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Chapter 13

A Review of Supply Chain Prices Analyses with Emphasis on Perishable Markets

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Abstract

Prices at different levels of the supply chain are linked through long-run relationships and tend to differ by the marketing costs. However, several aspects intervene in making price dynamics along the supply chain quite complicated and erratic. In particular, several issues on how marketing margins evolve over time and across commodities, as well as how prices are transmitted along the supply chain are still debated. The implications for the understanding of the economy, the management of the firms, and the regulations of the markets are important and pushed scholars to dedicate particular attention to these topics. In particular, how prices evolve in the supply chain of perishable products is an intriguing challenge that has stimulated a hot debate. We review the literature on price analyses, marketing margins, and vertical price transmission with particular emphasis on perishable products (fruits and vegetables) in order to conclude on the open issues worth further investigation.

Keywords: agricultural product, marketing margins, price transmission, supply chain

1. Introduction

The interest on prices dynamics in perishable markets and the number of studies focused on these topics have rapidly increased during last decades [1–7]: the implications for agricultural markets, for entrepreneurial strategies, and for producer and consumer welfare are relevant and worth for a deep investigation.

The main (and simple) framework to analyze price dynamics is the well-known Law of One Price (LOP) which states that prices in separated markets tend to differ by no more than

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shipping costs incurred in moving a good from one market to the other. A formal definition is provided by Stiglitz [8] who stated "there is a uniform price in the market and price differences are quickly eliminated by arbitrage [opportunities]". If price spreads exceed transaction costs—regardless the trade direction—arbitrageurs' activity will reduce the spread letting prices move toward the equilibrium condition.[1] Similarly, prices along the supply chain are linked by long-run relationships and tend to differ by the marketing costs, that is, the costs to market the good. In other terms, prices at retail level differ from prices at farm level by the additional costs necessary to market the good. While it is so simple to be described, it is very complex in reality. Market movements, entrepreneurial strategies, physical constraints and biological dynamics make price dynamics erratic. Studying how prices evolve along the supply chain, across different levels, is an intriguing challenge. Not surprisingly, the interest in understanding these aspects has rapidly increased during the last decades. It is important to distinguish two aspects of interest: the evolution of marketing margins and the vertical transmission of prices. With marketing margins, we refer to the spread between prices observed at different stage of the supply chain, while the concept of vertical price transmission regards price dynamics and the transmission of shocks along the supply chain.

The present chapter reviews the literature on price analyses, with particular focus on studies on perishable food markets (fruits and vegetables). We review studies on marketing margins and studies on vertical price transmission and conclude by deepening on some of the main issues related to marketing margins and vertical price transmission in perishable goods markets.

The reminder of the chapter is as follows: the section two focuses on aspects of marketing margins; the subsequent section focuses on vertical price transmission; section four is devoted to the analyses of marketing margins and vertical price transmission in perishable markets; we conclude with comments and reflections for future studies.

2. On marketing margins

The terms marketing margin refer to the difference between the retail price, paid by consumers for a finished product, and the farm price of raw products. For instance, assuming raw tomatoes are sold at 1.5 €, the marketing margin for processed tomatoes, say sold at 2 €, would be the difference of the two prices (in our example the marketing margins equals 0.5 €). Clearly the importance of analyzing marketing margins relies on the possibilities to analyze how market equilibria evolve at different stages of the supply chain.

Myers et al. [10] review a century of research on marketing margins, starting from the seminal analyses of Waugh [11] based on descriptive statistics aimed at assessing the size of marketing margins, and concluding with the description of Schroeter and Azzam [12] and Holt [13] on the impact of risk on marketing margins.

[1] A recent review on these issues is provided by Santeramo and Di Gioia [9].

Wohlgenant [14] provides a complete survey on theoretical and empirical issues in marketing margins analysis underlying some of the questions of interest for researchers and policy-makers (e.g., are margins too large/small compared to farm and retail prices? Why they differ among products/space/time? How quickly are price shocks transmitted along the supply chain? What are the determinants of margins movements? etc.).

The basic model to analyze marketing margins is a two-market static model subject to demand and supply shifters (i.e., exogenous variables capable of increasing or decreasing the whole market demand, or market supply). It is generally used for comparative statistics [15, 16] as it allows to conclude on margins dynamics under different economic assumptions (e.g., fixed and variable input proportions, markup pricing, etc.). However, Gardner [15, p. 406] pointed that "*no simple markup pricing rule can depict the relation between the farm and retail prices*," and generally, the empirical approaches lack of theoretical foundations.

Wohlgenant [14] revises the possible factors affecting marketing margins: an extensive literature has focused on the role of market power in order to provide theoretical [12, 17–20]

and empirical evidences [21–22]; other factors that affect farm and retail prices spread are price risks [12, 13], technical and structural changes [23, 24], product quality and seasonality [25, 26]. Wohlgenant' survey concludes that the approaches to model marketing margins are still inappropriate since they ignore significant economic aspects (namely the input substitutability between farm input and other inputs in producing retail products), and more research is needed either to understand the role of the mentioned factors on marketing margins as well as the role of actual trends in agricultural sector (e.g., increasing vertical integration and coordination, growing expenses in advertisements, introduction of new food safety regulations, etc.).

Traub and Jayne [27] investigated how price (de)regulation influenced the size of the marketing margins of maize ion South Africa. They found that deregulation leads to an increase in marketing margins of 20%: the authors admit their results are not supported by the literature and may prove to be disruptive of existing evidence. More recently, Dawe and Maltsoglou [28] investigated how price increases affect the welfare impacts, and what is the influence of marketing costs (i.e., the costs to market the goods). They show the importance of assuming a correct functional form for marketing costs and found that in a vast majority of cases, it is safer to assume that marketing costs are fixed, rather than proportional.

3. On vertical price transmission

Meyer and Cramon-Taubadel [29] present the state of the art of the literature on asymmetric price transmission discussing on the theories and empirical aspects. The adjustment to price shocks along the supply chain, from producer to wholesale and retail levels, and vice-versa, is an important aspect of the functioning of supply chains. Asymmetries in vertical price transmission may be due to several aspect of the market structure. For instance, imperfect price transmission may be caused by market power that induces oligopolistic behavior. The consequences of vertical price transmission are worth investigation: in fact, the asymmetry and the

speed of price transmission from farm level to final consumers result in positive or negative welfare effects for economic agents.

The literature on vertical price transmission is focused on four fundamental topics [30]: the magnitude of how price shocks are vertically transmitted along the supply chain; the speed of transmission of such shocks; the symmetric or asymmetric nature of price transmission; the direction of price transmission in terms of whether shocks are transmitted upwards or downwards.

According to Meyer and Cramon-Taubadel [29], there are two main causes of asymmetries in vertical price transmission: imperfect competition (i.e., market power) and adjustment costs. Moreover, asymmetries in price transmission seem to be related to political interventions, asymmetric information and inventory management.

Bailey and Brorsen [31] argue that no *a priori* explanations arising from the degree of market power may help predicting the positive or negative nature of asymmetries in price transmission: several authors [32–36] conclude that market power may induce asymmetric transmission, with positive asymmetric price transmission being induced by monopolistic behavior (i.e., increases in input prices tend to squeeze marketing margins; moreover, decreases in output prices are likely to be transmitted faster and/or more completely than increases in output prices). Lately, McCorriston et al. and Lloyd et al. [37–39] develop a framework to show how market power may lead to imperfect price transmission. Indeed, also in oligopoly, both positive and negative asymmetric price transmission may occur. Summing up, the literature still lacks of a solid link between market power and asymmetry in price transmission [29].

Another major explanation for asymmetric price transmission (APT) is provided by asymmetric adjustment costs[2] arising when firms change the quantities and/or prices of inputs and/or outputs. Bailey and Brorsen [31] conclude that positive asymmetric price transmission may be induced by the easiness for firms facing output reduction to disemploy inputs rather than to augment production by recruiting new inputs. Differently, Ward [40] concludes that negative asymmetric price transmission is likely to occur in markets of perishable products: retailers tend to hesitate to raise prices as they fear potential reductions in sales due to wastes for spoilage. Heien [41] raises arguments against Ward's conclusions: he argues that changing prices is less problematic when dealing with perishable products rather when dealing with storable products in that the price adaptation for products with long shelf-life requires high time costs and losses of goodwill. Finally, Peltzman [42] finds no evidence of a relationship between menu costs and APT, which might rather depend by the presence of high menu costs supported in fragmented supply chains. The strategic management of inventories may help to adapt production to exogenous shocks: as a result, the managerial strategies on inventories have been mentioned as possible cause of asymmetric price transmission. Balke et al. [43] argue that accounting methods such as first-in-first-out may lead to asymmetric price transmission. Blinder [44] and Reagan and Weitzman [45] argue that inventory management leads to positive APT. In particular, Reagan and Weitzman suggest that in periods of low demand

[2]The adjustment costs are defined as costs associated with changing retail prices and subsequently adapting retail logistics, wholesale costs and sales (e.g., advertisement and relabeling costs, storage and volume discounts).

firms will adjust the quantity produced and increase inventory rather than decrease output prices, increasing prices during periods of high demand. In summary, also for adjustments costs, the conclusions are ambiguous and sometimes contradictory, with some authors providing arguments for positive, and others for negative APT.

Another aspect that merit attention is the potential impact of government interventions, in terms of producer subsidies. Gardner [15] concludes on their role in influencing the asymmetries in farm-to-retail price dynamics, and evidence on such a mechanism is provided in the diary sector [6, 46]. Bailey and Brorsen [31] conclude on the role of asymmetric information in determining APT and point out that asymmetries in price series data can result from a distorted price reporting process. Kinnucan and Forker [6] and Cramon-Taubadel [47] consider APT in the framework of the Gardner's marketing margin model: the price spread between farm and retail levels is due to demand changes at retail-level as well as to changes in supply at farm level. Assuming perfect competition and constant returns to scale, the model suggests that changes in demand at retail level may have a large influence on marketing margins with respect to changes in supply at farm level. Kinnucan and Forker [6] argue that the marketing margins induced by these shifts tend to provoke asymmetric price transmission; conversely, Cramon-Taubadel [47] concludes that positive or negative APT arises depending on the predominant shift.

In conclusion, although many studies found imperfect price transmission along the supply chain, there is not a clear consensus but rather a variety of evidences depending on commodities, countries and data under analysis. It seems evident that more research relationships among prices along the supply chain and the underlying behavior of agents are needed: Although a large number of studies have investigated the phenomenon of price transmission in agricultural markets, it is still not possible to draw strong conclusions to support policy decisions. Meyer and Cramon-Taubadel [29] are skeptical on the actual results provided by the literature unable to explain the economical relevance of evidence of imperfect price transmission. They suggest that it would be premature to draw far-reaching conclusions for theory and policy on the basis of work to date: their critic pertains either the commonly adopted tests to measure the transmission, still not fully reliable and precise in the statistical sense, and the theories capable to explain asymmetric price transmission.

More recently, there is been a renewed turmoil in the literature that leads to an increasing number of studies on vertical price transmission. First, Frey and Manera [48] reviewed the literature on econometric models of asymmetric price transmission, concluding that asymmetries are likely to occur in a wide range of markets. The authors deepen on the sets of models adopted to study asymmetries: autoregressive distributed lags, partial adjustments, error correction models, and vector autoregressive models. Clearly, more recent models are not surveyed in the mentioned study. For instance, Brummer et al. [49] adopt a Markov switching vector error correction model to investigate asymmetries in the wheat market. Hassouneh et al. [50] adopt a STAR model (smoothing transition autoregressive model) to conclude on vertical price transmission in the poultry sector.

Several other papers have instigated price dynamics along the supply chain: Acosta and Valdes [51] and Antonioli and Santeramo [52] explore price dynamics in diary markets; Santeramo and Cramon-Taubadel [53] focus on perishable food products; Tifaoui and Cramon-Taubadel

[54] investigate the dynamics in butter market. The list may be long and never exhaustive as more and more papers are published every year. A recent survey that is worth reading has been recently published by Swinnen and Vandeplas [55]: they deepen on conceptual issues in price transmission analyses of agricultural supply chains.

4. A focus on perishable markets

Marketing margins and vertical price transmission in fresh produce markets have been objects of studies due to the relevant policy implications deriving from such analyses (e.g., the assessment of the efficiency of the produce marketing system and/or of the functioning of markets both vertically and spatially separated), but nowadays, the literature still lacks of economic explanations for the peculiar results found for perishable products [56]. The present section briefly reviews the findings of recent studies.

Wohlgenant [14] estimated an econometric model to assess marketing margins dynamics in eight commodities sectors detecting symmetric dynamics, compatible with a competitive behavior, in all but fresh fruits sector, for which he found evidence of constant return to scale but not for competitive behavior. These findings have important implications for supply chain. In particular, the evidence of constant return to scale for perishable products (e.g., fruits) suggests that competitive behavior is impeded by perishability. In other terms, the fear of losing products due to waste for spoilage prevents the adoption of competitive pricing strategies along the supply chain.

As regard price transmission,[3] Ward [40] seminal work on vertical price transmission in perishable goods markets determined the supply chain ring primarily responsible for establishing price and also tested for pricing asymmetries. He found that the pricing point for fresh produce existed at the wholesale market level (price transmission runs from wholesale markets to retail and producer levels) and that price decreases were more likely to be fully passed on to the retail and producer level sectors than were price increases. As above mentioned, he argued that retailers selling perishable goods might be reluctant to raise prices in line with an increase in farm-level prices given the risk that they will be left with unsold spoiled product. Heien [41] raises different arguments and concludes that changing prices is less problematic when dealing with perishable products. Although the mentioned papers are dated, not many theoretical advances have been made, nor the controversial theories abovementioned have been clarified.

Girapunthong et al. [57] applied Ward's pricing asymmetry model to fresh tomatoes data: he found the prices at producer level influence price at wholesale and retail levels; he also argues that increases in producer prices have a major impact on wholesale prices than decreases in producer prices. The controversy results might be explained by the structural changes occurred in the market for fresh tomatoes, that is, by changes in the entire structure of the market (e.g., changes in amount of contracts, concentration of retailers and suppliers, etc.).

[3] A detailed review of major findings is provided in **Table 1**.

Author	Journal	Year	Product	Frequency	Results[a]
Aguiar and Santana	Agribusiness	2002	Tomatoes	Monthly	Positive asymmetry
			Onions	"	Symmetry
Bakucs et al.	Studies in Agricultural Economics	2007	Potatoes	Monthly	Symmetry
			Carrots	"	Symmetry
			Parsley	"	Symmetry
			Tomatoes	"	Positive asymmetry
			Peppers	"	Symmetry
Bernard and Willett	Journal of Agricultural and Applied Economics	1996	Broiler	Monthly	Negative asymmetry
Bernard and Willett	Applied Economics Letters	1998	Broiler	Weekly	Symmetry
			Broiler	Monthly	Positive asymmetry
Brooker et al.	Journal of Food Distribution Research	1997	Peppers	Weekly	Positive asymmetry
Hassan and Simioni	Économie Rurale	2004	Tomatoes	Weekly	Negative asymmetry
			Chicory	"	Negative asymmetry
Girapunthong et al.	Journal of Food Distribution Research	2003	Tomatoes	Monthly	Asymmetry[b]
Hassan and Simioni	Économie Rurale	2004	Chicory	Weekly	Symmetry
			Tomatoes	"	Symmetry
Heien	American Journal of Agricultural Economics	1980	Potatoes	Monthly	Positive asymmetry
			Apples	"	Symmetry
			Oranges	"	Negative asymmetry
			Lettuce	"	Symmetry
			Tomatoes	"	Symmetry
Kuiper and Lansink	Agri Business	2013	Broiler	Monthly	Positive asymmetry
			Apples	Monthly	Symmetry
			Carrots	"	Symmetry
			Potatoes	"	Symmetry
Pick et al.	Agri Business	1990	Lemons	Weekly	Positive asymmetry[c]
			Oranges	"	Positive asymmetry[c]
Powers	Agri Business	1995	Lettuce	Weekly	Positive asymmetry
Schertz Willet et al.	Agri Business	1997	Apples	Monthly	Positive asymmetry

Author	Journal	Year	Product	Frequency	Results[a]
Ward	American Journal of Agricultural Economics	1982	Carrots	Monthly	Symmetry
			Celery	"	Negative asymmetry
			Cabbage	"	Negative asymmetry
			Cucumbers	"	Symmetry
			Peppers	"	Negative asymmetry
			Potatoes	"	Negative asymmetry
			Tomatoes	"	Negative asymmetry
Worth	Economic Research Service	1999	Carrots	Monthly	Positive asymmetry
			Celery	"	Symmetry
			Lettuce	"	Symmetry
			Onions	"	Symmetry
			Potatoes	"	Symmetry
			Tomatoes	"	Positive asymmetry

[a]Results on symmetry, positive and negative asymmetry depend on time frequency.

[b]Positive asymmetry among wholesaler and retailer prices; negative asymmetry among wholesaler and producer prices.

[c]However, over time price changes appear to be symmetric.

Table 1. –Major findings in applied analyses of vertical price transmission in perishable markets.

Sexton et al. [58] completed a study to analyze grocery retailer behavior concluded that there is considerable independence in retailers in setting prices for produce commodities and that higher volumes led to larger margins. Similarly, Girapunthong et al. [57] found that the retail price is more likely to change after increases in producer prices than after decreases in producer prices. According to Sexton et al. [58], retailers have been more aggressive in using their market power to influence prices paid to producers for product (e.g., higher volumes of product in the market are used to bid down producer prices without equal declines in retail prices, widening the farm-to-retail margin), and many shippers tried to counter the market power exercised by large retailers consolidating their businesses with firms located in several areas of production.

Recently, Santeramo and Cramon-Taubadel [53] show that vertical price transmission is symmetric for products not affected by large losses for spoilage and tends to be asymmetric for very perishable products. Their results are in line with numerous studies [40, 42, 46] and in contrast with the results presented by Kim and Ward [59]. In addition, Santeramo [7] concludes that, in markets of perishable products, price rises tend to be slowly transmitted and do not influence distant markets; on the contrary, shocks originated by price decreases spread across markets. The results are in line with Ward [40] who has demonstrated that the high perishability, and the inability to delay sales through temporary storage implies that decreases in wholesale prices have a larger effect on retail prices than increases.

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5. Conclusions

The interest on prices dynamics in perishable markets has rapidly increased during last decades due to the implications that studies on these topics may have on the understanding of agricultural markets and of entrepreneurial strategies. Prices along the supply chain are linked by long-run relationships and tend to differ by the marketing costs. Despite the simplicity of this statement, market movements, entrepreneurial strategies, physical constraints and biological dynamics make price dynamics along the supply chain quite complicate. An aspect of particular interest is the perishability of the products in that it may influence sellers' strategies, consumers' perceptions, and thus policymakers' attention to a market.

We reviewed the literature on perishable food markets, and, in particular, we deepened on research undertaken to understand how marketing margins evolve and how vertical price transmission works, especially in perishable goods markets.

Based on our review, we try to conclude on lessons for the values chain. First, marketing margins are an important indicator of how welfare effects are distributed along the value chain. Their dynamics are also a good indicator of the functioning of the supply chain. By reviewing dated and recent studies, we conclude that price spreads along the supply chain are largely influenced by the perishability of the products, characteristics that must be taken into account in analytical analyses. In particular, there is a consensus that marketing margins of perishable products evolve and react differently to price shocks with respect to the marketing margins observed along the supply chains on storable produce. In particular, the wastes due to spoilage and the difficulty of managing inventories complicated reduce the incentive for strategical behavior. In addition, along the supply chain of perishable products, price rises are slowly transmitted and not transmitted to distant markets. To the extent that managers and policymakers intend to forecast price dynamics along the supply chain, and react in a strategic way, it is clear that their horizon should not be long: the dynamics affecting supply chains of perishable products in distant markets are not influential and should not be considered with much care. Differently, the degree of perishability and the logistic plays a significant role in determining how prices evolve along the value chain.

The literature falls short on several practical aspects that deserve further attention. For instance, it is still under-investigated if and how reducing spoilage influence price dynamics along the supply chain. Put differently, is it the loss for spoilage that influences price dynamics, or is it the risk of wastes that induce economic agents to behave differently? Moreover, how market concentration at different stage interacts with the perishability has not been investigated. We acknowledge that is not an easy task: to the extent that no solid frameworks exist to study market power, nor spoilage due to perishability, understanding how the two phenomena interact is a very challenging task. Yet, the impossibility to disentangle the effects raises doubts on any conclusions may be provided by the literature on price dynamics in perishable markets. Theoretical studies are in limited number [60]: a large effort in this direction is required.

Lastly, further aspects that merit attention are the potential impacts that price regulation has on transversal price dynamics (i.e., horizontal and vertical price dynamics). Few studies have analyzed these issues [61–63], and further investigation is needed.

A good note should close the present chapter: Although large gaps impede strong conclusions on how price evolves along the value chain of perishable products, the increasing availability of high frequency data (weekly and daily) should encourage researchers to deepen on the unresolved issues. Research on price dynamics in perishable markets is likely to become very relevant in the next future.

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