Price dispersion, search costs and consumers and sellers heterogeneity in retail food markets

Giovanni Anania
(University of Calabria, Italy; ganania@unical.it)

and

Rosanna Nisticò
(University of Calabria, Italy; r.nistico@unical.it)

Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012.

Price dispersion, search costs and consumers and sellers heterogeneity in retail food markets

Giovanni Anania (University of Calabria, Italy)

and

Rosanna Nisticò (University of Calabria, Italy)

Abstract

Price dispersion, i.e. a homogeneous product being sold at different prices by different sellers, is among the most replicated findings in empirical economics. The paper assesses the extent and determinants of spatial price dispersion for 14 perfectly homogeneous food products in more than 400 retailers in a market characterized by the persistence of a large number of relatively small traditional food stores, side by side large supermarkets. The extent of observed price dispersion is quite high, suggesting that monopolistic competition prevails as a result of the heterogeneity of consumers and services offered. When prices in an urban area (where the spatial concentration of sellers is much higher and consumer search costs significantly lower) are compared with those in smaller towns and rural areas, differences in search costs and the potentially higher degree of competition do not yield lower prices; quite the contrary, they are, on average, higher in the urban area for 11 of the 14 products considered. Supermarkets proved to be often, but not always, less expensive than traditional retailers, although average savings from food shopping at supermarkets were extremely low. Finally, the results of the study suggest that retailers have different pricing strategies; these differences emerge both at the firm level and for supermarkets within the same chain. The results presented in the paper suggest that what is important in explaining price dispersion is the contemporaneous heterogeneity of retailers (in terms of services) and consumers (in terms of search and shopping preferences), which makes it possible for a monopolistic competition structure of the market to emerge and for small traditional food retailers to remain in business.

Keywords: price dispersion, retail pricing, food markets.

JEL classification: L81; D83; D43; Q13.

Acknowledgements

We wish to thank Alberto Pozzolo for useful comments on an earlier version of this paper and Simone Lo Scalzo for the excellent research assistance he provided in the statistical analysis of the data.

Price dispersion, search costs and consumers and sellers heterogeneity in retail food markets

1. Introduction

In recent years linkages among different agents along food chains have received growing attention, both from research and in policy debates. In increasingly globalized food markets, the relations between one element of the chain and the others are often imperfectly competitive, opening the possibility for the exercise of market power, with direct implications for the incomes of the weakest actors along the chain, most often located at its opposite ends, small-scale producers and consumers. This paper aims at contributing to the understanding of the functioning of food chains by addressing a specific element of their final stages, that between retailers and final consumers. In particular, the paper addresses pricing strategies by food retailers by assessing the extent and determinants of price dispersion, i.e. the fact that at any given time on a specific market the same product is often offered and sold at different prices.

The existence of price dispersion, even for homogeneous products, is among the most replicated findings in empirical economics. After Stigler's (1961) seminal paper, a rich literature flourished, both theoretical and empirical, analyzing the causes and consequences of such "ubiquitous" price dispersion.[1] Stigler considers price dispersion as a measure of ignorance of the market: nobody can possibly know all the prices quoted by different sellers at any given time, and consumers who wish to ascertain the lowest price must do a search that involves a cost. Most of the literature expanding on Stigler's theory focuses on models where differences in search and production costs are the factors generating the dispersion. Examples include Burdett and Judd (1983), Carlson and McAfee (1983), Salop (1977), Salop and Stiglitz (1977), Stahl (1989) and Waldeck (2008). Other contributions consider price dispersion as endogenously generated, resulting from the randomized behavior adopted by identical firms (Varian, 1980) and consumers (Butters, 1977; Salop and Stiglitz, 1982; Burdett and Jude, 1983). This literature contemplates different types of consumer search strategies involving different costs to collect information: "fixed sample size", "sequential" consumer searches and "information clearinghouse" approaches.[2] However, research has systematically confirmed that significant price dispersion should be expected even if search costs can be assumed to be very low. Varian (1980) distinguishes between "spatial" price dispersion – i.e. different stores contemporaneously offering identical items at different prices - and "temporal"

---

[1] Baye *et al.* (2006) provide a survey of the theoretical and empirical literature on price dispersion.

[2] "Information clearinghouse" is a term used to indicate both newspapers and internet price comparison websites (Baye *et al.*, 2006).

price dispersion – i.e. stores varying their selling price for a given commodity over time, for example by means of promotional sales. Empirical evidence of spatial price dispersion has been found in virtually all markets which have been investigated, including automobiles (Dahlby and West, 1986), air travel (Borenstein and Rose, 1994; Gerardi and Shapiro, 2009), services (Pratt *et al.*, 1979), gasoline and products sold in gas station stores (Adams, 1997; Barron *et al.*, 2004; Lewis, 2008), books and CDs (Ancarani and Shankar, 2004; Brynjolfsson and Smith, 2000; Clay *et al.,* 1999 and 2001), scanners and digital cameras (Baylis and Perloff, 2002; Haynes and Thompson, 2008), and prescription drugs (Sorensen, 2000).

Several studies addressed the extent and determinants of price dispersion with specific reference to food products, as we refer in section 2, but, to the best of our knowledge, this study is the only one conducted in a developed country market characterized by the strong persistence of traditional food retailers (i.e. small shops often specializing in selling one specific category of food product only, such as bread, fresh fruit and vegetables, fish, meat, etc) side by side with large supermarkets. The only three studies we found addressing price dispersion for food products in Europe (Bahadir-Lust *et al.,* 2007; Lloyd *et al.,* 2009; Griffith *et al.*, 2009) all consider retailers belonging to a supermarket chain.

In addition to measuring the extent of price dispersion in food markets, this paper attempts to answer several questions related to its determinants, including: How relevant are promotional sales in explaining spatial price dispersion? How important is seller heterogeneity in explaining price dispersion, i.e. are consumer prices higher in traditional food retailers than in supermarkets? Is price dispersion greater in supermarkets than in traditional small stores? Is price dispersion within each supermarket chain smaller than between all supermarkets? Are prices and price dispersion higher in smaller towns and rural communities, where search costs can be assumed to be higher, than in urban settings? Do low/high price setters remain so over time?

We believe the results of our study address a relatively less investigated aspect of food markets and may be relevant for a better understanding of the implications for consumers of changes occurring along the food chain.

The paper is organized as follows: the next section provides an overview of relevant empirical contributions assessing the extent and determinants of price dispersion in food retail markets; section three presents the results of our study and section four concludes by discussing their implications and significance.

2. Price dispersion in food retail markets

Empirical research has found significant price dispersion in food retail markets. Ambrose (1979) analyzed prices for 54 grocery products in 6 small independent stores, 4 large independent stores and in 4 stores belonging to a chain, located in inner city, suburban and rural areas in Nebraska. He found prices to be higher in small independent stores and in stores located in rural areas. Leibtag *et al*. (2010) use Nielsen Homescan data to analyze food purchases by about 40,000 US households over the 2004-06 time period. They find prices in nontraditional discount food retailers (stores such as Wal-Mart, Costco, and Family Dollar) lower than in traditional supermarkets for 82% of the products (having controlled for differences in brand and package size); expenditure weighted average prices are 7.5% lower in nontraditional food stores. When the analysis is disaggregated at the market level, price differences become smaller as the share of nontraditional discount food retailers increases. Lloyd *et al*. (2009) use a very detailed data base of weekly observed prices of over 1,700 grocery products sold in the seven largest retail chains in the UK to address the role of promotional sales in price variability over time. They conclude that the influence of promotional sales on price variation across the chains is modest, explaining at most 29 percent of price variability. Significant price dispersion across the seven chains considered emerges from the study; even after excluding discount sales, the average difference in the prices of products carrying the same bar code is about 25 percent. Griffith *et al*. (2009) use information on food purchases by 25,000 families in Great Britain over the 2006 calendar year to analyze four dimensions of their buying behaviors aimed at containing spending: purchasing products offered at discounted prices, generic brands, and in bulk, and choosing where to buy. They show that potential and actual savings from these four sources are significant. In Israel Lach (2002) found price dispersion for four products (three of them food items: frozen chicken, coffee and flour) to be significant and to persist even after controlling for unobserved product heterogeneity. Temporal price dispersion within stores was significant; over the length (48 months) of the sample period most stores were observed to post the lowest and the highest price. Stores moving up and down the cross sectional price distribution implies that consumers cannot learn which stores consistently post lower prices; this is a condition for price dispersion to persist. Pesendorfer (2002) analyzes prices of two market leader ketchups in 21 supermarkets in Springfield, Missouri over a two year period. Prices of Heinz and Hunt's 32 ounce bottles both show substantial price dispersion on a given day, with the lowest price being about 30 percent below the average one. Sexton *et al*. (2003) address retailer behavior in procurement and sale by 20 grocery chains in six U.S. metropolitan markets focusing on fresh produce (iceberg lettuce, fresh tomatoes and bagged salads). They conclude that retailers do exert oligopoly power in setting prices, but not to the full extent available to them as a result of geographical dispersion, brand differentiation and inelastic consumer demands. Hosken and Reiffen (2004) consider monthly prices of 20 food products in 30 U.S. metropolitan areas for up to 5 years. They conclude that grocery products typically have a “regular” price and stay at that price at least 50% of the time, most of the deviations from the regular price are downward and promotional sales account for 20 to 50 percent of observed annual price variability. Bahadir-Lust *et al.* (2007) analyze data over a 43-week period for 10 food products sold by grocery stores in Germany in order to test whether the location of a store on the price distribution curve changes over time. Their results show remarkable differences in posted prices over time and across stores, even after controlling for their heterogeneity, which accounts for 30% of observed price dispersion. Berck *et al.* (2008) use grocery scanner data from 174 stores in the US to determine the role of food perishability on sales patterns. Hong *et al.* (2002) collected weekly data on prices and quantities for 10 branded grocery products, including food products, sold in a single store in Texas finding negative serial correlation of prices and quantities. Devine and Marion (1979) conducted an experiment by providing through daily newspapers for five weeks consumers in the Ottawa-Hull area with information on prices for sixty-five food products in twenty-six local stores. When compared with price developments in a control area, the provision of consumers with low cost information on prices induced a decline of the level and dispersion of an aggregate price index across stores as well as within chains.

Contrary to expectations, price dispersion is not observed across retailers only, but within stores as well. Quantity surcharges, i.e. the per unit price of a brand’s larger package being higher (rather than lower) than the per unit price of the same brand’s smaller package, occurs frequently. Sprott *et al.* (2003) cite research which found quantity surcharges in 16 to 34 percent of grocery supermarket brand products available in more than one package size.

3. Results

The analysis is based on the results of a survey of retail prices for 14 perfectly homogeneous food items in 437 stores located in towns of different demographic sizes in Calabria, a region in Southern Italy. The survey was conducted between April 8 and 11, 2010 by university students under the direct supervision of the authors. The description of the 14 food items is given in table 1; they are all processed products, well known to consumers, univocally identified by their brand, packaging and volume/size. Unlike other studies that also analyze price dispersion for food products in Europe (Bahadir-Lust *et al.,* 2007; Lloyd *et al.,* 2009; Griffith *et al.*, 2009), the stores in our survey do not all belong to a supermarket chain, whereas we consider different typologies of sellers (supermarkets and traditional food stores). Furthermore, we compare price dispersion across and within stores in an urban area, where seller density is higher and search costs lower, with those in smaller towns and rural areas.

Our sample covers 10% of the 4,350 food retail stores operating in Calabria in 2001, at the time of the most recent Italian Census of Manufacture and Services.[3] 57% of the stores in the sample are supermarkets (including very large ones, sometimes referred to as “hypermarkets”), the remaining 43% are traditional retail stores. Small traditional retailers (specialized food shops in which the seller handles most of the items) are 26% of the stores in the sample, while 17% are “superettes” (relatively small shops in which buyers have the freedom to pick most of the items from the shelves). Supermarkets are over-represented in the sample with respect to their share in the 2001 census (5.1%), and traditional retail stores under-represented.

In total, 4,149 prices are used in the analysis; the number varies between 193 (MILKTDM) and 386 (NUTELLA), as not all products were sold in every retail store (table 2).

3.1 How much price dispersion?

Based on the specific characteristics of the products - perfectly homogeneous, well known to consumers and frequently purchased - and markets – with relatively low search costs, because of the high number of sellers - considered in this study, one would expect a relatively low level of spatial price dispersion. However, empirical research conducted in contexts very different from the one analyzed here has found food products being characterized by a significant degree of price dispersion.

The results of our survey for the entire sample are presented in table 2. The ratio between the maximum and minimum prices for the 14 products ranges between 1.45 (MILKGRA) and 2.96 (SPAGBAR) and exceeds 2 for 7 out of the 14 products. The significantly lower price dispersion for MILKGRA is due to the fact that during the week of the survey the manufacturer distributed it with a “suggested” promotional retail price clearly displayed on the label (figure 1); in fact, the “suggested” sale price was the observed retail price in 294 out of the 353 stores selling that specific brand of milk.

The coefficient of variation - which provides a measure of variability independent of the magnitude of the price and, as a result, is directly comparable across products - varies between 4.8% (MILKGRA) and 23.5% (YOGDAN); it exceeds 10% in 11 cases (table 2).

From the results of our survey we can conclude that the extent of the observed spatial price dispersion is fairly large. Our results appear to be of the same order of magnitude as those reported

[3] Because of the historical trend towards a rapid reduction of food stores, it is reasonable to assume that the coverage of the population of active retail stores in 2010 was significantly larger than 10%.

for a range of different food products in Altroconsumo (2010), Baye *et al.* (2006; table 1, pp. 325-330), Degeratu *et al.* (2000), Lach (2002) and Pesendorfer (2002).

Price dispersion and its variability around the trend both tend to decline as the average price of the food item increases (figure 2); this is likely the result of two interlinked reasons: as the average price increases, the same coefficient of variation stems from wider absolute differences in prices, which become more easily detectable by consumers and, most important, more significant in terms of their effect on consumer expenditure, increasing their willingness to search. In other words, seller pricing decisions appear to assume consumers are more concerned with absolute differences in prices than percentage ones.[4]

If instead of analyzing the dispersion of the price of each product, the dispersion of the cost of the "basket" constituted by one unit of each of the 14 products analyzed is considered, dispersion drops significantly, signalling that retail stores strategically price the products they sell, choosing at any given time to price some of them below, and others above the average (table 3). This is consistent with a strategy aimed at making it difficult for consumers to identify which stores are systematically selling at prices above average (because they would then decide to shop elsewhere) and, at the same time, setting a large number of prices at or above average (in order to generate the expected returns). These results are in line with McAfee (1995), who suggests that prices across goods tend to be negatively correlated, i.e. firms offering some goods at high prices will tend to offer others at low prices. As argued by Bahadir-Lust *et al.* (2007), if one store provides better services it should post higher prices for all products in comparison with other stores. Hence, a negative correlation across products suggests that price dispersion cannot be explained by store heterogeneity only. A number of authors (Bahadir-Lust *et al.*, 2007; Gerardi and Shapiro, 2009; Haynes and Thompson, 2008; Lewis, 2008; Sorensen, 2000) use fixed effects in order to detect price differences resulting from seller heterogeneity. All these studies confirm that significant price dispersion still emerges even after controlling for store differences.

There are only 15 retail stores in our sample selling all 14 items. If the analysis is extended to the sub-samples of retail stores selling the same basket of 13, 12, 11 and 10 products, choosing in all instances the set of products which maximizes the number of retail stores selling them, the ratios between the maximum and minimum cost of the basket vary between 1.15 and 1.21, while coefficients of variation remain for all 5 baskets below 5% (table 3).

[4] A slightly negative relation between the coefficient of variation and the price of the products and services considered has been found also by Lach (2002) and Pratt *et al.* (1979).

3.2 How relevant are promotional sales in explaining spatial price dispersion?

One of the factors which can explain price dispersion are promotional sales, which retailers, most often supermarkets, use to attract new customers and/or retain current ones. Several theoretical models account for price dispersion in the presence of promotional sales (Burdett and Judd, 1983; Butters, 1977; McAfee, 1994 and 1995; Robert and Stahl, 1993; Varian, 1980). Hong *et al.* (2002) account for price dispersion in the presence of promotional sales of storable goods, which consumers can stock up when prices are low. Following a promotional sale the more price-sensitive consumers are out-of-the market and firms will raise the price in order to extract maximum revenue from the price-insensitive consumers. One important result of the model is that when consumer inventories are high, the monopoly price will be charged, while when inventories are low firms will price more competitively in order to attract the more price-sensitive consumers. Hosken and Reiffen (2004) and Lloyd *et al.* (2009) test empirically the results implied by some of these models in food markets. In Hosken and Reiffen (2004) sales account for a larger percentage (20% to 50%) of annual price variations. Lloyd *et al.* (2009) analyzed average prices in 7 main food retail chains in the UK over three years to conclude that sales have a significant but relatively modest role, smaller than that played by the retailer, in explaining price dispersion; overall sales explain 13% of price variability, with percentages for individual food product aggregates varying between 2% and 29%.

12 out of the 14 products considered in our research were at the time of the survey on promotional sale in at least one of the stores; in fact, the number of stores offering the products considered as a promotional sale varies between 0 (MILKTDM and SPAGVOI) and 294 (MILKGRA). If we exclude MILKGRA, in 49 of the 437 retail stores at least one of the remaining 13 products was offered on a promotional sale; in 18 of them there were at least two on special offer. The largest number of stores offering the product “on sale” is observed for MILKPARM (24) and YOGDAN (22). Surprisingly enough, only in 5 cases was the lowest of the prices advertised as a special promotional sale the minimum observed price for that product; most often (in 7 cases out of 12) there were few retail stores selling the same item at a price below the minimum observed “on sale” price without highlighting that price as being a special offer. This seems to suggest either a sophisticated pricing strategy, where the firm is offering a low price without advertising it because it is targeting the very price-sensitive consumers only, or a bounded rationality framework for the behaviour of at least some of the firms. If MILKGRA is excluded from the analysis, a positive linkage exists between the percentage of stores selling that product as a promotional sale and the coefficient of variation of the price of the same product. On the contrary, if MILKGRA is included, clear evidence emerges for a linkage in the opposite direction. We thus conclude that promotional

sales, if driven by a market-wide promotion by the producer have a lowering effect on price dispersion, while the contrary is true if they are the result of decisions taken at the retail firm level.

3.3 Are consumer prices higher in supermarkets than in traditional food retailers?

A specific characteristic of the market which is the focus of this study is the significant persistence of a large number of traditional, relatively small, food retailers. Because of their higher acquisition prices and, likely, operational costs with respect to those of supermarkets, traditional stores are expected to show higher retail prices. To a certain extent our survey confirms this expectation: shopping at supermarkets is often, though not always, cheaper than in traditional stores (table 4). The highest price is observed in a traditional store for 6 out of the 14 products and in a supermarket for 2 products (the maximum price is the same in the two groups of stores for the remaining 6 products). Supermarkets show the lowest observed price for 8 of the 14 products; for three products this is the case for traditional stores, while in the remaining three the minimum price in the two groups of stores is the same. The average price is lower in supermarkets for 11 products, but two products are cheaper, on average, in traditional retail stores.[5]

The statistical significance of the difference between average prices in supermarkets and traditional retail stores has been tested by estimating by OLS two very simple linear models:

$$\boldsymbol{\pi}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \delta_j\, \mathbf{x}^j_{ir} + \alpha\, \mathbf{w}_{ir} + \varepsilon_{ir} \qquad (1)$$

where $\boldsymbol{\pi}_{ir}$ is the price of the r-th product (r = 1, 2, …, 14) in the i-th store divided by the average price of the same product across all stores carrying it; $\mathbf{x}^j_{ir}$ is a dummy variable which equals 1 if $j = r$; and $\mathbf{w}_{ir}$ is a dummy variable which equals 1 if the store is a supermarket, 0 if it is a traditional retailer; and

$$\mathbf{P}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \gamma_j\, \mathbf{x}^j_{ir} + \Sigma_{j=1,2,\ldots,14}\, \beta_j\, \mathbf{z}^j_{ir} + \varepsilon_{ir} \qquad (2)$$

where $\mathbf{P}_{ir}$ is the price of the r-th product in the i-th store; and $\mathbf{z}^j_{ir}$ is a dummy variable which equals 1 if $j = r$ and the store is a supermarket, 0 otherwise. δ_j, α, γ_j and β_j are the parameters to be estimated and ε_{ir} are the error terms (results are shown in table 5).

Model (1) allows us to assess the difference in prices in supermarkets and traditional retail stores jointly for all 14 products, while model (2) does the same on a product by product basis.

When considered jointly, prices in supermarkets are, on average, lower than in traditional food stores by 3.9% and the difference is statistically significant at the 1% confidence level. The

[5] Ambrose (1979) found grocery prices to be, on average, lower in chain stores than in independent ones, and in large independent stores lower than in small ones.

estimated values of γ_j and β_j in equation (2) are nothing but the average price of the j-th product in traditional retail stores, and the difference between the average price of the j-th product in supermarkets and in traditional retail stores, respectively. The tests show that, for 8 out of the 14 products, the average price in the supermarkets was statistically significantly lower than that in traditional retail stores (in 5 cases at the 99% confidence level, in one case at the 95% confidence level and in the remaining 2 cases at the 90% level), while the contrary never happens, since in the other 6 cases the two average prices turn out not statistically different.

Table 6 allows us to compare the cost of baskets of products, instead of considering them individually. Traditional retail stores, being much smaller in size, tend to offer a lower number of references than supermarkets; in fact, no traditional retail store carries all 14 food items, only two sell the full set but MILKTDM, and the most common basket of 10 products (that obtained by excluding MILKTDM, BABYFPLA, SPAGVOI and COFFEELAV) is sold by 10 traditional stores only. Nevertheless, the information in table 6 provides useful indications, complementing those which emerged when products were considered individually. The lowest cost of each basket is always found in a supermarket, but the same is also true for the highest cost. Beside the 13 products basket, which is sold by two traditional retail stores only, the average cost of the baskets considered is always lower in supermarkets, although average savings are relatively small (between 1.7% and 2.5% of total expenditure).

Another interesting aspect is the pricing behaviours of stores that are parts of the same chain. Most consumers, especially those who devote relatively little effort to finding the cheapest store to do their food shopping, tend to believe supermarkets belonging to the same chain offer identical, or very similar, prices. According to theory however, it should be otherwise, as this would imply that retail stores belonging to certain chains could be identified a priori as being cheaper than those belonging to certain other chains.[6] To address this point we calculated price dispersion in supermarkets belonging to the 11 chains which in our sample have at least 6 stores; this means considering 159 supermarkets out of the 249 covered by the survey. When average prices in each of the chains are compared with average prices across all supermarkets in the sample one finds out that no chain shows a lower (or a higher) than average price for all 14 items. The number of products offered at a higher than average price varies among the 11 chains between 4 and 12. However, the number of products sold at above or below average prices in a certain chain, alone, does not provide enough information to assess the advantage of shopping in that specific chain. Figure 3 gives the

[6] Varian (1980) argues that spatial price dispersion may exist only if temporal price dispersion occurs. In fact, with temporal price dispersion consumers are unable to learn from experience which stores systematically charge low prices, and spatial price dispersion would be unlikely to persist if consumers could learn from experience which firms charge low prices.

ratio between the average total cost of the basket of the 14 products in each chain of stores and the average cost of the same basket calculated for all supermarkets in the sample, and the number of products sold in the same chain at above average prices. A positive link between the two variables emerge. Yet this relationship appears not to be a general rule. In fact, one of the chains with the largest number of items (11 out of 14) sold at a price above the average shows an average expenditure for the 14 products which is 2% below the average expenditure calculated across all supermarkets (SISA), and the largest average savings (6%) occur in a chain where 6 of the 14 products are sold at an above average price (STANDA). This suggests that different chains use different strategies in their pricing decisions, and that at least some of those pricing a relatively large number of food items above average have other food items priced well below average, or, to put it differently, that chains offering (truly advantageous) promotional sales are, at the same time, often selling many other items at not-so-advantageous prices. This is consistent with the conclusions reached in Griffith *et al.* (2009, pp. 111-112), who found Tesco to be the supermarket chain where consumers saved the most, but, at the same time, 79 out of the 189 product groups considered were sold at above average prices.

Finally, it would be reasonable to expect price dispersion within supermarkets belonging to the same chain to be less than that observed across all supermarkets. The results of our survey, however, suggest that this is not necessarily the case. In fact, for 34% of the prices of the 14 products sold in the 11 supermarket chains with at least 6 stores in our sample, the coefficient of variation calculated for the stores belonging to the same chain is larger than the one calculated considering all supermarkets.

3.4 Is price dispersion larger within supermarkets than within traditional food retailers?

Since supermarkets can be assumed to engage in more sophisticated pricing strategies than traditional retail stores, one would expect to find higher price dispersion among the former. However, this does not seem to be the case; in fact, the coefficients of variation of prices are higher in traditional retail stores for 10 of the 14 products and lower for three (in one case, BEERPERO, the two groups of stores show the same value of the coefficient) (table 4). Furthermore, wider price dispersion is not systematically associated to products for which stores show higher average retail prices; in fact, this is the case only for 7 products, while in 5 cases the group of stores showing the highest coefficient of variation is the one with the lowest average price (table 4).

The opposite result emerges when the coefficients of variation for the cost of the baskets considered in table 6 are compared. The higher dispersion of the cost of the baskets observed in supermarkets is not in contradiction with the lower dispersion observed in the same group of stores for individual prices, as it may be the result of more careful pricing. However, the small number of traditional retail stores selling the four baskets considered in the analysis suggests we should be cautious when drawing conclusions on the differences in the variability between the two groups.

In general, price dispersion for individual products in supermarkets and traditional food retailers appears relatively close to that observed for the entire sample. What remains to be seen is whether the determinants of price dispersions are the same in supermarkets and traditional food retailers, or if the similar price dispersion observed is the result of different factors/behaviours in the two groups of stores.

3.5 Are prices and price dispersion higher in smaller and rural communities than in urban settings?

In an urban setting, because of the greater density of retailers, consumer search costs are definitely lower. Hence, one can expect both lower prices and lower price dispersion. However, literature results on the effects of competition on price dispersion are not conclusive.[7]

Ambrose (1979) compared grocery prices in retail stores located in inner city, suburban and rural areas. His results show higher prices in retail stores located in rural areas, followed by those in suburban and inner city areas, respectively.

In table 7 prices and price dispersion in the stores located in the Cosenza-Rende urban area are compared with those in the rest of the sample, where most stores are located in smaller towns and rural areas. 118 (27%) of the 437 retail stores in the sample fall in the urban area; the share of supermarkets in the two groups is practically the same (58% for the urban area, 56% in the rest of the sample). Average prices in the urban area are not systematically lower than those in smaller towns and rural areas. On the contrary, for 11 of the 14 products the average price is higher in the urban area. In table 8 the results obtained by estimating by OLS the following four simple models are presented:

$$\boldsymbol{\pi}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \delta_j\, \mathbf{x}^j_{ir} + \eta\, \mathbf{k}_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (3)$$

[7] Carlson and McAfee (1983) develop an equilibrium price dispersion model showing that as the number of firms increases the variance of prices rises. In Stahl (1989), firm entries do not lead to a competitive outcome, the reason here being that, as the number of stores increases, the probability of any one of them being the lowest-priced store decreases, thus reducing the incentive for lowering the price. Janssen and Moraga-Gonzales (2004) present an oligopoly model where some consumers search costlessly. They prove that the expected price does not necessarily increase in the number of firms, but rather it depends on the different degrees (low, medium or high) of search intensity. However, as the number of firms tends to infinity the expected price increases, except in the case of low search intensity. Waldeck (2008) extends the model proposed by Stahl (1989) and shows how, as the proportion of informed consumers rises, the mean price increases, while price dispersion exhibits a reverse U-shaped pattern. This approaches zero when search intensity is very low, then it increases as search increases, and eventually falls when the proportion of informed consumers approaches one. Another strand of papers maintains, on the contrary, the existence of a positive relationship between price dispersion and competitive intensity, including the classical paper by Borenstein and Rose (1994) and Anderson and de Palma (2005).

$$\boldsymbol{\pi}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \delta_j\, \mathbf{x}^j_{ir} + \alpha\, \mathbf{w}_{ir} + \eta\, \mathbf{k}_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (4)$$

$$\mathbf{P}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \gamma_j\, \mathbf{x}^j_{ir} + \Sigma_{j=1,2,\ldots,14}\, \varphi_j\, \mathbf{s}^j_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (5)$$

$$\mathbf{P}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \gamma_j\, \mathbf{x}^j_{ir} + \Sigma_{j=1,2,\ldots,14}\, \varphi_j\, \mathbf{s}^j_{ir} + \Sigma_{j=1,2,\ldots,14}\, \beta_j\, \mathbf{z}^j_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (6)$$

where $\mathbf{k}_{ir}$ is a dummy variable which equals 1 if the store is located in the Cosenza-Rende urban area, 0 otherwise; $\mathbf{s}^j_{ir}$ is a dummy variable which equals 1 if j = r and the store is located in the Cosenza-Rende urban area, 0 otherwise; δ_j , α, η, γ_j , φ_j and β_j are the parameters to be estimated; and $\boldsymbol{\varepsilon}_{ir}$ are the error terms.

When the effect on all products jointly is considered (Model 3), prices in the urban area are higher than those in smaller towns and rural areas by 1.2% (this difference is statistically significant at the 99% confidence level). In fact, at average prices, the basket of the 14 products in the food retail stores located in the urban area is 1.6% more expensive than in the rest of the region (it costs €30.61 vs. €30.14). When differences due to the type of store (supermarket/traditional food store) are controlled for (Model 4) prices in the urban area are 1.3% higher than in smaller towns and rural areas. If the effect on individual products is estimated (Model 5) prices are higher in the urban area for 11 of the 14 products, and for 4 the difference is statistically significant, although for one of them at 10% level only. On the contrary, prices are lower in the rural area for three products, only one of which at a statistically significant level (99%). Similar results emerge when price differences due to the type of store are controlled for (Model 6).

Price dispersion measured by the coefficients of variation, on the contrary, is lower in the urban area for 9 of the 14 food products considered (table 7). Observed differences in price dispersion in the urban areas *vis a vis* smaller towns and rural areas are, in some cases, quite marked.

These results suggest that, while the greater density of sellers in the urban area definitely does not translate into increased price competition among retailers and lower prices, it does yield lower price dispersion.[8] This means that differences in search costs across markets may have a limited

[8] A negative relationship between price dispersion and seller density is also found by Barron *et al.* (2004) for the gasoline retail market. Lewis (2008) agrees with these results when considering the gasoline retail sector as a whole. On the contrary, when the market is split in two typologies of sellers - one consisting of stations belonging to the premium brand group and one grouping discount brands and independent (unbranded) stations - his estimates confirm the negative relationship for the group of discount and unbranded stations, but an insignificant, or weakly positive, relationship emerges for the premium brand sellers. Moreover, when price dispersion is measured for stations in the same area, rather than for the city as a whole, the relationship with station density for premium brand sellers becomes strongly positive. Similarly, in the Gerardi and Shapiro (2009) study on the airline industry, competition has a negative effect on price dispersion. However, when they distinguish between routes characterized by relatively heterogeneous elasticities of demand and routes with a homogeneous customer base, the negative effect is more pronounced for the former. Tang *et al.* (2010) test empirically if price dispersion is inverse U-shaped in the proportion of informed

impact on the level of prices, while in the presence of lower search costs sellers seem to be more careful in limiting price dispersion, which their customers may detect more easily. Our results are consistent with the model proposed by Waldeck (2008), where the mean price in a market for a homogeneous good turns out to be an increasing function of the search intensity (i.e. the proportion of informed consumers). Moreover, in Waldeck (2008) price dispersion is a reverse U-shaped function of the proportion of informed consumers.

3.6 Do low/high price setters remain so over time?

Theory suggests that retailers are expected over time to vary in both directions the prices of the different goods they sell. In fact, temporal price dispersion is a necessary condition for spatial price dispersion, otherwise consumers would be able to identify from experience stores selling a given product at a lower price and would not buy it from stores offering it at a higher price (Varian, 1980). Lach (2002) found evidence of most stores in his sample falling over a 48 month period in both the lower and the upper quartiles of the price distribution of the three food products considered. Hong *et al.* (2002) proved empirically that a negative serial correlation of prices and quantities for storable goods exists because of consumer inventories. Their results also confirm that there is a positive relationship between current sales and the price in the previous period.

In order to assess the temporal pattern of prices, we compare prices surveyed in 2010 with prices in 2009 for the 178 retailers in our sample (out of 437) involved in an identical survey conducted between April 2 and 5, 2009.

The statistical significance of the sign of the relationship between prices for the same product in the same store surveyed one year apart has been tested by estimating by OLS the following models:

$$\boldsymbol{\Omega}^{2010}{}_{ir} = \phi\, \boldsymbol{\Omega}^{2009}{}_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (7)$$

$$\boldsymbol{\Omega}^{2010}{}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \psi_j\, \mathbf{t}^{j}{}_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (8)$$

$$\boldsymbol{\Omega}^{2010}{}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \psi_j\, \mathbf{t}^{j}{}_{ir} + \upsilon\, \mathbf{w}_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (9)$$

$$\boldsymbol{\Omega}^{2010}{}_{ir} = \Sigma_{j=1,2,\ldots,14}\, \psi_j\, \mathbf{t}^{j}{}_{ir} + \Sigma_{j=1,2,\ldots,14}\, \xi_j\, \mathbf{z}^{j}{}_{ir} + \boldsymbol{\varepsilon}_{ir} \qquad (10)$$

where $\boldsymbol{\Omega}^{2010}{}_{ir}$ is equal to $\mathbf{P}_{ir}$ in 2010 divided by the average price in 2010 of the r-th product across all stores which carry it, minus 1; $\boldsymbol{\Omega}^{2009}{}_{\mathbf{ir}}$ is defined analogously for 2009; $\mathbf{t}^{j}{}_{ir}$ is equal to $\boldsymbol{\Omega}^{2009}{}_{\mathbf{ir}}$

consumers, i.e. buyers who use shopbots to compare prices. They find that as shopbot usage increases, price dispersion decreases and don't exclude that "*as the share of informed consumers approaches zero or one, price dispersion should be declining smoothly to zero*" (p. 585).

multiplied by $\mathbf{x}^j_{ir}$; ϕ, ψ_j ,υ and ξ_j are the parameters to be estimated; and $\boldsymbol{\varepsilon}_{ir}$ are the error terms (results are shown in table 9).

Over time pricing strategies do not show a negative relation between prices in 2009 and 2010, with stores who offered a given product at an above (below) average price in 2009 more likely to offer the same product at a below (above) average price one year later. On the contrary, when the relationship between prices in 2009 and 2010 is assessed jointly for all products (Model 7) this is positive and statistically significant at the 99% confidence level.; Moreover, when the linkage is assessed product by product (Model 8), in 13 out of the 14 instances retailers who offered the product at an above or below average price in 2009 were more likely to do the same one year later; the positive sign of the coefficient is statistically significant, at different levels of confidence, for 8 of the 13 products. These results are confirmed when the effect on the price relationship of the type of store is controlled for (Models 9 and 10). However, in the case of supermarkets, on average, the positive linkage is weaker (statistically at 99% confidence level) than in traditional food stores (Model 9); when the same effect is assessed product by product (Model 10), results suggest a similar conclusion for 12 of the 14 products, although only for two products is the negative sign of the coefficient statistically significant (at 5% and 10% significance level). Finally, the store effect is never sufficient to make the sign of the temporal price relation for products sold in supermarkets switch with respect to that observed in traditional food stores (i.e. $\psi_j + \xi_j > 0$, for all j). In the few cases where a negative relationship emerged in Models 8, 9 and 10 between prices in 2009 and prices in 2010, this turned out always statistically no different from zero.

These results, at least in principle, are consistent with retailers offering, over time, certain products at above average prices and others at below average price, without revealing an equally stable overall pricing profile, i.e. their prices consistently being, overall, either low or high. To check if this is actually the case we considered the same-store cost in 2009 and 2010 for a given basket of products. Even limiting the number of products to 10, only 23 of the 178 stores involved in the two surveys sold those products at both times (figure 4). Even with all the necessary caution, given the small number of stores, the indication which emerges is that those stores which charged, overall, relatively higher prices in 2009 were doing the same one year on.

Our results seem consistent with those of Bahadir-Lust *et al.* (2007) who find evidence of persistence over time of the position of stores in the cross sectional price distribution. Similar conclusions are also in Baylis and Perloff (2002) regarding non food products.

One possible explanation is firm heterogeneity - in terms of services offered, such as number of references, opening hours, proximity, parking convenience and reputation - and consumer heterogeneity - in terms of their shopping preferences. Differences in store-specific consumer demand, such as a those due to the store being located in an area with a lower (or higher) than average per capita income, may also play a role.

4. Conclusions

The aim of this paper has been to contribute to the empirical literature on price dispersion by assessing its extent and determinants for a group of perfectly homogeneous food products. As far as we know, this is the first attempt to address the price dispersion issue in a retail market characterized by a marked heterogeneity of sellers as a result of the persistence of a large number of relatively small traditional food retailers, side by side with large supermarkets.

Some of the results reached in this specific market setting confirm those obtained elsewhere, while others may offer original insights to the empirical literature on price dispersion.

Although (i) the products considered are perfectly homogeneous and (ii) frequently purchased, (iii) the number of sellers high, and (iv) search costs relatively low, the observed price dispersion is quite high. Its magnitude has been found to be of the same order detected for food products by other studies in environments different from ours, suggesting that greater heterogeneity of firms, because of the persistence of a large number of traditional food retailers, does not lead to increased price dispersion.

The extent of price dispersion observed suggests that monopolistic competition prevails among sellers as a result of their heterogeneity in terms of services rendered. This is consistent with Carlson and McAfee (1983) and McAfee (1995). Further evidence of heterogeneity of firms' characteristics different from heterogeneity in operational and procurement costs, which is another factor suggested to explain price dispersion is provided by the circumstance that, in our study, many retailers selling at relatively high (low) prices in 2010 were doing the same one year earlier.

High price dispersion in the presence of low search costs and frequently repeated purchases signal that these factors are counteracted in consumer decisions about searching by the relatively low prices of the commodities considered, which reduce expected marginal benefits from search efforts. Seller pricing behaviors suggest that consumers are more sensitive to absolute price differences than percentage ones, i.e. they are more interested in detecting a 10% price difference which translates in savings of 2€ than a 50% price difference involving saving 20 cents.

Promotional sales are found to contribute in a significant way to price dispersion. Based on the results of our survey, however, we conclude that this is not always the case. In fact, if the promotional sale is market-wide, decided by the manufacturer, it reduces, rather than increases, spatial price dispersion, while the contrary is true if promotional sales are the result of decisions taken by retailers.

When prices in an urban area (where the spatial concentration of sellers is much higher and consumer search costs significantly lower) have been compared with those in smaller towns and rural areas, differences in search costs proved to have a significant, albeit limited, positive effect on price dispersion. In agreement with Waldeck (2008), the potentially higher degree of competition in the urban area deriving from the lower search costs and high density of sellers did not yield lower prices – on the contrary they were higher, on average, for 11 of the 14 products considered - confirming the hypothesis that food retail is an imperfectly competitive market.

Supermarkets proved to be often, but not always, less expensive than traditional retailers. Yet, average savings from food shopping at supermarkets were extremely low. This is consistent with McAfee's (1995) conclusion that prices across goods tend to be negatively correlated and helps explain the persistence of traditional retail stores - consumers keep shopping at them because they are often not significantly more expensive than supermarkets. In addition, if factors other than prices are considered, traditional retail stores provide fewer of the services many consumers ask for, and often of a lower quality, but they may provide other services which are not strong points for supermarkets, such as a convenient location and the social pleasure deriving from more personal interactions while shopping. On the other hand, the economic squeeze traditional retailers face (between the constraint to contain prices, and higher operational and acquisition costs) is confirmed by their steady decline. This means that in developed country markets which experience, like the one considered in this study, a progressive reduction of traditional retail stores and an increase in the number of supermarkets, one should not expect this process to bring significantly lower consumer prices, but rather a change in services available to consumers.

The results of our study suggest that there is no one-rule-fits-them-all for firm strategic behaviors, as different pricing decision makings by sellers emerge. Explaining these differences and their motivations is beyond the scope of this study, but our results show that such differences exist both between one store and another, and within different supermarket chains. While a relatively large literature exists aimed at measuring the extent of price dispersion for very different products and market settings, very little is known about the decision rules governing the different pricing strategies adopted by retailers which generate price dispersion. In order to investigate this issue one would need information involving retail prices and quantities sold over a period of time, for a large number of different products and an heterogeneous sample of retailers.

In conclusion, our study confirms that significant price dispersion occurs even where, according to theory, it should be low. The products being homogeneous, purchases frequently repeated, the number of sellers high, and search costs relatively low did not suffice to keep price dispersion low. Our results suggest that what is more important in explaining price dispersion in retail food markets is the contemporaneous occurrence of retailer heterogeneity (in terms of services rendered), and consumer heterogeneity (in terms of propensity to search and preferences regarding how to shop, i.e. "supermarket lovers" vs. "social shoppers"), which makes it possible for a monopolistic competition market structure to emerge and for a large number of traditional food retail stores to remain in business.

We believe the results of our study may be relevant for understanding price dispersion in markets different from those of food products, such as those characterized by perfectly homogeneous, well known products, involving frequently repeated purchases, with relatively low unit prices, sold by a large number of heterogeneous stores and bought by a large number of heterogeneous consumers.

In conclusion, three are the main implications of this study from a more general food policy analysis perspective.

The first one is that, because of the large extent of dispersion of food retail prices, one should be careful in not to dismiss this fact when assessing the transmission to consumers of price changes occurring in previous stages along the chain. Because of the imperfectly competitive structure of the food retail sector and the heterogeneity of consumers, retailers may well decide not to pass to consumers a reduction in their procurement cost, deciding to increase their returns instead, or to lower the price of a different product; on the contrary, they may decide not to increase their selling price when they have to pay more for the product, in this case most likely deciding to increase the price of another product instead.

The second implication of the results of our study has to do with public and private interventions to limit the negative implications of price dispersion on poor consumers' food expenditure. Consumers heterogeneity means that some of them will invest in searching for lower prices while others will not. While income can be expected to be negatively correlated with the effort exerted in searching, other socio-economic characteristics - such as social accountability, education and time availability - often have a counterbalancing effect, making poor consumers investing less, rather than more, in searching. Because of the wide price dispersion, a targeted action aimed at providing poor consumers with timely, easily accessible and costless information regarding retail food prices, in the proximity of where they live, for a set of basic goods may have a non marginal positive impact on their income.

Finally, our study identified lower price dispersion and higher, rather than lower, prices in the urban area, suggesting the possibility of price discriminating collusive behaviors by the retailers to capture benefits resulting from the higher incomes prevailing in the urban area. This implies an additional cost for poor consumers located in urban areas, suggesting the need for public action aimed at restoring competition by effectively limiting the possibility for the exercise of market power by larger retailers.

References

Adams A. F. III Search Costs and Price Dispersion in a Localized, Homogeneous Product Market: Some Empirical Evidence. Review of Industrial Organization 1997; 12, 5-6; 801-808.

Altroconsumo. Inchiesta: prezzi troppo alti e tutti uguali? Altrocunsumo 2010; 243, December; 12-13.

Ambrose DM. Retail Grocery Pricing: Inner City, Suburban, and Rural Comparisons. Journal of Business 1979; 52, 1; 95-102.

Anderson SP, de Palma. Price Dispersion and Consumer Reservation Prices. Journal of Economics & Management Strategy 2005; 14, 1; 61-91.

Ancarani F, Shankar V. Price Levels and Price Dispersion Within and Across Multiple Retailer Types: Further Evidence and Extension. Journal of the Academy of Marketing Science 2004; 32, 2; 176-187.

Bahadir-Lust S, Loy J-P, Weiss CR. Are They Always Offering the Lowest Price? An Empirical Analysis of the Persistence of Price Dispersion in a Low Inflation Environment. Managerial and Decision Economics 2007; 28; 777-788.

Barron JM, Taylor BA, Umbeck JR. Number of Sellers, Average Prices, and Price Dispersion. International Journal of Industrial Organization 2004; 22, 8-9; 1041-1066.

Baye MR, Morgan J, Scholten P. Information, Search, and Price Dispersion. In: Henderschott T. (Ed), Economics and Information Systems (Volume I). Elsevier: Amsterdam; 2006. P. 323-373.

Baylis K, Perloff JM. Price Dispersion on the Internet: Good Firms and Bad Firms. Review of Industrial Organization 2002; 21, 3; 305-324.

Berck P, Brown J, Perloff JM. Villas-Boas S. B. Sales: Tests of Theories on Causality and Timing. International Journal of Industrial Organization 2008; 26, 6; 1257-1273.

Borenstein S, Rose NL. Competition and Price Dispersion in the U.S. Airline Industry. Journal of Political Economy 1994; 102, 4; 653-683.

Brynjolfsson E, Smith MD. Frictionless Commerce? A Comparison of Internet and Conventional Retailers. Management Science 2000; 46, 4; 563-585.

Burdett K, Judd K. Equilibrium Price Dispersion. Econometrica 1983; 51, 4; 955-969.

Butters GR. Equilibrium Distribution of Sales and Advertising Prices. Review of Economic Studies 1977; 44; 465-491.

Carlson JA, McAfee RP. Discrete Equilibrium Price Dispersion. Journal of Political Economy 1983; 91, 3; 480-493.

Clay K, Krishnan R, Wolff E, Fernandes D. Retail Strategies on the Web: Price and Non-price Competition in the Online Book Industry. 1999; mimeo.

Clay K, Krishnan R, Wolff E. Prices and price dispersion on the web: evidence from the online book industry. The Journal of Industrial Economics 2001; 49, 4; 521-539.

Dahlby B, West DS. Price Dispersion in an Automobile Insurance Market. Journal of Political Economy 1986; 94, 2; 418-438.

Degeratu AM, Rangaswamy A, Wu J. Consumer choice behaviour in online and traditional supermarkets: The effects of brand name, price, and other search attributes. International Journal of Research in Marketing 2000; 17; 55-78.

Devine DG, Marion BW. The Influence of Consumer price Information on Retail Pricing and Consumer Behavior. American Journal of Agricultural Economics 1979; 61, 2; 228-237.

Gerardi KS, Shapiro AH. Does Competition Reduce Price Dispersion? New Evidence from the Airline Industry. Journal of Political Economy 2009; 117, 1; 1-37.

Griffith R, Leibtag E, Leicester A, Nevo A. Consumer Shopping Behavior: How Much Do Consumers Save? Journal of Economic Perspectives 2009; 23, 2, Spring; 99-120.

Hosken D, Reiffen D. Patterns of retail price variation. RAND Journal of Economics 2004; 35, 1; 128-146.

Haynes M, Thompson S. Price, price dispersion and number of sellers at a low entry cost shopbot. International Journal of Industrial Organization 2008; 26, 2; 459-472.

Hong P, McAfee RP, Nayyar A. Equilibrium Price Dispersion with Consumer Inventories. Journal of Economic Theory 2002; 105; 503-517.

Janssen MCW, Moraga-Gonzales JL. Strategic Pricing, Consumer Search and the Number of Firms. Review of Economic Studies 2004; 71, 4; 1089-1118.

Lach S. Existence and persistence of price dispersion: an empirical analysis.The Review of Economics and Statistics 2002; 84, 3; 433-444.

Leibtag E, Barker C, Dutko P. How Much Lower Are Prices at Discount Store? An Examination of Retail Food Prices, USDA-ERS: Washington; Economic Research Report n. 105; 2010, October.

Lewis M. Price Dispersion and Competition with Differentiated Sellers. The Journal of Industrial Economics 2008; 56, 3; 654-678.

Lloyd TA,. Morgan CW, McCorriston S, Zgovu E. Do Sales Matter? An Exploration of Price Discounting in UK Food Retailing. Paper prepared for presentation at the IAAE Conference, Beijing 2009, August 16-22; mimeo.

McAfee RP. Endogenous availability, cartels, and merger in an equilibrium price dispersion. Journal of Economic Theory 1994; 62, 1; 24-47.

McAfee RP. Multiproduct Equilibrium Price Dispersion. Journal of Economic Theory 1995; 67, 1; 83-105.

Pesendorfer M. Retail Sales: A Study of Pricing Behavior in Supermarkets. Journal of Business 2002; 75, 1; 33-66.

Pratt JW, Wise DA, Zeckhauser R. Price differences in almost competitive markets. The Quarterly Journal of Economics 1979; 93, 2; 189-211.

Robert J, Stahl DO II. Informative Price Advertising in a Sequential Search Model. Econometrica 1993; 61, 3; 657-686.

Salop S. The Noisy Monopolist: Imperfect Information, Price Dispersion and Price Discrimination. Review of Economic Studies 1977; 44, 3; 393-406.

Salop S, Stiglitz JE. Bargains and Rip-offs: A Model of Monopolistically Competitive Price Dispersion. Review of Economic Studies 1977; 44, October; 493-510.

Salop S, Stiglitz JE. The Theory of Sales: A Simple Model of Equilibrium Price Dispersion with Identical Agents. The American Economic Review 1982; 72, 5; 1121-1130.
Sexton R, Mingxia Z, Chalfant J. Grocery Retailer Behavior in the Procurement and Sale of Perishable Fresh Produce Commodities., USDA-ERS: Washington; 2003, September; Contractors and Cooperators, Report No. 2.
Sorensen AT. Equilibrium Price Dispersion in Retail Markets for Prescription Drugs. Journal of Political Economy 2000; 108, 4; 833-850.
Sprott DE, Manning KC, Miyazaki AD Grocery Price Setting and Quantity Surcharges. Journal of Marketing. 2003; 67, July; 34-46.
Stahl DO II. Oligopolistic Pricing with Sequential Consumer Search. The American Economic Review 1989; 79, 4; 700-712.
Stigler G. The Economics of Information. Journal of Political Economy 1961; 69, 3; 213-225.
Tang Z, Smith MD, Montgomery A. The Impact of Shopbot Use on Prices and Price Dispersion: Evidence from On-line Book Retailing", International Journal of Industrial Organization 2010; 28, 6; 579-590.
Varian HR. A Model of Sales. The American Economic Review 1980; 70, 4; 651-659.
Waldeck R. Search and Price Competition. Journal of Economic Behaviour & Organization 2008; 66; 347-357.

Figure 1 Label of the “GRANAROLO milk” at the time of the survey, with the “suggested” promotional retail price clearly displayed.

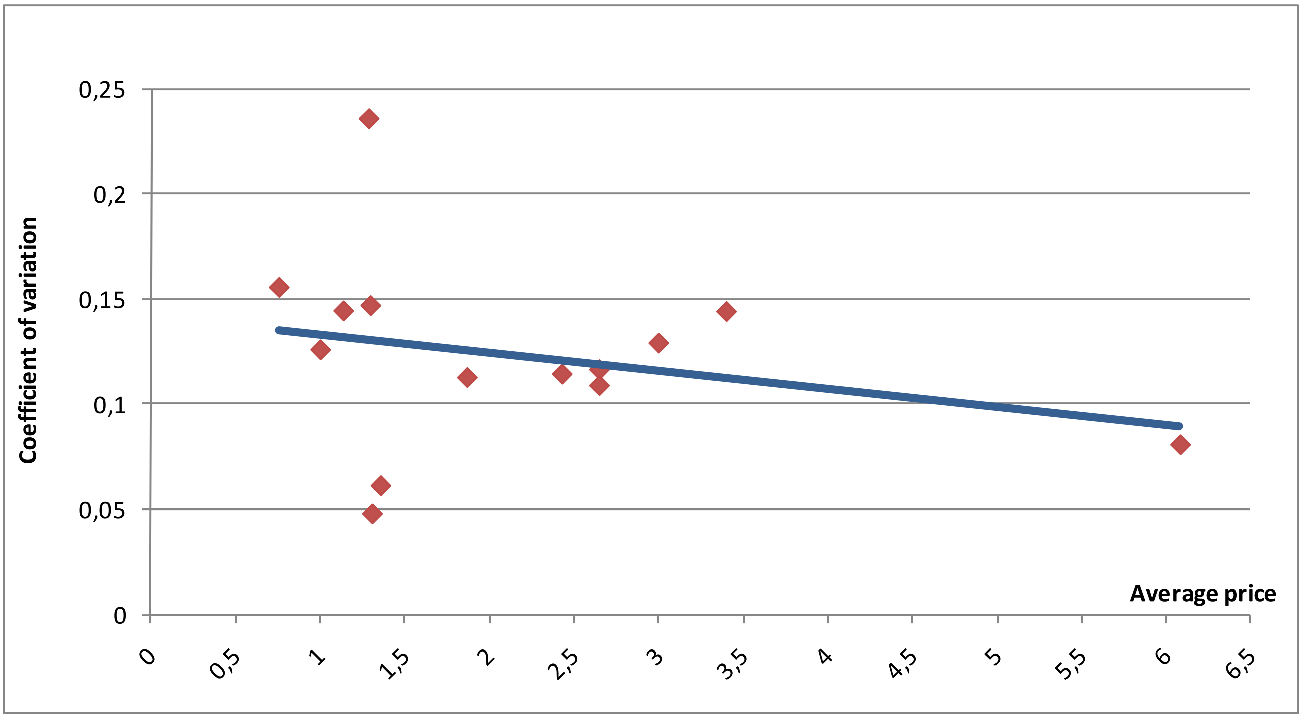

Figure 2 Average prices and coefficients of variation for the 14 products.

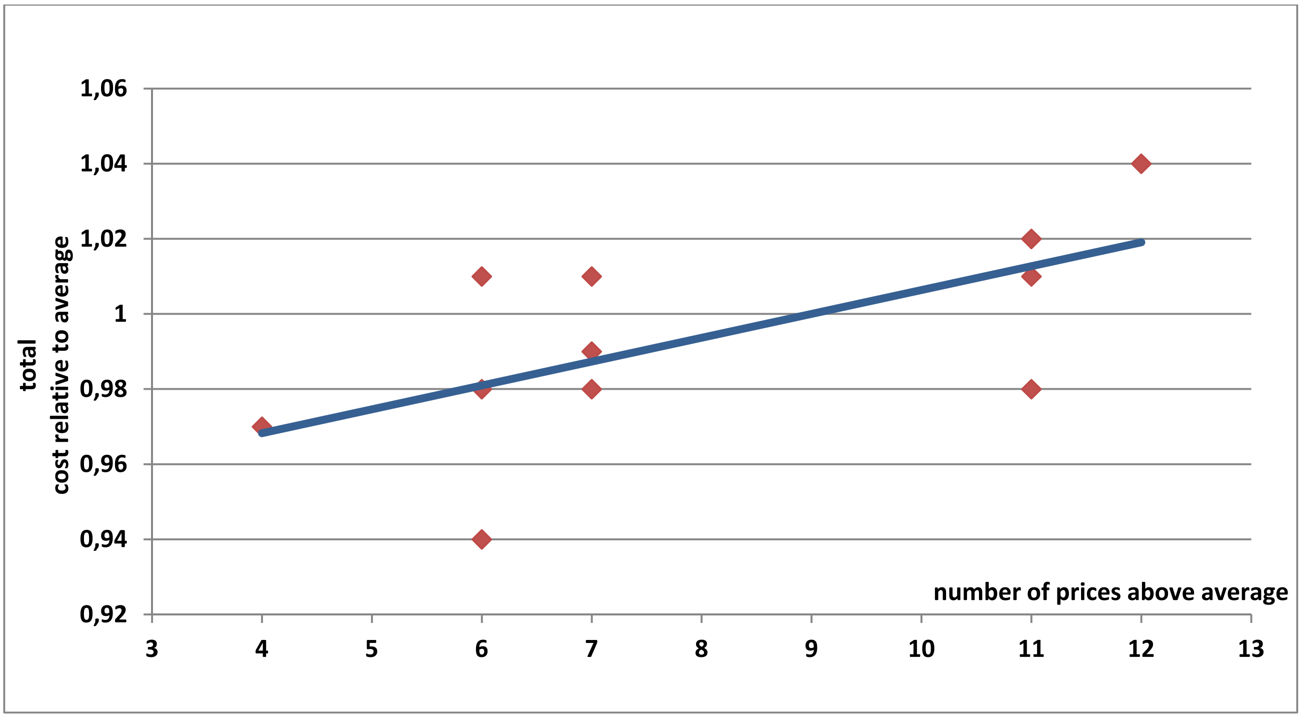

Figure 3 Number of average prices above the average calculated across all supermarkets in the sample and ratio between the total average cost of the 14 products and that calculated across all supermarkets in the sample, by supermarket chain.

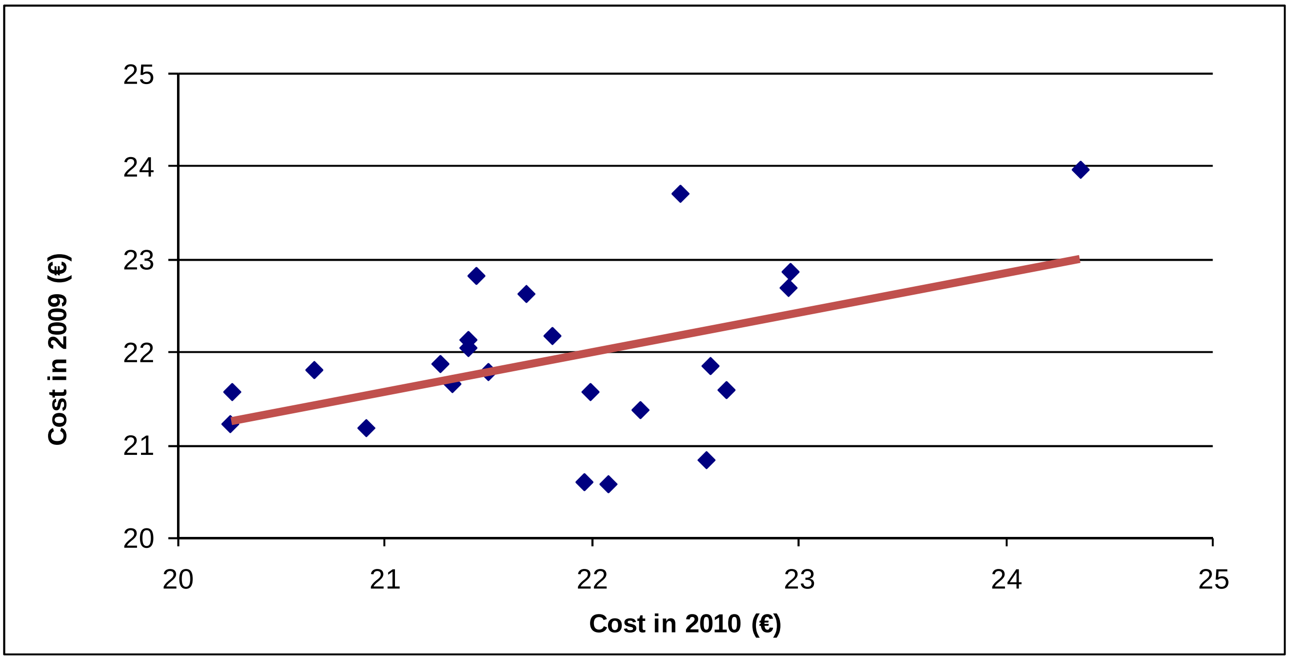

Figure 4 Same store cost of 10-product basket in 2009 and 2010 (23 stores) (all products but MILKTDM, BABYFPLA, SPAGVOI and COFFEELAV).

Table 1 Food products considered in the survey

	Label	Description
1	MILKGRA	*Granarolo-Centrali del latte di Calabria* , Milk, whole, pastourized, "*Alta qualità* ", plastic (PET) bottle, 1 lt
2	MILKTDM	*Torre di Mezzo* , Milk, whole, pastourized, glass bottle, 0.75 lt
3	MILKPARM	*Parmalat* , Milk, whole, UHT, "*Bontà e gusto* ", plastic (PET) bottle, 1 lt
4	YOGDAN	*Danone* , Yogurt, skimmed, with fruit, "*Vita snella* ", package of two, 125 gr each
5	COCACOLA	*Coca cola* , six can pack, 330 cc each
6	NUTELLA	*Ferrero* , "*Nutella* " spread, glass container, 400 gr
7	BEERPERO	*Peroni* , beer, "*Birra Peroni* ", three bottle pack, 330 cc each
8	WATERLEV	*Levissima* , mineral water, 6 plastic bottle pack, 1.5 lt each
9	COFFEELAV	*Lavazza* , coffee, "*Espresso - Crema e gusto* ", 250 gr
10	COFFEEILLY	*Illy* , coffee, "*Espresso* ", metal container, 250 gr
11	SPAGBAR	*Barilla* , spaghetti, "*n. 5* ", 500 gr
12	SPAGDEC	*De Cecco* , spaghetti, "*n. 12* ", 500 gr
13	SPAGVOI	*Voiello* , spaghetti, "*n. 104* ", 500 gr
14	BABYFPLA	*Plasmon* , baby food, "*Omogeneizzato Le selezioni* ", "*Nasello con patate* ", package of two, 80 gr each

Table 2 Price dispersion (prices in €)

MILKGRA	MILKTDM	MILKPARM	YOGDAN	COCACOLA	NUTELLA	BEERPERO	WATERLEV	COFEELAV	COFFEEILLY	SPAGBAR	SPAGDEC	SPAGVOI	BABYFPLA
Number of prices surveyed for each product													
353	193	322	285	369	386	350	334	310	224	366	245	201	211
Minimum price													
1,10	1,10	0,75	0,95	1,99	2,20	1,39	1,53	1,75	4,40	0,49	0,55	0,59	1,75
Maximum price													
1,60	1,65	1,70	1,99	4,80	4,09	2,56	3,80	3,49	6,99	1,45	1,39	1,42	3,15
Pmax / Pmin													
1,45	1,50	2,27	2,09	2,41	1,86	1,84	2,48	1,99	1,59	2,96	2,53	2,41	1,80
Minimum "on sale" price													
1,29	NA	0,75	0,95	2,93	2,21	1,39	1,92	1,89	5,45	0,49	0,69	NA	1,75
Average price (µ)													
1,31	1,36	1,30	1,29	3,40	2,65	1,87	3,00	2,43	6,08	0,76	1,14	1,00	2,65
Standard deviation (б)													
0,06	0,08	0,19	0,30	0,49	0,31	0,21	0,39	0,28	0,49	0,12	0,16	0,13	0,29
Coefficient of variation (%) (б/µ x 100)													
4,8%	6,2%	14,7%	23,5%	14,4%	11,6%	11,3%	12,9%	11,4%	8,1%	15,5%	14,4%	12,6%	10,9%

Table 3 Cost dispersion of selected product baskets (one unit of each product; costs in €)

all 14 products	13 products: all products but MILKTDM	12 products: all products but MILKTDM and BABYFPLA	11 products: all products but MILKTDM, BABYFPLA and SPAGVOI	10 products: all products but MILKTDM, BABYFPLA, SPAGVOI and COFFEELAV
Number of retail stores selling the specific basket				
15	**29**	**40**	**60**	**82**
Minimum cost				
27,64	**26,23**	**23,73**	**22,47**	**20,19**
Maximum cost				
31,89	**30,50**	**27,75**	**27,02**	**24,43**
Cmax / Cmin				
1,15	**1,16**	**1,17**	**1,20**	**1,21**
Average cost (μ)				
29,51	**28,01**	**25,67**	**24,63**	**22,09**
Standard deviation (б)				
1,08	**1,02**	**1,06**	**1,10**	**1,06**
Coefficient of variation (%) (б/μ x 100)				
3,6%	**3,6%**	**4,1%**	**4,5%**	**4,8%**

Table 4 Price dispersion in supermarkets and in traditional retail stores (prices in €).

MILKGRA	MILKTDM	MILKPARM	YOGDAN	COCACOLA	NUTELLA	BEERPERO	WATERLEV	COFEELAV	COFFEEILLY	SPAGBAR	SPAGDEC	SPAGVOI	BABYFPLA
Supermarkets													
Number of prices surveyed for each product													
217	124	205	179	222	224	205	199	179	168	218	167	139	146
Minimum price													
1,10	1,10	0,79	0,95	1,99	2,20	1,39	1,89	1,75	4,40	0,49	0,60	0,59	1,75
Maximum price													
1,59	1,62	1,69	1,99	4,80	4,09	2,56	3,80	3,49	6,99	1,40	1,39	1,29	3,12
Pmax / Pmin													
1,45	1,47	2,14	2,09	2,41	1,86	1,84	2,01	1,99	1,59	2,86	2,32	2,19	1,78
Average price (µ)													
1,30	1,35	1,31	1,22	3,28	2,57	1,83	2,97	2,43	6,08	0,74	1,13	1,00	2,65
Standard deviation (б)													
0,05	0,08	0,18	0,29	0,40	0,29	0,20	0,37	0,26	0,46	0,11	0,16	0,11	0,30
Coefficient of variation (%) (б/µ x 100)													
4,1%	5,6%	13,8%	23,8%	12,3%	11,1%	11,0%	12,6%	10,67%	7,6%	14,6%	13,9%	11,0%	11,3%
Traditional retail stores													
Number of prices surveyed for each product													
136	69	117	106	147	162	145	135	131	56	148	78	62	65
Minimum price													
1,25	1,10	0,75	0,98	2,05	2,25	1,50	1,53	1,75	4,50	0,49	0,55	0,69	1,79
Maximum price													
1,60	1,65	1,70	1,99	4,80	4,00	2,50	3,80	3,49	6,99	1,45	1,39	1,42	3,15
Pmax / Pmin													
1,28	1,50	2,27	2,03	2,34	1,78	1,67	2,48	1,99	1,55	2,96	2,53	2,06	1,76
Average price (µ)													
1,32	1,38	1,28	1,39	3,58	2,77	1,92	3,05	2,42	6,08	0,79	1,14	1,02	2,66
Standard deviation (б)													
0,07	0,10	0,21	0,29	0,55	0,30	0,21	0,40	0,30	0,58	0,13	0,18	0,16	0,26
Coefficient of variation (%) (б/µ x 100)													
5,7%	7,0%	16,1%	21,1%	15,4%	10,9%	11,0%	13,2%	12,5%	9,5%	15,8%	15,5%	15,4%	9,9%

Table 5 Testing average price differences between supermarkets and traditional retail stores.

	Model 1, dependent variable π_{ir}			Model 2, dependent variable p_{ir}		
x1	1,0241	*(,)*	***	1,3209	*(,01)*	***
x2	1,0268	*(,01)*	***	1,3774	*(,01)*	***
x3	1,0277	*(,01)*	***	1,2841	*(,02)*	***
x4	1,0224	*(,01)*	***	1,3934	*(,03)*	***
x5	1,0235	*(,01)*	***	3,5780	*(,05)*	***
x6	1,0242	*(,01)*	***	2,7705	*(,02)*	***
x7	1,0242	*(,01)*	***	1,9257	*(,02)*	***
x8	1,0235	*(,01)*	***	3,0513	*(,03)*	***
x9	1,0230	*(,01)*	***	2,4249	*(,03)*	***
x10	1,0300	*(,01)*	***	6,0850	*(,08)*	***
x11	1,0255	*(,01)*	***	0,7943	*(,01)*	***
x12	1,0233	*(,01)*	***	1,1422	*(,02)*	***
x13	1,0315	*(,01)*	***	1,0213	*(,02)*	***
x14	1,0273	*(,01)*	***	2,6562	*(,03)*	***
w	-0,0393	*(,)*	***			
z1				-0,0178	*(,01)*	**
z2				-0,0238	*(,01)*	*
z3				0,0306	*(,02)*	
z4				-0,1693	*(,04)*	***
z5				-0,2963	*(,05)*	***
z6				-0,2011	*(,03)*	***
z7				-0,0912	*(,02)*	***
z8				-0,0852	*(,04)*	*
z9				0,0101	*(,03)*	
z10				-0,0021	*(,08)*	
z11				-0,0550	*(,01)*	***
z12				-0,0087	*(,02)*	
z13				-0,0245	*(,02)*	
z14				-0,0085	*(,04)*	
Observations	4149			4149		
F	28826,09			16717,73		
R-squared	0,9833			0,9874		

Robust standard errors in parenthesis.

****, **, * signal significance at 1%, 5% and 10%, respectively.*

Table 6 Cost dispersion of selected product baskets in supermarkets and traditional retail stores (costs in €).

all 14 products	13 products: all products but MILKTDM	12 products: all products but MILKTDM and BABYFPLA	11 products: all products but MILKTDM, BABYFPLA and SPAGVOI	10 products: all products but MILKTDM, BABYFPLA, SPAGVOI and COFFEELAV
Supermarkets				
Number of retail stores selling the specific basket				
15	**27**	**34**	**51**	**72**
Minimum cost				
27,64	**26,23**	**23,73**	**22,47**	**20,19**
Maximum cost				
31,89	**30,50**	**27,75**	**27,02**	**24,43**
Cmax / Cmin				
1,15	**1,16**	**1,17**	**1,20**	**1,21**
Average cost (μ)				
29,51	**28,02**	**25,60**	**24,54**	**22,03**
Standard deviation (б)				
1,08	**1,05**	**1,09**	**1,13**	**1,09**
Coefficient of variation (%) (б/μ x 100)				
3,6%	**3,7%**	**4,3%**	**4,6%**	**4,9%**
Traditional retail stores				
Number of retail stores selling the specific basket				
0	**2**	**6**	**9**	**10**
Minimum cost				
…	**27,48**	**24,93**	**24,03**	**21,68**
Maximum cost				
…	**28,25**	**27,00**	**26,28**	**23,67**
Cmax / Cmin				
…	**1,03**	**1,08**	**1,09**	**1,09**
Average cost (μ)				
…	**27,87**	**26,03**	**25,13**	**22,59**
Standard deviation (б)				
…	**0,54**	**0,85**	**0,79**	**0,71**
Coefficient of variation (%) (б/μ x 100)				
…	**1,9%**	**3,3%**	**3,1%**	**3,1%**

Table 7 Price dispersion in the urban area (Cosenza-Rende) and in the rest of the sample (smaller towns and rural areas) (prices in €).

MILKGRA	MILKTDM	MILKPARM	YOGDAN	COCACOLA	NUTELLA	BEERPERO	WATERLEV	COFEELAV	COFFEEILLY	SPAGBAR	SPAGDEC	SPAGVOI	BABYFPLA
Urban area (Cosenza-Rende)													
Number of prices surveyed for each product													
103	62	86	72	97	97	87	91	76	61	85	49	41	47
Minimum price													
1,10	1,11	0,75	0,95	2,50	2,20	1,48	2,10	1,95	4,49	0,49	0,70	0,59	1,75
Maximum price													
1,49	1,45	1,69	1,99	4,80	4,05	2,49	3,60	3,49	6,90	1,00	1,36	1,35	3,15
Pmax / Pmin													
1,35	1,31	2,25	2,09	1,92	1,84	1,68	1,71	1,79	1,54	2,04	1,94	2,29	1,80
Average price (µ)													
1,30	1,35	1,32	1,25	3,50	2,66	1,92	3,02	2,46	6,17	0,77	1,18	1,02	2,69
Standard deviation (б)													
0,039	0,058	0,199	0,305	0,487	0,315	0,213	0,328	0,235	0,392	0,075	0,134	0,135	0,341
Coefficient of variation (%) (б/µ x 100)													
2,97%	4,26%	15,14%	24,36%	13,92%	11,83%	11,10%	10,85%	9,57%	6,35%	9,74%	11,35%	13,25%	12,67%
Rest of the sample													
Number of prices surveyed for each product													
250	131	236	213	272	289	263	243	234	163	281	196	160	164
Minimum price													
1,10	1,10	0,79	0,95	1,99	2,20	1,39	1,53	1,75	4,40	0,49	0,55	0,69	1,75
Maximum price													
1,60	1,65	1,70	1,99	4,80	4,09	2,56	3,80	3,49	6,99	1,45	1,39	1,42	3,12
Pmax / Pmin													
1,45	1,50	2,15	2,09	2,41	1,86	1,84	2,48	1,99	1,59	2,96	2,53	2,06	1,78
Average price (µ)													
1,32	1,37	1,30	1,30	3,36	2,65	1,86	2,99	2,42	6,05	0,76	1,13	1,00	2,64
Standard deviation (б)													
0,070	0,094	0,189	0,302	0,486	0,307	0,208	0,407	0,291	0,521	0,128	0,169	0,124	0,272
Coefficient of variation (%) (б/µ x 100)													
5,32%	6,85%	14,51%	23,23%	14,45%	11,59%	11,20%	13,61%	11,99%	8,62%	16,94%	15,02%	12,42%	10,30%

Table 8 Testing average price differences between the urban area (Cosenza-Rende) and rest of the sample (smaller towns and rural areas)

	Model 3, dep. variable π_{ir}			Model 4, dep. variable π_{ir}			Model 5, dep. variable p_{ir}			Model 6, dep. variable p_{ir}		
x1	0,9925	*(,)*	***	1,0205	*(,)*	***	1,3156	*(,)*	***	1,3273	*(,01)*	***
x2	0,9964	*(,)*	***	1,0228	*(,01)*	***	1,3658	*(,01)*	***	1,3814	*(,01)*	***
x3	0,9968	*(,01)*	***	1,0245	*(,01)*	***	1,2994	*(,01)*	***	1,2800	*(,02)*	***
x4	0,9974	*(,01)*	***	1,0193	*(,01)*	***	1,2991	*(,02)*	***	1,4022	*(,03)*	***
x5	0,9966	*(,01)*	***	1,0203	*(,01)*	***	3,3650	*(,03)*	***	3,5435	*(,05)*	***
x6	0,9973	*(,01)*	***	1,0211	*(,01)*	***	2,6509	*(,02)*	***	2,7685	*(,03)*	***
x7	0,9963	*(,01)*	***	1,0212	*(,01)*	***	1,8555	*(,01)*	***	1,9088	*(,02)*	***
x8	0,9968	*(,01)*	***	1,0202	*(,01)*	***	2,9921	*(,03)*	***	3,0431	*(,04)*	***
x9	0,9975	*(,01)*	***	1,0200	*(,01)*	***	2,4228	*(,02)*	***	2,4178	*(,03)*	***
x10	0,9976	*(,01)*	***	1,0267	*(,01)*	***	6,0493	*(,04)*	***	6,0601	*(,08)*	***
x11	0,9967	*(,01)*	***	1,0226	*(,01)*	***	0,7584	*(,01)*	***	0,7908	*(,01)*	***
x12	0,9984	*(,01)*	***	1,0209	*(,01)*	***	1,1257	*(,01)*	***	1,1327	*(,02)*	***
x13	1,0010	*(,01)*	***	1,0290	*(,01)*	***	1,0015	*(,01)*	***	1,0189	*(,02)*	***
x14	0,9968	*(,01)*	***	1,0246	*(,01)*	***	2,6388	*(,02)*	***	2,6480	*(,03)*	***
k	0,0120	*(,)*	***	0,0126	*(,)*	***						
w				-0,0394	*(,)*	***						
s1							-0,0195	*(,01)*	***	-0,0203	*(,01)*	***
s2							-0,0114	*(,01)*		-0,0119	*(,01)*	
s3							0,0158	*(,02)*		0,0156	*(,02)*	
s4							-0,0476	*(,04)*		-0,0389	*(,04)*	
s5							0,1322	*(,06)*	**	0,1266	*(,05)*	**
s6							0,0113	*(,04)*		0,0078	*(,03)*	
s7							0,0672	*(,03)*	**	0,0659	*(,02)*	***
s8							0,0309	*(,04)*		0,0281	*(,04)*	
s9							0,0325	*(,03)*		0,0320	*(,03)*	
s10							0,1253	*(,06)*	*	0,1268	*(,06)*	**
s11							0,0139	*(,01)*		0,0176	*(,01)*	*
s12							0,0531	*(,02)*	**	0,0536	*(,02)*	**
s13							0,0139	*(,02)*		0,0168	*(,02)*	
s14							0,0514	*(,05)*		0,0531	*(,05)*	
z1										-0,0186	*(,01)*	**
z2										-0,0240	*(,01)*	*
z3										0,0305	*(,02)*	
z4										-0,1676	*(,04)*	***
z5										-0,2943	*(,05)*	***
z6										-0,2010	*(,03)*	***
z7										-0,0905	*(,02)*	***
z8										-0,0845	*(,04)*	*
z9										0,0088	*(,03)*	
z10										-0,0150	*(,08)*	
z11										-0,0558	*(,01)*	***
z12										-0,0105	*(,02)*	
z13										-0,0260	*(,02)*	
z14										-0,0138	*(,04)*	
Observations	4149			4149			4149			4149		
F	28033,69			26761,67			18099,58			12508,22		
R-squared	0,9829			0,9833			0,9869			0,9875		

Robust standard errors in parenthesis.

****, **, * signal significance at 1%, 5% and 10%, respectively.*

Table 9 Testing linkages between prices for the 14 products in the same store in 2010 and 2009 (dependent variable Ω^{2010}_{ir}).				
	Model 7	**Model 8**	**Model 9**	**Model 10**
Ω^{2009}_{ir}	0,1327 *(,03)* ***			
t1		0,0074 *(,03)*	-0,0139 *(,04)*	0,0087 *(,03)*
t2		0,0447 *(,02)* **	0,0447 *(,01)* ***	0,0447 *(,02)* ***
t3		0,1426 *(,08)* *	0,1397 *(,08)* *	0,1426 *(,08)* *
t4		0,0781 *(,12)*	0,0651 *(,11)*	0,0575 *(,11)*
t5		0,4300 *(,11)* ***	0,4156 *(,11)* ***	0,4036 *(,11)* ***
t6		0,2293 *(,1)* **	0,2058 *(,1)* **	0,2006 *(,1)* **
t7		0,1674 *(,1)* *	0,1633 *(,1)* *	0,1582 *(,1)*
t8		0,1544 *(,06)* **	0,1466 *(,06)* **	0,1411 *(,07)* **
t9		0,0438 *(,11)*	0,0479 *(,1)*	0,0446 *(,1)*
t10		0,0863 *(,13)*	0,0785 *(,13)*	0,0835 *(,13)*
t11		0,0312 *(,04)*	0,0275 *(,04)*	0,0252 *(,04)*
t12		0,3302 *(,17)* **	0,3277 *(,17)* **	0,3289 *(,17)* **
t13		0,4806 *(,13)* ***	0,4663 *(,13)* ***	0,4738 *(,13)* ***
t14		-0,0801 *(,13)*	-0,0800 *(,13)*	-0,0801 *(,13)*
w			-0,0117 *(,)* ***	
z1				0,0007 *(,)*
z2				-0,0056 *(,01)*
z3				0,0002 *(,01)*
z4				-0,0185 *(,03)*
z5				-0,0214 *(,01)* *
z6				-0,0143 *(,01)*
z7				-0,0265 *(,01)* **
z8				-0,0199 *(,02)*
z9				-0,0024 *(,01)*
z10				-0,0042 *(,01)*
z11				-0,0194 *(,01)*
z12				-0,0062 *(,01)*
z13				-0,0056 *(,01)*
z14				-0,0074 *(,02)*
Observations	1531	1531	1531	1531
F	22,68	4,23	5,09	2,95
R-squared	0,0197	0,0381	0,0441	0,0476

Robust standard errors in parenthesis.

****, **, * signal significance at 1%, 5% and 10%, respectively.*