but also result in asymmetric price transmission. For instance, Reagan and Weitzman (1982) argue that firms prefer to increase inventory in times of low prices instead of lowering their output prices. In times of high market prices, on the other hand, firms respond by increasing their prices. This is because the cost of increasing inventory at times of decreasing prices is less than the cost of producing new inventory at times of increasing prices.

4.3 Other factors

Other factors affecting price transmission are the number of stages in the chain, the cost share of farm input in final output, the food processing technology, psychological pricing, government regulations, the perishability of the product, and inflation. The effect of farm input cost share on the degree of price transmission was formally shown by Bettendorf and Verboven (2000). They show that the low share of the costs of farm outputs in marginal costs reduced more farm price transmissions than did the degree of retail market power. Government policies that influence food prices also have their own effects on price transmission. Romain et al. (2002) show, for instance, that policies that open local markets for competition and those that put ceilings on retail prices lead to a symmetric transmission of farm price changes to the retail stage. Government policies can also have the effect of reducing farm price transmissions. For instance, Kinnucan and Forker (1987) attribute the asymmetric price transmission by retailers to government regulation that support the prices received by farmers. They argue that middlemen may view farm price increases as permanent, whereas they view farm price decreases as temporary expecting the government to intervene to raise back farm prices. This turn results in a less complete transmission of farm price decreases. Psychological pricing consists of setting prices just below some particular pricing points. These pricing points contribute to price rigidity because consumers are believed to react easily if prices go beyond those pricing points (Herrmann and Moeser, 2006). The perishability of a product also determines the degree of price transmission. Kim and Ward (2013) find that falling farm prices are transmitted far faster than rising farm prices because the rise in the prices of highly perishable goods can reduce the volume of sales. Finally, inflation is shown by Acharya et al. (2011) to have an asymmetric effect on the transmission of farm price to consumers. This is because retailers are reluctant to reduce prices in times of inflation while they transmit price increases.
5 Factors affecting food price volatility transmission and food price transmission: implications

A comparison of factors affecting price volatility transmission and food price transmission reveals that actors’ market power is an important factor that reduces both types of transmissions (see Chapter 5, McCorriston and von Cramon-Taubadel). Factors such as adjustment costs and various pricing strategies of actors downstream to the farm sector also relate to actors’ exercise of market power. While a lower price volatility transmission benefits chain actors, a lower price transmission could be economically costly. The retail sector is often alleged to use market power to keep consumer prices rigid or to transmit only farm price increases to the consumers. A competitive retail market implies a higher transmission of farm price decreases to the consumers while it also implies a transmission of farm price volatilities. Alternatively, while a competitive retail sector implies a higher transmission of consumer price increases to the farmers, it also implies an increased transmission of consumer price drops caused by sudden drop in demand (due to, for instance, consumer panics resulting from news on an animal health scare). This indicates that market measures intended to improve price transmissions can have the undesired effect of increasing price volatility transmission.

Contracts are the second most important factor mentioned in the price volatility transmission literature. Contracts are however not indicated as an important factor within the price transmission literature. The use of contracts among competitive chain actors can reduce price volatility transmission while enhancing the transmission of the predictable portion of price changes. Although one can hypothesize that the factors reducing price transmission also reduce the transmission of price volatility, one should still conduct empirical research to verify this. Such empirical studies are currently lacking and are an interesting avenue for future research.

This review showed that since both price transmission and price volatility transmission deal with price linkages in the chain, both types of transmissions can be affected by similar factors. While such factors can have desirable effects on one type of transmission, they may have the opposite effect on the other type of transmission. This indicates that different market measures that complement each other apply for the two types of transmissions. An example is the encouragement of market competitions to enhance price transmissions while at the same time encouraging contractual relations among chain actors.

References


