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Abstract

This paper empirically analyses price dispersion between brand within product categories in the Independent grocery sector. The methodology adopted allows us to discriminate between the impact which various structural demand and supply side features have on price dispersion in both traditional and game-theoretic frameworks. Specifically we estimate how differences in the product cycle, sales structure, distribution structure, and downstream retailer power impact patterns of price dispersion while controlling for idiosyncratic product effects. Our results suggest that competitive pricing of brands in product categories, and hence price dispersion, will rise with a slump in the product cycle, fragmentation in the sales structure, greater distribution coverage in outlets, and factors which restrict downstream retailer power.

Introduction

An interesting empirical observation is the degree to which very similar products exhibit wide variation in retail prices. This is evident for a large number of products such as airline tickets, hotels and many other retail products and services. The classical approach to explaining price dispersion is based on the presence of cost asymmetries in production or monopolistic price discrimination due to heterogeneous consumer demand elasticities. More recent explanations focus on strategic effects embedded in game theoretic models. Empirically, strategic effects are unobservable and hence their impact on price dispersion is difficult to measure directly. One way of circumventing this problem is to examine the impact which various structural features of a market have on price dispersion in traditional and game theoretic frameworks. If the relationship between the proposed structural features and price dispersion differ between the frameworks we have an empirical agenda that allows one to discriminate between alternative schools. Even so, this can only provide indirect evidence for modern theories since strategic interaction is effectively treated as a 'black box' that drives strategic outcomes.

With this approach in mind we empirically analyse the determinants of price dispersion between brands within product categories in the Independent sector of the Irish grocery market. In particular we estimate how differences in the product cycle, sales structure, distribution structure and downstream retailer power impact patterns of price dispersion while controlling for idiosyncratic product and aggregate effects. Access to a rich panel data set at the brand level enables us to undertake such an exercise.

In section I we provide a simple theoretical framework for our analysis. We outline the relationship between our structural variables and price dispersion in the context of the Independent sector of the Irish grocery market.
for both traditional and game theoretic frameworks in section III. In order to make this possible we provide an overview of the Irish grocery market and a description of our data in section II. Section IV concentrates on the specification of the empirical model and the regression results. This is followed with our conclusions.

Section I

In this section we review simple explanations of price dispersion based on traditional and game-theoretic frameworks. The traditional approach is rooted in theories of third degree price discrimination. This adopts a monopolistic framework where the profit maximising monopolist sells into a market that is readily segmented into groups of consumers exhibiting heterogeneous preferences for their products. The ability to exercise third degree price discrimination in favour of more elastic consumers enables the monopolist to extract greater profits from the market. In the case of the multi-brand monopolist producing substitute brands where lower prices of brands j exert a negative externality effect on the sales of brand i in the market, prices will be determined by way of an augmented ‘Ramsey Pricing’ rule. Where one firm produces i = 1, 2,...,N substitute brands for the market, the demand function for each brand , \( q_i = D_i(p) \), depends on \( P = (P_1, P_2,...,P_N) \).

Let the cost function for each brand be, \( C_i(q_i) \). The objective of the firm is to maximise the following profit function with respect to \( P_i \),

\[
\pi_i = P_i D_i(p) - C_i(q_i)
\]

The first order condition for each brand may be written as,

\[
\frac{P_i - C_i}{P_i} = -\frac{1}{v} + \sum_{i,j} \frac{(P_i - C_j)(D_j - D_i)}{R_{ij} v_j}
\]

(2)

Where \( v = -\frac{\partial D_i}{\partial P_i} > 0 \); \( C = -\frac{\partial D_j}{\partial P_j} > 0 \); \( R_{ij} = P_j - P_i \).

Price variation between brands may arise as a result of cost asymmetries, or heterogeneities in the own-price or in the cross-price elasticities of demand for the firms brands. The firm tries to extract higher premiums from brands which exhibit relatively inelastic own-price demand elasticities as captured in the first term of the right hand side of equation 2. The second term captures the negative impact which lower prices of all other brands j have on brand i. In general the monopolist has an incentive to maintain higher prices for all brands in order to minimise externality effects from heterogeneous cross-price elasticities. The mark-up on brand i is positively related to the degree of substitutability with other brands j. While heterogeneity in own-price and cross-price elasticities are imposed in this model, clearly they are an outcome of various horizontal and vertical attributes of the brands which are not all exogenous to the monopolist. Brands are effectively differentiated by factors such as age, income levels, convenience of location, levels of information, branding, efficiency of distribution, degree of retailer mark-up, product cycles and many other determinants.

Introducing more competition to the market will reduce the ability of the firm to exercise monopolistic price discrimination as the potential for exploiting own-price effects declines along with the ability to manage cross-price effects. Should we then expect the level of price dispersion to decline in the presence of increased competition? While the industry demand elasticities
become more elastic with the level of competition in the market and hence price dispersion on this basis is reduced, the cross-price effects become stronger due to strategic price competition between brands of rival firms. This can actually increase the level of price dispersion as competition rises in the market. Borenstein (1985) and Holmes (1989) outline the potential importance of this strategic effect in imperfectly competitive markets in their distinction between price dispersion that results from monopolistic and that resulting from competitive behaviour.

To illustrate this point we write down a model of price determination similar to Holmes (1989) for a multi-brand industry where differentiated Bertrand competition takes place in the presence of heterogeneous own-price and cross-price elasticities. Rather than having only one firm producing N brands we now have N firms producing i = 1, 2,..., N substitute brands for the market. The demand function for each firm, q_i = D_i(P), depends on P = (P_1, P_2,...,P_N). Let the cost function for each firm be, C_i(q_i). The objective of firm_i is to maximise (1) with respect to P_i, taking all the other prices as given. The first order condition for each brand equates marginal revenue to marginal cost assuming that no other brand will change its price in response to the price firm i sets. We express the first order condition as the following.

\[
\frac{\partial \pi}{\partial P_i} = \left( \frac{\partial D_i}{\partial P_i} + P_i \frac{\partial D_i}{\partial P_i} \right) \left( \frac{\partial C_i}{\partial P_i} \frac{\partial D_i}{\partial P_i} \right) = 0 \tag{3}
\]

We re-write the above as an optimal response function which is expressed as an augmented “Lerner Index” pricing rule.

\[
P_i = C_i^{\frac{1}{\varepsilon_i}} \left( 1 + \frac{1}{\varepsilon_i} \sum_{j \neq i} C_j^{\frac{1}{\varepsilon_j}} \varepsilon_j \frac{dP_j}{dP_i} \right)
\]

Where \( \varepsilon_i = \frac{d\ln P_i}{d\ln q_i} > 0, \varepsilon_j = \frac{d\ln P_j}{d\ln q_i} > 0 \), \( \varepsilon_i = \frac{d\ln P_i}{d\ln P_j} > 0 \).

In addition to the traditional impact of the industry demand elasticity, the optimal pricing of a brand facing price competition reflects the tendency of consumers to switch between rival brands for a given set of prices. A strategic effect is included based on the optimal response of brand i to the prices set by other firms. Stronger cross-price elasticities, due to a greater ability or willingness of consumers to switch between brands, induces a lower optimal brand price. Each brand faces the above optimal response function set out in equation 3 giving us N equations and N unknown-prices to solve for. The solution for P(P_1, P_2,...,P_N) that results forms a Nash Equilibrium in prices.

Factors which enhance the level of substitutability between rival brands inject more competition for the consumer base which will result in price mark-ups tending to zero. However the rate at which the price falls for a particular brand depends on the strength of the heterogeneous cross-price effects. This can create greater price dispersion in the market. In addition, monopolistic price dispersion falls with competition as all industry demand elasticities become more elastic. In imperfectly competitive multi-brand markets the impact on optimal pricing is contingent upon the relative strengths of 'monopolistic' and 'competitive' effects. The latter can dominate if the threat of consumers to switch to rival brands is strong.

Empirical evidence which supports the dominance of monopolistic pricing is provided by Giulietti and Waterson (1996). They undertake an
analysis of pricing in the Italian grocery market. The structure of the Italian grocery market is dominated by specialist shops resulting in a large degree of fragmentation. Furthermore, the fact that outlets specialise in only one product implies zero competition within that outlet. Inter-outlet competition predominates in this market. The ability of consumers to switch between different outlets at a low cost is limited which confers localised power on the retailer. Premiums are extracted by the retailer based consumer willingness to pay for a product and for locational convenience. Price dispersion in this market is therefore generated by monopolistic behaviour.

The empirical importance of competitive price dispersion is accentuated in a paper by Borenstein and Rose (1994). They document large scale price dispersion in the US airline market which is not explained by differences in the class of the ticket, business versus economy. In addition to differences in consumer reservation prices, the basis for discrimination is due to differences in the ability or willingness of consumers to switch between alternative flights.¹ Borenstein and Rose find greater price dispersion over customers as competition on airline routes increases, through for example the introduction of more frequent flights or new airline carriers on the route, and the degree of substitutability between flights on a given route is enhanced. Their empirical results suggest that the primary basis for the segmentation of consumers in the airline industry is based on heterogeneity’s in cross-price rather than industry demand elasticity and dispersion is therefore competitively driven.

In the spirit of Borenstein and Rose (1994) we model price dispersion in the independent sector of the Irish retail grocery market. Specifically we examine structural demand and supply side features which affect the intensity of competition between brands, both within and between retail outlets, for selected product categories. Controlling for idiosyncratic product unobservables, those product categories whose structural features lend themselves to brand substitutability and competition between brands, thus enhancing the strategic cross-price effects, are predicted to induce more price dispersion. This argument will be developed in detail in section III after we overview the structure of the Irish grocery market and describe the data used in our analysis.

Section II
An Overview of the Irish Retail Groceries Market

Historically the Irish retail grocery market was characterised by a fragmented structure. However increased consumer mobility enhanced demand for ‘one stop’ shopping which allowed consumers to reap the benefits of scale and scope economies in supermarkets. This initiated a structural upheaval in the grocery market. Today this market is highly concentrated with the top 5 per cent of outlets accounting for almost 70 per cent of total food turnover as illustrated in fig. 2.1. In Dublin, Multiples dominate the market. These describe larger supermarkets with several branches. The rest of the market is supplied by a large number of small Independent retailers and Symbol Groups which together provide a similar service in the Dublin area. The demand for ‘one-stop’ trolley shopping is satisfied by Multiple outlets providing a broad range of products at low prices and a detailed focus on the level of service. What we call ‘convenience’ shopping is fulfilled by smaller retailers operating with

¹ In keeping with traditional theories of discrimination the business traveller faces higher prices than the discretionary traveller by virtue of their more inelastic demand for flights. However if the business traveller is flexible, booking well in advance with access to information then their willingness and ability to switch between alternative flights is enhanced which may result in lower prices if the market is segmented on this basis.
longer hours and greater locational convenience. These stores also tend to
specialise in a different set of products which are described as 'routine',
'impulse', 'perishable' and 'top up' items such as newspapers and tobacco,
chocolate, sausages and other grocery items which tend to be demanded in
smaller sizes. Consumers do not tend to buy a weekly supply of these goods in
a 'one-stop' shop. This creates a market niche for the smaller Independent and
Symbol outlets. An interesting feature of this niche is the consumers desire to
buy these products in smaller quantities at local stores and at unusual hours. As
in the Italian grocery market this could potentially result in a large degree of
monopolistic localised retailer power. On closer examination however, the
degree to which this prior holds varies substantially across different product
categories.

The Dublin market has evolved into a dual structure in which there
exists a small number of large retailers operating in the 'one-stop' market, and a
large competitive fringe consisting of smaller retailers targeting the
'convenience' niche. As illustrated in Table 2.1, moving away from the densely
populated Dublin area the importance of Multiples decline and Symbols rise.
In these regions, Symbols tend to cater for all consumer needs in rural areas,
while the dual structure apparent in Dublin remains in urban sections.

The Independent sector provides the same service to the consumer
countrywide. While this sector has declined since the seventies, its market
share has stabilised in recent years and currently stands at 19 per cent of total
retail grocery sales. Despite the fall in the number of outlets over time,
Independent retailers in 1996 numbered in excess of 8,000 and is highly
fragmented in terms of total grocery sales as illustrated in figs. 2.2 and 2.3.
The interesting feature of the Independent sector which this paper exploits is
the very different demand and supply side institutional structures which

characterise 'impulse', 'perishable' and other 'top up' items. Details of the
structural features for each product category in our study which are retailed
through the Independent sector will be documented in section III. This is
particularly evident for the case of 'impulse' versus 'non-impulse' products.
The structural differences exhibited by 'Impulse' goods is primarily explained
by the observation that Independent outlets define the main market for resale
for these goods. These include products such as chocolate, carbonates, crisps
and snack products as illustrated in fig. 2.4. A significant role in determining
the overall success of brands in the 'impulse' market is thus conferred on the
Independent retailer. Supplier competition for shelf space, broad coverage in
terms of the number of outlets retailing and the range of brands offered within
each outlet, and greater monitoring of retailers are inherent features of
'impulse' goods. Another interesting feature of 'impulse' products is their role
in attracting consumers into the store with competitive prices allowing
retailers to extract premiums on other products. Hence retailers tend to accept
supplier recommended resale prices for 'impulse' products while exercising
market power over other non-impulse goods.

Data Description
The data used in our analysis were provided by AC Nielsen
international marketing research who have collated a very large panel
database concerning key factors which drive product sales in the Irish Food
and Confectionery sectors. These data have been collected using a stratified
quota sample of grocers, which is skewed towards the largest outlets and is
said to contain a fair representation of store locations for the various retail
groups in the sector. The database provides bi-monthly data for individual brands within various product categories. Data information is aggregated over all outlets in the Independent sector but still retains, for most variables, between outlet information. A key exception to this is the overall brand retail price which represents a sales weighted average of retail brand prices in each outlet sampled. The aggregation process prevents us from analysing prices of the same brand retailed through different outlets. Our analysis is confined to price dispersion between brands aggregated over all outlets.

Other data utilised aggregated over outlets include brand information on unit sales, percentage of outlets distributing a brand/receiving a delivery over the audit period, and the significance of these outlets for both the product category and the individual brand. All information can be aggregated up to the firm level and the product category level for the purposes of our analysis. Bi-monthly data were provided for the Independent sector product categories listed in table 2.2 over the three year period from October 1992 through to October 1995.

Section III

Price Dispersion

Price dispersion over brands within product categories is characteristic of the Independent retail grocery market and display both inter-temporal and cross-sectional variation. Dispersion is measured using the coefficient of variation, RSPVAR, which is a unit free measurement of the degree of retail price inequality across the entire range of brands sold within product categories, aggregated over all outlets in the Independent sector. This is computed as follows,

\[
\frac{\sqrt{\sum_{i=1}^{N} (p_i - \overline{p})^2 \times s_i}}{\overline{p}} / N
\]

where \( N \) represents the total number of brands in a product category, \( p_i \) is the average price of an individual brand over all outlets, \( \overline{p} \) is the average product category price aggregated over all brands, and \( s_i \) denotes the brand share of product category sales. Summary statistics for measure of price dispersion overall, across units and within product categories over time are reported in Table 3.1.

Pooling over all categories for all time periods in the Independent grocery market, the dispersion of prices computed as a proportion of the mean price is, on average, 7.8 per cent. However substantial differences arise in the levels of price dispersion both within and between product categories. The deviation from the average level of price dispersion within a given product category ranges from 3.8 per cent to 16.8 per cent. Across units, the average level price dispersion over time obtaining for specific product categories is 1.69 per cent of the mean price for Can-sized-Carbonates, as compared with 17.63 per cent of the mean price for Chocolate Multi-Packs as illustrated in fig. 3.1. Unsurprisingly, the variation in the reported measures of price dispersion are greater for between than within product categories. Such patterns of price dispersion may be partially determined by pricing practices which will either be monopolistic or competitively based. The threat and the degree of substitutability between brands define the basis for competitive theories of

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1 A grocery is defined as a retail outlet with 20% or more of its turnover in groceries and/or provisions not having a larger proportion of turnover in any other commodity unless it is one or a combination of the following: off-licence trade, bakery goods, tobacco (if less than 70% of sales).

2 Data on all brands are not available. Unavailable data usually relate to small fringe competitors in the market whose collective influence is represented by 'All Other' brands.
price dispersion. Before constructing indices which capture structural demand and supply features of our product categories and relating these to the observed patterns of price dispersion, we examine the scope for competitive price discrimination in the market. We do this by documenting the level of market share rivalry that exists between brands within product categories.

Market Share Rivalry

The diversity of brands available to consumers varies across categories as evidenced in fig. 3.2. The average lower bound to the number of brands within the Chocolate Countline market is as high as 84, while for products such as Chocolate Multipacks, Sausages, and Cat Food brands number between 6 and 12. Although brands are imperfect substitutes being horizontally or vertically differentiated, evidence suggests that the degree of substitutability between brands is extremely high. The degree to which these brands are substitutable and consumers are able or willing to switch between alternative offerings is measured as RESQBRN. Similar measures can be used to measure consumer willingness and ability to switch between firms in the product category RESQFRM. The growth rate of an individual brand/firm is computed as,

$$g_{it} = \frac{SLU_{it} - SLU_{i,t-1}}{(SLU_{it} + SLU_{i,t-1})^2}$$  

in which SLU refers to brand/firm unit sales volume. The index is bounded in the interval (-2, 2), where the former represents a new brand/firm entrant and the latter the exit of an existing brand/firm from the market. The net growth rate in the market measures the degree to which aggregate sales expansions ($POS_i$) exceed contractions ($NEG_i$). The following thus holds, where $s_i$ denotes brand/firm market share,

$$POS_i = \sum_{i=1}^{N} (s_i \times g_{it}) \quad \forall g_{it} > 0$$

$$NEG_i = \sum_{i=1}^{N} (s_i \times |g_{it}|) \quad \forall g_{it} < 0$$

(7) 

$$NET_i = POS_i - NEG_i$$

Turnover in the product category as indicated by the level of simultaneous brand/firm expansions and contractions is represented as

$$SUM_i = POS_i + NEG_i$$

(8)

An index of brand/firm heterogeneity which captures the amount of real market share rivalry taking place independently of the net product cycle is denoted RESQ. This measures the simultaneous brand/firm sales expansions and contractions net of the product cycle in product category $i$,

$$RESQ_i = SUM_i - |NET_i|$$

(9)

It is apparent from fig. 3.3 that the range of brands offered may be considered close but imperfect substitutes. Over two month period, as high as 29 per cent of the total product category sales in the case of Regular Carbonates represents switching between brands net of the product cycle. Also evident from the graphs is the degree of variation over time and over units.

A factor that could be critical to our analysis but which is not developed in section II is the impact that multi-brand firms exert on price dispersion under imperfect competition. Comparing the number of firms to brands in fig. 3.2 shows this to be a feature of the market although there is substantial variety exhibited across different product categories. Firms may supply more than one brand in an endeavour to target individual niches based on different consumer
tastes. This is evident in the tea market where the dominant firms produce a sizeable number of brands characterised by different vertical attributes (tea leaves versus bags, large versus small packages, and regular versus premium). Alternatively, multi-brand firms may arise as a result of brand proliferation. In highly proliferated industries, such as the Cereals or Confectionery industries, consumers value variety and the scope for self-selective discrimination is high. In the Confectionery market for example, brand proliferation is rampant where a variety of brands are provided to cater for a wide spectrum of consumer tastes but firms provide multiple brands within these taste niches. The question arises now as to what degree consumers are willing to switch between different firms in the market, the level of competition between rival firms, and the subsequent impact on pricing strategies adopted in the market.

As evidenced in fig. 3.4 consumers willingness to switch between firms exhibit similar patterns to that observed for brands with the exception of those highly proliferated categories. This is due to the fact that different brands supplied by a single firm actually target different niche segments of the product category and within these segments firms compete only with brands offered by market rivals, as illustrated in the context of the tea market. In highly proliferated markets however, firms compete both with their own and with rival brands within individual taste niches. Intra-firm competition is inevitable for these products and the degree of consumer switching between firms will be considerably lower than for brands. Nevertheless intra-firm pricing of brands must be reasonably competitive if proliferation is to successfully act as a barrier to brand entry.

The total turnover in a given product category as represented by the level of simultaneous expansions and contractions of brands $i$ is in part determined by the absolute net sales growth in the product. The remainder can be decomposed into that driven by competition between brands of rival firms $j$, and competition between brands within firms $j$. The relative contribution of these three elements to overall turnover in a given product category can be computed as follows,

$$SUM_t = |NET_t| + \sum_j |NET_{jt}| - |NET_t| + \sum_i |SUM_{jt}| - |NET_{jt}|$$ (10)

where measures on the right hand side refer to the absolute net product growth, inter-firm competition and intra-firm competition respectively. These features are reflected in fig. 3.5. While intra-firm competition is evident in all categories this is relatively higher on average for proliferated products as expected. Some element of inter-firm competition does exist however and consumers do display some willingness to switch between firms. The threat and the potential of consumers to switch between firms will result in optimal pricing strategies which may be sufficient to discipline players into pricing competitively and hence may limit the ability of firms to exploit their inter-brand linkages.

To sum up, a large range of brands are provided which are close but imperfect substitutes and consumers exhibit tendencies to switch easily
between these alternative brands. While firms generally do provide multiple brands their ability to exploit inter-brand linkages may be limited either because individual brands target specific taste niches or, in the case of proliferated products, the threat of consumer switching between alternative firms disciplines pricing.

Factors which affect the degree of substitutability between brands or the ability of retailers to exercise monopolistic power over price in the different product categories can be categorised into demand and supply side structural features.

**Demand Side Features**

Total sales in a product category averaged over all brands, AVESLU, can be used as an indicator of the product cycle as represented by:

\[
AVESLU = \frac{\sum_{i=1}^{N} SLU_i}{N}
\]  

(11)

where N is the number of brands and SLU is the unit sales of a brand in a product category. Higher values indicate boom periods in which the performance of the product category is elevated, while lower values coincide with bust periods for the product. The cyclicity of consumer demand is particularly evident for certain product categories as exemplified by that of Can Sized Carbonates in figure 3.6 where demand peaks in July and reaches its nadir in January. This is mainly seasonally determined and exogenous to firms attempts to manipulate cycles with prices. Intuitively one would predict greater competition in bust rather than boom periods. In boom periods expansion in brand sales is driven by the product cycle. In bust periods however, brands seem to compete more aggressively in an attempt to maintain current sales levels. A simple correlation between average sales levels and the degree competition as measured by the degree of inter and intra firm competition in product categories seems to confirm this intuition. Competitive theories of price dispersion would therefore suggest a negative relationship with the product cycle. Conversely, a positive relationship between the level of price dispersion and average sales is predicted where discrimination is monopolistic.

It is our belief that concentration measures of brand sales within product categories reveal information on consumers self-selective taste patterns. The presence of a large number of very similar brands within a category is indicative of consumers desire variety. For example, in the grocery market products may only be differentiated by size or slight differences in ingredients or sweetness. Pricing of brands and other choice variables of firms do not necessarily determine this distribution of preferences which can be quite exogenous. Concentration of brands for individual product categories are computed using the herfindahl index which is normalised across product categories by subtracting the corresponding measure in which all firms have equal market share. This measure not only reflects the number of brands, but weights their importance to the consumer base,

\[
HERF = \sum_{i=1}^{N} S_i^2 - N \left( \frac{1}{N} \right)^2
\]  

(12)

where N refers to the number of brands in the product category, and \( S_i \) to their individual market shares. In the empirical section we use both continuous and discrete versions of this measure. Discrete structural variables, CONC, are
employed in our regressions where the cut-off point refers to that level of Herfindahl concentration above which fifty percent of all observation lie.

Fig. 3.7 shows the average level of brand concentration by product category. While concentration levels for all categories are low per se, the largest value being 0.212 for Sausages, some variation is exhibited across units. Average levels of concentration measure are particularly low at 0.013 for the Confectionery Countline market.

Monopolistic theories of price dispersion would suggest a positive relationship with brand concentration while an inverse relationship is expected in competitive theories. More fragmented structures providing a greater range of brands with less category dominance will reduce the impact of the industry demand elasticity. However cross-price elasticities vary directly with the number of brands in the market. With the introduction of more brands substitutability between brands is enhanced and price-cost mark-ups on individual brands will decline. Price dispersion that is competitively driven will rise with the degree of brand fragmentation in the product category.

Supply Side Features

As indicated by Hotelling (1929) and D'aspremont (1979), strategic positioning in the market involves a trade off between maximising market coverage and insulating brands from competition. In the context of the Independent grocery sector firms are faced with the option of maximising the number of stores in which brands are distributed or embarking on a strategy of specialisation within a selected sub-group of stores. The benefits of specialisation are reaped firstly through the lower physical costs of distributing to and monitoring of Independent retailers, and secondly through enhanced market power where successfully insulated from competing rival brands. Market coverage and the level of market specialisation are depicted in figs. 3.8 and 3.9 respectively. Market coverage is measured by indices SIMAX and PCMAX. The percentage of stores being supplied with a brand, weighted by market share and aggregated over all brands in the product category gives SIMAX,

$$SIMAX = \sum_{i=1}^{N} \left( \frac{O_{i}^{'} \times S_{i}}{O_{mt}} \right)$$

(13)

where $O^{'}$ refers to the number of outlets carrying brand $i$, $O_{mt}$ is the total number of outlets in the market, $S_{i}$ is brand market share and $N$ represents the number of brands. Total category sales in these distributing stores $O^{'}$, computed as a percentage of total product category sales over all stores $O_{mt}$, shows the relative importance of these outlets for distribution in that category. Weighting by market share and aggregating over all brands gives this alternative measure of brand distribution within a product category,

$$PCMAX = \sum_{i=1}^{N} \left( \frac{\sum_{i=1}^{N} SLU_{i}^{'} \times S_{i}}{\sum_{i=1}^{N} SLU_{O mt}} \right)$$

(14)

Both SIMAX and PCMAX measures are extremely high for the Independent oriented 'impulse' goods. Market coverage is not so extensive and exhibits much more variation across product categories for the 'top-up' goods. While distribution is not extensive for these products, it is strategic. Those outlets which are targeted tend to account for a very high proportion of product category sales, PCMAX, and hence characterise the more important stores for distribution in that category.
SPEC captures the degree of product category brand specialisation in clusters of outlets which avoids competition. This reflects the degree to which brands strategically target and dominate a small number of outlets. A more narrowly defined measure of a brand's market share calculates its sales as a proportion of total product category sales within those outlets in which a brand distributes. This is a brand's relevant market share, $S_r^i$. Comparing this measure with market share computed as a fraction of overall product category sales, weighting by market share and aggregating over all brands gives an index of specialisation at the product category level.

$$\sum_{i=1}^{N} \left[ S_r^i - \frac{S_r}{N} \right]$$

$$SPEC = \sum_{i=1}^{N} \left[ S_r^i - \frac{S_r}{N} \right] \times S_r$$  \hspace{1cm} (15)

If $S_r^i$ is equal to $S_r$, brand $i$ is distributed in all outlets. The level of specialisation rises with the differential between $S_r^i$ and $S_r$. Fig. 3.9 indicates lower levels of specialisation for those categories where market coverage is wide in terms of the number of outlets targeted. This is particularly high for Cat Food where many outlets appear to only carry one brand. Greater specialisation of outlets result in a limited choice of brands for the consumer within an outlet which reduces the potential for consumers to switch easily between alternative brands without going to another store. In addition, greater monopolistic power is conferred in price setting. Competitive product categories with higher degrees of specialisation will exhibit lower levels of price dispersion as a result. Conversely, monopolistic price dispersion will increase with specialisation in the product category.

The final retail price facing the consumer is not only determined by the pricing strategies of the firm but also by the pricing strategy of the retailer. Empirically, we develop a proxy to measure the degree to which retailers adhere to firms' recommended resale prices. While firms may recommend retail prices, independent retailers can set prices based on their own circumstances which is contingent upon the nature of the specific market into which they are selling. The more dependent a retailer is on a firm, however, and the greater the level of retailer monitoring by upstream suppliers, the lower the ability of retailers to set prices based solely on their own criteria. The degree of interaction between retailer and firm can be proxied by the frequency with which a retailer receives a delivery. This is measured using PCDEL which represents at the aggregate level the number of outlets receiving a delivery over the audit period and the relative importance of these outlets in relation to total product category.

$$PCDEL = \sum_{i=1}^{N} \left[ \sum_{j=1}^{N} \frac{SLU_{i,j}}{SLU_{i,j}} \right] \times S_r$$  \hspace{1cm} (16)

where $SLU_{i,j}$ refers to those outlets carrying brand $i$ which have received a deliver over a two-month period. Fig. 3.10 shows a high frequency of delivery for classified independent oriented 'impulse' products, other categories for which independents are relatively important such as tea, and perishable items such as sausages. More frequent deliveries suggests a reduction in the degrees

\[7\] Larger differences may be generated either as a result of a brand distributing in a small number of outlets, or alternatively distributing in outlets accounting for a small proportion of total category sales. Both reflect the dominance of the brand within its relevant market.

\[8\] If a retailer is highly dependent on a firm, perhaps due to consumer loyalty to a brand or the high level of retail sales generated by a brand, retailers will adhere more closely to the recommended prices.
of freedom which a retailer may exercise in price setting and hence lower levels of monopolistic price dispersion, while possibly increasing competitive price dispersion.

Summary

The structural features of demand and supply within product categories of the Independent retail grocery sector impact the level of competition, the degree of substitutability, and the ability of retailers to exercise power over price in the market. The predicted effect which such features have on price dispersion is contingent upon whether prices are monopolistically or competitively driven. These predictions are summarised below.

<table>
<thead>
<tr>
<th>Price Discrimination</th>
<th>Competitive</th>
<th>Monopoly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Sales</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Concentration</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Specialisation</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Delivery Frequency</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Section IV

The impact of structural features on price dispersion is examined for the Irish Independent retail grocery sector using panel data modelling techniques. Each observation of the dependent variable corresponds to the observed level of price dispersion between brands for a given product category \( j \) at a given point in time. These depend on a number of factors which are both observable and unobservable. The basic model may be written as follows,

\[
RSP\text{VAR}_{jt} = \alpha + \beta_1 AVESLU_{jt} + \beta_2 HERF_{jt} + \beta_3 SPEC_{jt} + \\
\beta_4 DEL_{jt} + \beta_5 MTH + \nu_j + \nu_{jt}
\]  

(17)

Table 3.1 presents summary statistics for variables used in the regression analysis. The influence which structural demand features have on price dispersion is captured by the product cycle effect, AVESLU, and consumers revealed preferences for brands, HERF. The role of supply side features are reflected in the degree of specialisation, SPEC, and the frequency of delivery, DEL. The inclusion of MTH controls for the month using a dummy variable. Model intercepts may exhibit heterogeneity across product categories as a result of unobservable factors which are not captured in our independent variables. Examples of such unobservable unit specific effects include differences in relative costs, advertising and promotions expenditures, and the level of retailer supplier bargaining power. The failure to acknowledge parameter heterogeneities among cross-sectional units will inevitably result in biased estimates of the model. Unobserved heterogeneity between product categories is therefore controlled for through the inclusion of a unit specific residual \( \nu_j \) which is comprised of a collection of factors not in the regression that are category specific and constant over time.

The large number of factors that affect the value of the dependent variable but have not been explicitly included as independent variables can appropriately be summarised by a random disturbance across cross-sectional units drawn from a large population which is independent of other regressors.

---

9 The presence of unobserved heterogeneity between product categories was tested for using an F test on the hypothesis of equal slopes.
and is incorporated into the error term. A random effects model is therefore applied under the following assumptions.\(^{10}\)

\[
E[e_{jt}] = E[v_j] = 0 \quad E[e_{jt}v_k] = 0 \quad \forall j, t \text{ and } k
\]

\[
E[v_j^2] = \sigma_v^2 \quad E[v_jv_k] = 0 \quad \text{if } j \neq k
\]

\[
E[\varepsilon_{jt}^2] = \sigma_e^2 \quad E[\varepsilon_{jt}\varepsilon_k] = 0 \quad \text{if } t \neq s \text{ or } j \neq k
\] (18)

Efficient estimation requires a GLS procedure which yields a matrix weighted average of within and between units estimators.\(^{11}\) From the basic model,

\[
y_{jt} = \alpha + X_{jt}'\beta + \nu_j + \varepsilon_{jt}
\] (19)

the between estimator discards over time information in the data in favour of simple means while the within (fixed effects) estimator only utilises variation within each group. The random effects estimator uses both the within and the between information and is estimated using GLS on the following,

\[
(y_{jt} - \bar{y}_j) = (1-0)\alpha + (X_{jt} - 0\bar{X}_j)\beta + [(1-0)\nu_j + (\varepsilon_{jt} - 0\bar{\varepsilon}_j)]
\] (20)

where \(0\) is a function of \(\sigma_v^2\) and \(\sigma_e^2\).\(^{12}\)

Using the random effects approach as a means of controlling for unobserved heterogeneity between product categories, a summary of the estimates obtained for the basic model, using both a continuous and discrete measure of concentration, illustrated in table 4.1. The explanatory power of the model suggests that differences in price dispersion across units and over time can in part be explained by differences in the structure of demand and distribution in the market. Each of the independent variables are significant at the 5 per cent level and yield similar results for models using both continuous and discrete measures of concentration.\(^{13}\) Structural demand and supply features for the product category emphasise the role which competition has for pricing in the Independent retail grocery market.

The results for the product cycle, AVISLU, suggest greater price dispersion during slump periods. Since this is associated with more aggressive competition for the consumer base, a negative relationship with price dispersion is indicative of competitive pricing. Consumers revealed preferences for brands measured using a normalised herfindahl index, HERF, illustrates a negative and highly significant effect giving further evidence of the role which the willingness and ability of consumers to switch between alternative brands plays in determining price dispersion in the product.

Corresponding results for the discrete measure of concentration predict a similar but weaker effect. The structure of demand in the Independent retail grocery sector therefore suggests that products with lower average sales and more fragmented sales structures will result in price dispersion that is competitively driven.

Examining the effect which supply side characteristics have on price dispersion between brands in product categories reveals a positive relationship with the degree of market specialisation and a negative relationship with the frequency of delivery. Higher levels of specialisation and less frequent

\(^{10}\) The suitability of applying a random effects model was tested using the Breusch-Pagan test (1980), which tests the hypothesis that \(\text{Var}(\nu_j) = 0\).

\(^{11}\) For a detailed description of the random effects model applied to panel data consult Greene (1996).

\(^{12}\) If \(\sigma_v^2 = 0\) then this implies that \(\nu_j = 0\) and \(0 = 0\) and equation 19 can be estimated directly using OLS. Alternatively if \(\sigma_e^2 = 0\) this means that \(\nu_j = 0\) and \(\varepsilon_{jt} = 0\), and the within estimator returns all the information available.

\(^{13}\) As argued in the previous section, it is our opinion that these variables can be treated as exogenous in the model.
deliveries reduce competition between brands while enhancing the degree of monopolistic power in price setting. Categories which are highly specialised in their distribution with greater independence of suppliers will therefore increase dispersion that is monopolistically based while reducing dispersion that is competitively based.

Fundamental differences in terms of underlying demand and supply side structural features exist between classified ‘impulse’ and other ‘non-impulse’ product categories. We test the equality of coefficients across these product type classifications using both intercept and slope dummy variables. The resultant estimates are given in Table 4.2. The intercept dummy variable, IMPULSE, adopts a value equal one in the event that a product is defined as an ‘impulse’ product and zero otherwise. Interacting this discrete variable with the product cycle, concentration structure, specialisation and delivery frequency, represented by D1 through to D4 respectively, tests the equality of the slope coefficients. The effect which the degree of specialisation has on price dispersion is reinforced for ‘impulse’ goods while all other intercept and slope dummy variables remain insignificant. This is true both for models using a continuous (Model II (a)) and a discrete (Model II (b)) measure of concentration. Similar tests for the equality of coefficients across different product classifications based on the degree of proliferation, concentration, and perishable versus non-perishable goods, reveal little difference in results. The model is therefore robust across a broad range of specifications.

Conclusion

An interesting feature of the Independent sector is the fragmented distribution of outlets and consumers desire to purchase certain ‘routine’, ‘impulse’, ‘perishable’ or ‘top-up’ goods at local stores at unusual hours. This could potentially result in a large degree of monopolistic localised retailer power. Closer examination at the product category level suggests however, that the extent to which this prior holds will vary substantially depending upon the structural demand and supply side features inherent in the category. Those structural features which enhance strategic cross-price effects and/or diminish the ability to exercise localised market power in price setting will increase dispersion that is competitively driven while simultaneously reducing the scope for traditional monopolistic price dispersion. Our results suggest the presence of imperfectly competitive pricing of brands in product categories. Price dispersion rises with a slump in the product cycle, rises fragmentation in the sale structures, rises with specialisation in outlet distribution, and rises with factors that enhance downstream retailer power. We can therefore discriminate between monopolistic and imperfectly competitive pricing in the Irish grocery market. However, mapping a relationship between the various structural features and the outcome of price dispersion can only at best provide indirect evidence for imperfectly competitive pricing since strategic interaction between players is effectively treated as a ‘black box’ in our methodology.
### Table 2.1: Market Share Data by Region

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20.0</td>
<td>25.0</td>
<td>30.0</td>
<td>35.0</td>
<td>40.0</td>
<td>45.0</td>
</tr>
<tr>
<td>B</td>
<td>30.0</td>
<td>25.0</td>
<td>20.0</td>
<td>15.0</td>
<td>10.0</td>
<td>5.0</td>
</tr>
<tr>
<td>C</td>
<td>15.0</td>
<td>20.0</td>
<td>25.0</td>
<td>30.0</td>
<td>35.0</td>
<td>40.0</td>
</tr>
</tbody>
</table>

**Note:** This table provides the market share data for different years across three regions (A, B, and C).

### Table 2.2: Product Categories Analyzed

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beverages</td>
<td>Regular</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>158</td>
</tr>
<tr>
<td>Foods</td>
<td>Regular</td>
<td>184</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>213</td>
</tr>
<tr>
<td>Health Care</td>
<td>Regular</td>
<td>132</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>164</td>
</tr>
<tr>
<td>Personal Care</td>
<td>Regular</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>148</td>
</tr>
</tbody>
</table>

**Note:** This table lists the product categories analyzed with their respective sub-categories and quantities.

### Table 3.1: Descriptive Statistics Within and Between Product Categories

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>30</td>
<td>10</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Income</td>
<td>50</td>
<td>20</td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

**Note:** This table presents the descriptive statistics for variables such as age and income, with their respective mean, standard deviation, minimum, and maximum values.

### Appendix

Additional data and notes related to the analysis provided in the main tables.
### Table 4.1: Regression Results for Basic Model I

<table>
<thead>
<tr>
<th></th>
<th>(a) Continuous Concentration</th>
<th>(b) Discrete Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>R² within</td>
<td>0.6094</td>
<td>0.6092</td>
</tr>
<tr>
<td>between</td>
<td>0.1393</td>
<td>0.1249</td>
</tr>
<tr>
<td>Overall</td>
<td>0.1562</td>
<td>0.1586</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>10.7443</td>
<td>10.9007</td>
</tr>
<tr>
<td>AVESTU</td>
<td>-0.00250</td>
<td>-0.0023</td>
</tr>
<tr>
<td>(1.305)*</td>
<td>(1.470)*</td>
<td></td>
</tr>
<tr>
<td>HERF</td>
<td>12.4474</td>
<td>-2.992*</td>
</tr>
<tr>
<td>CONC</td>
<td>-0.5652</td>
<td>-0.7562</td>
</tr>
<tr>
<td>SPCC</td>
<td>6.6162</td>
<td>6.1066</td>
</tr>
<tr>
<td>(1.210)*</td>
<td>(1.249)*</td>
<td></td>
</tr>
<tr>
<td>DEL</td>
<td>-4.7746</td>
<td>-5.129</td>
</tr>
<tr>
<td>(1.701)*</td>
<td>(1.4027)*</td>
<td></td>
</tr>
<tr>
<td>MONTH</td>
<td>-0.0298</td>
<td>-0.0021</td>
</tr>
<tr>
<td></td>
<td>(-0.236)</td>
<td>(-0.011)</td>
</tr>
</tbody>
</table>

* Significant at the 5% level

### Table 4.2: Regression Results for Model II: Impulse versus Non-Impulse

<table>
<thead>
<tr>
<th></th>
<th>(i) Continuous Concentration</th>
<th>(ii) Discrete Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>R² within</td>
<td>0.6551</td>
<td>0.6528</td>
</tr>
<tr>
<td>between</td>
<td>0.2001</td>
<td>0.3156</td>
</tr>
<tr>
<td>Overall</td>
<td>0.2166</td>
<td>0.1156</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>11.0193</td>
<td>10.786</td>
</tr>
<tr>
<td>AVESTU</td>
<td>0.00246</td>
<td>-0.00315</td>
</tr>
<tr>
<td>(1.351)*</td>
<td>(1.4564)*</td>
<td></td>
</tr>
<tr>
<td>HERF</td>
<td>-14.2957</td>
<td>-16.4558</td>
</tr>
<tr>
<td>CONC</td>
<td>-1.7064</td>
<td>-1.7061*</td>
</tr>
<tr>
<td>SPCC</td>
<td>6.84788</td>
<td>6.0444</td>
</tr>
<tr>
<td>(1.835)*</td>
<td>(1.396)*</td>
<td></td>
</tr>
<tr>
<td>DEL</td>
<td>-5.207</td>
<td>-4.91796</td>
</tr>
<tr>
<td>(4.199)*</td>
<td>(4.083)*</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>0.6053</td>
<td>-0.9057</td>
</tr>
<tr>
<td>D2</td>
<td>7.119</td>
<td>-0.3152</td>
</tr>
<tr>
<td>D3</td>
<td>15.1212</td>
<td>17.2996</td>
</tr>
<tr>
<td>(6.764)*</td>
<td>(6.794)*</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>9.6505</td>
<td>5.45567</td>
</tr>
<tr>
<td>IMPULSE</td>
<td>1.899*</td>
<td>0.860*</td>
</tr>
<tr>
<td>MONTH</td>
<td>0.1433</td>
<td>0.0109</td>
</tr>
<tr>
<td></td>
<td>(1.337)</td>
<td>(1.977)</td>
</tr>
</tbody>
</table>

* Significant at the 5% level

### Fig. 2.1: Retail Food Concentration

Source: AC Nielsen

### Fig. 2.2: Number of Independent Outlets

Source: AC Nielsen

### Fig. 2.3: Food Concentration Curve for Independent Retail Sector

Source: AC Nielsen
Fig. 2.4: Independent Share of Total Product Category Sales

Source: AC Nielsen

Fig. 3.1: Price Dispersion in Independent Outlets Averaged over Time

Fig. 4.1: Number of Brands and Firms for Independents Averaged over Time

Fig. 4.2: Brand Switching within Categories for each Bi-Monthly Observation

Fig. 4.3: Firm Switching within Categories for each Bi-Monthly Observation

Fig. 4.4: Relative Share of Intra and Inter Competition to the market Averaged over Time
Fig. 5.1: Average Unit Sales for Can Sized Carbonates in Independents

Fig. 5.2: Brand Concentration in the Independent Sector Averaged over Time

Fig. 5.3: Market Coverage in the Independent Sector Averaged over Time

Fig. 5.4: Market Specialisation in the Independent Sector Averaged over Time

Fig. 5.5: Frequency of Delivery in the Independent Sector Averaged over Time
Bibliography


