Micro-Marketing and Chain-Store Competition: Customized vs. Uniform Store-Level Pricing

Paul W. Dobson
Business School, Loughborough University, Loughborough LE11 3TU, United Kingdom
E-mail: p.w.dobson@lboro.ac.uk, Tel: +44 1509 223297, Fax: +44 1509 223961

Michael Waterson
Department of Economics, University of Warwick, Coventry CV4 7AL, United Kingdom
E-mail: michael.waterson@warwick.ac.uk, Tel: +44 2476 523427, Fax: +44 2476 523032

Comments welcome, on this draft, but do not quote.

Version: December, 2006

Micro-Marketing and Chain-Store Competition: Customized vs. Uniform Store-Level Pricing

ABSTRACT

Developments in information gathering and processing have led to considerable interest in *micro-marketing*. In the quest for increased profits, managers of retail chains may be attracted to the idea of customizing prices to the store level according to local demand and competitive conditions. For example, if chain stores face lower demand and/or more competition in some locations than others, it may be tempting to price lower in those areas. However, we show generally and illustrate through means of a specific model that there is a strategic incentive to soften competition by committing *not* to customize prices at the store level and instead adopt uniform pricing across the store network. Moreover, for a range of parameter values that we characterize, this incentive is sufficiently strong to allow for higher profits to be achieved under uniform pricing rather than local pricing. We also show that the strategic incentive is enhanced when all firms in the industry agree (or are obliged by a competition authority) to adopt a similar policy, and even that there are cases where both firms and consumers (as a group) are benefited thereby.

Key words: micro-marketing; retail chains; price discrimination; uniform pricing; consumer welfare

Version: December, 2006

1. Introduction

Large national or regional chain store groups now dominate most sectors of retailing. Competition has become focused on a battle between large chains with a resultant squeeze on independents. In their relentless drive for further growth, chains often appear to have the best of both worlds. They have the cost savings and marketing clout of a large purchaser coupled with the potential flexibility to tailor offers across the local markets they serve. This potential flexibility has been realized through developments in information gathering and processing and has led to considerable interest by retail managers in *micro-marketing*, or the customization of marketing mix variables to the store-level (Montgomery 1997). The question we examine in this paper is whether the prospect of tuning prices to particular conditions can have negative impacts on the firm through the competitive process. In short, are there circumstances where micro-marketing reduces income?

At a basic level, micro-marketing may involve determining price bands for a *zone pricing* policy, whereby stores are clustered together according to general price bands. More sophisticated micro-marketing may involve store-by-store customization of individual product prices. Also, the approach can extend considerably beyond prices to cover a multitude of other store-level marketing elements. Thus, at the heart of micro-marketing, and in common with all of its possible forms, lies the concept of offering the customers of a store in one location something different from the chain's consumer offer in another location. When applied to setting different store-level price bands, it represents a form of third-degree price discrimination, with consumers in one location paying higher prices and thus being in a worse position than consumers in another location.

One concern for managers using micro-marketing might be negative consumer sentiment towards a retailer using discriminatory practices that would detrimentally impact on the chain's image and/or have an adverse effect on overall demand.[1] Another might be arbitrage.

The concern we focus on is different. A retailer's use of micro-marketing may impact on competition. Hence, insights from single-firm models can be misleading. In particular, a price-led micro-marketing policy based on meeting or beating local competition may alter competitor behavior, possibly triggering more aggressive responses and thereby intensifying competition. This is an especially

[1] Anderson and Simester (2001) raise a quality signaling issue in this regard. If negative consumer sentiment is the concern then the retailer might look to micro-marketing strategies that have broadly neutral consumer welfare effects. For example, Montgomery (1997) suggests adjusting store-level prices while holding the average category price and revenues at a constant level. Alternatively Chintagunta et al. (2003) propose using balanced price discrimination strategies across stores that generate additional profits without appropriating "too much" consumer surplus. Even with these restrictions, Montgomery's (1997) analysis indicates that micro-marketing pricing strategies could increase gross profit margins by 4% to 10% over a uniform pricing strategy, feeding through to an increase in operating profit margins of 33% to 83%. Chintangunta et al. (2003) find that a constrained store-level pricing policy could yield additional gross profits of 5.6% to 7.4% over uniform pricing (compared with an increase of 9.6% to 16.3% for unconstrained store-level pricing).

important consideration when micro-marketing covers most or all (rather than just a few) product categories and store-wide prices will be affected, so increasing the chance of there being an intensification of retail price competition.

We develop a model of retail oligopoly, governed by competition between rival chains, to examine the impact on profits of customizing store-level prices, which we term "local pricing", by comparison with the retailer adopting "uniform pricing", namely chain-wide prices applicable to all their stores. We show both a general tendency and provide an illustrative characterization of when it is in a firm's interests to price uniformly across stores.

Concerns about whether customizing prices intensifies competition have been the subject of a burgeoning literature on price discrimination in oligopoly (e.g. see Stole (2005) and Armstrong (2006) for detailed surveys).[2] A particularly useful distinction to emerge has been between what Corts (1998) terms "best-response symmetry" and "best-response asymmetry" situations, in which, respectively, competitors hold the same or opposite view as to whether markets are "strong" or "weak".

Under best-response asymmetry, clear results can emerge where all prices may fall with "all-out competition" or may rise with "all-out price gouging", depending on the extent to which rivals aggressively target consumers with tastes more naturally inclined towards their rivals.[3] Moreover, the finer the degree of market segmentation and the more precise the information on consumers, in the limit offering personalized pricing (i.e. first-degree price discrimination), the more exaggerated the net effect on prices may become (e.g. Shaffer and Zhang 2002, Chen and Iyer 2002, Liu and Serfes 2004, Acquisti and Varian 2005, and Ghose et al. 2005).

By contrast, our focus is on arguably more relevant "best-response symmetry" situations, where firms share the *same* view on what constitutes a strong market (indicating potential for higher prices) and a weak market (suggesting lower prices). This applies to local retail markets where retailers' positions are more dependent on market conditions which affect all players (e.g. the area is affluent rather than poor or competition is limited as opposed to intense) than on idiosyncratic differences (say, due to consumer preferences for particular chains altering considerably across areas). At a general level, Holmes (1989) made significant progress in setting out the issues. He showed that equilibrium prices (not surprisingly) will be higher in the strong markets and lower in the weak markets. Corts (1998) relaxed Holmes'

[2] On the related literature on using coupons to discriminate between groups of consumers in oligopoly, see Shaffer and Zhang (1995) and Bester and Petrakis (1996) on *inter*-store (geographic) discrimination and Besanko et al. (2003) on an *intra*-store discrimination (such as issuing customized coupons at the point of sale).

[3] All-out competition arises when each firm is under intense competitive pressure to ensure that consumers more favorably inclined to themselves are not taken away by rivals, while at the same time aggressively targeting (with low prices) consumers more favorably inclined towards rivals. In contrast, with all-out price gouging, competitors are less concerned about targeting rivals' strong markets, and more inclined to focus on securing their own "home" markets, with the result that competition is dampened. See Corts (1998) and Armstrong (2005) for some illustrations.

assumption of symmetry and found that unambiguous price effects occur in some cases. Neither Holmes nor Corts allowed competition, in the sense of firm numbers, to differ across markets. Yet we commonly see that in the largest markets, most players are present, whilst in smaller markets, only a subset is represented.

In order to provide guidance for managers in these situations, we investigate how specific market conditions (relating to the size and affluence of local markets and the intensity of local competition) influence retail oligopolists' choice of whether or not to customize prices on a store-by-store basis and how this choice is likely to impact on profits. Our framework builds on Dobson and Waterson (2005), which looked at the pricing choices facing a single retail chain. However, we considerably extend this analysis to examine the more realistic situation where there is more than one retail chain operating in an economy, and where multiple retailers compete with each other on a national as well as a local basis. This allows us to consider a range of issues such as how each retailer views its position relative to a rival retail chain, whether individual and joint preferences over customizing prices differ, and whether partial collusion in the form of (tacit) agreement or understanding over pricing policy alters outcomes in a beneficial way to retailers and perhaps consumers as well.

We show quite generally that market conditions exist where it will be both individually and jointly profitable for retailers to eschew customizing prices and instead set uniform prices across their stores. For the individual retailer, this means forgoing high prices and high profits in the local markets where it has monopoly power and instead leveraging this market power across all its markets to raise prices in those markets where the intensity of competition otherwise makes them low. It entails sacrificing some local profits, but with the benefit of softening competition more broadly sufficiently to raise firm profits overall. We explore the conditions that support unilateral action in this manner. Although these are limited, there is considerably more scope for raising profits through uniform pricing if joint policy commitments are feasible (or where such pricing is required by a competition authority either formally through a ban on localized price discrimination or as an implicit condition to allow for other actions, e.g. mergers or store acquisitions from rivals[4]). A surprising result is that such semi-collusion (a joint understanding over pricing policy, but not over individual prices) can also be in the interests of consumers, i.e. a genuine win-win situation.

[4] For example, further to our discussion of UK grocery retailing in the next section and especially in the context of several major acquisitions that have been made by large (often national-pricing) retailers, the UK competition authorities have taken keen interest in even relatively small acquisitions made by retailers using local pricing. For instance, the UK Competition Commission recently required the grocery retailer Somerfield, with a national market share of less than 6%, to divest 12 (out of 115) stores previously acquired from another grocery retailer, Morrison, on concerns that the former's use of local pricing would allow it to exploit enhanced local market power to raise prices to consumers in the local markets served by those stores. See Competition Commission (2005) for details.

Specifically, we characterize conditions that support all firms adopting uniform pricing, all firms customizing their prices, and a mix of the two with asymmetric choices being made (where one chain adopts uniform pricing while a rival chain customizes its prices even when they are in ostensibly symmetric situations[5]). This is indeed what is found in practice. In some sectors, customizing prices appears the norm,[6] in others uniform pricing is common,[7] and yet in others a mix is observed.

As a prelude to our theoretical analysis, to gain further insight into the factors affecting pricing policy choices and the character of local retail markets we consider an example, the UK's grocery retailing sector. Until very recently this sector had an almost even split amongst the major retailers between those adopting local pricing and those adopting (national) uniform pricing. Interestingly, the balance in the last couple of years has swung in favor of retailers adopting uniform pricing. The questions arising from this case provide a key focus for our subsequent analysis and the nature of our theoretical model. Following on from this, we show a general result and set out the analytical framework in §3 in respect of a two-stage game theoretic model where firms first select and commit to their pricing policy (i.e. local or uniform pricing) and then they compete by setting individual prices. The pricing outcomes under each of the possible pricing policy configurations are shown in §4. Pricing policy choices based on individual preferences are examined in §5. Then, joint preferences are considered in §6. The impact of choices on consumer welfare is examined in §7. We conclude by discussing the implications of the analysis in §8.

2. An Illustration: "Local Price Flexing" in UK Grocery Retailing

Grocery retailing represents the largest retail sector in the UK, with annual sales of £95bn (approximately $170bn) in 2005. Four retailers – Tesco, Sainsbury, Asda and Morrison/Safeway – dominate the national market, accounting for around 75% of sales of grocery items (i.e., food and drink, cleaning products, toiletries and household goods), and indeed 30% of all retail sales in the UK.[8] These four supermarket retailers have primarily positioned themselves as "one stop shops", operating with very wide product ranges in large format stores. As such, they jointly account for nearly 95% of grocery sales for stores exceeding 1,400 sq meters (viewed by the UK competition authorities as the critical size distinguishing

[5] Following Lal and Rao (1997), our results offer another insight as to why retail sectors may simultaneously support both EDLP and Hi-Lo pricing retailers – though, in our case the issue is about consistency of prices across markets, rather than over time.

[6] For example, see Thomadsen (2006) on fast food, Goldberg and Verboven (2005) on cars, and Dalkir and Warren-Boulton (1999) on office stationery and equipment.

[7] Examples include clothing, electrical goods, and catalogue-based chain store retailers in the UK (Dobson and Waterson 2005).

[8] For instance, see IGD (2005) and Mintel (2005). Tesco alone is estimated to take more than one eighth of UK consumer retail expenditure.

one-stop grocery shops, serving primary shopping needs, from smaller stores catering for "top-up" and "convenience" grocery shopping).

While most of the retail grocery chains operate on a national level in the UK, there is considerable variation in regional and local market shares and concentration levels. Table 1 provides some summary evidence, based on a very detailed report into the sector undertaken by the UK's Competition Commission ("CC" hereafter) in 2000.[9] In particular, high levels of local concentration[10] were found in more rural areas[11] (notably in Scotland and Wales) and certain urban areas where a proliferation of stores from the same chain existed[12]. In addition to market structure differences, consumer income levels also differ from region to region (tending to be higher in the southern part of the UK) and from district to district (tending to be higher in urban areas as opposed to rural areas[13]), suggesting the presence of variation in local consumer demand and willingness to pay.

With differences in both local competition and local demand conditions, it might be thought that retailers would seek to take advantage of opportunities to set prices differently from store to store on micro-marketing grounds. In particular, retailers might set higher prices in areas where local competition was limited and/or average income levels were high, while setting lower prices in areas of more intense local competition and/or low average incomes. However, the CC (2000) found an almost even split between those firms that adjusted prices on a local basis and those that adopted uniform prices across all their stores. Of the fifteen main grocery chains operating in the UK, seven were found to vary prices from store to store based on local competition and demand conditions – a practice the CC called "local price flexing" – while eight used national pricing, with no local variation in prices.

---

[9] The table shows the separate positions of Morrison and Safeway prior to their merger in March 2004.

[10] In determining the degree of local concentration and the extent of store choice facing consumers at the local level, the UK competition authorities have tended to examine local markets in respect of drive times between stores or choice in post code (zip code) areas. For UK supermarkets, the Competition Commission (CC 2000, Appendix 6.3) identified that out of 1,700 stores surveyed, 175 stores were found to have a "monopoly" or "duopoly" status in local catchments (in respect of 10-minute drive times in urban areas and 15-minute drive times in rural areas around each of the stores). However, when restricted to competition between the major "one-stop-shop" grocery retailers and with 10-minute drive times, then 627 out of the 1,700 stores were found to have "monopoly" or "duopoly" status.

[11] This is perhaps not surprising with rural areas being less densely populated and store replenishment being more difficult in remote areas (i.e. in the absence of a nearby regional distribution centre).

[12] For instance, the British media has designated a number of areas as "Tesco towns" (e.g., see "Supermarkets to carve up high street", *Sunday Times* (London), February 19, 2006). As market leader, Tesco presently has the largest market share in 67 of the 120 postal districts in the UK, having more than 40% of the market in 14 districts, and more than 45% in five towns ("Power of 'big four' revealed in new figures", *The Guardian* (London), November 10, 2005). At the more disaggregated postal code level, it has been reported that out of the 1,452 postal areas of the UK, Tesco was found to have "an almost total stranglehold" on the retail food market in 108 areas, while accounting for over 50% of grocery spending in a further 104 areas ("Tesco profits feed fears of a stranglehold", *Sunday Times* (London), April 18, 2004).

[13] Even so, the range of income per capita varies considerably within both urban and rural areas. For instance, the CC (2000, Appendices 13.4 and 13.5) found that for a sample of urban areas, at postcode sector level, income per capita ranges from as low 35% to as high as 155% of the national average.

Table 1. Market Characteristics in UK Grocery Retailing, 1999

Main UK grocery retailers	*General character & pricing policy*	*Total grocery stores*	*National Market Shares*		*Regional Market Shares*		*Local Concentration*	
			All grocery stores (%)	*Grocery stores > 1,400 sq m (%)*	*Highest regional share (12 broad UK regions) (%)*	*Highest broad postcode share (120 narrow regions) (%)*	*% stores in local monopoly (10/15-minute drive time)*	*% stores in local duopoly (10/15-minute drive time)*
One-stop shops								
Tesco	Value-led Hi/Lo	642	23.0	28.5	46.5	53.6	6.0	10.3
Sainsbury	Hi/Lo	424	18.7	24.8	35.9	56.7	0.5	4.1
Asda	EDLP	227	12.2	16.8	24.8	46.8	0.0	3.1
Safeway	Hi/Lo	498	11.5	13.8	28.4	51.0	9.2	9.8
Morrison	EDLP + deals	95	3.9	5.4	21.9	45.0	0.0	4.2
Other chains								
Somerfield / Kwik Save	Hi/Lo Soft Discount	1,442	9.8	3.1	17.2	30.0	NA	NA
M&S	Premium	294	4.9	2.2	12.1	NA	NA	NA
Waitrose	Premium	119	3.0	2.5	9.0	NA	NA	NA
Aldi	Hard Discount	219	1.4	0.0	3.1	NA	NA	NA
Lidl	Hard Discount	173	0.9	0.0	2.6	NA	NA	NA
Netto	Hard Discount	120	0.7	0.0	2.1	NA	NA	NA
Budgens	Hi/Lo	177	0.7	0.0	0.9	NA	NA	NA
Iceland	Specialized/deals	770	3.0	0.0	0.3	NA	NA	NA
Booth	Premium	24	0.2	0.1	1.3	NA	NA	NA
Co-operatives	Hi/Lo	1,920	6.4	2.8	7.7	NA	NA	NA

Source: adapted from CC (2000; Tables 5.2, 5.3, & 8.30, Appendices 5.2 & 7.1)

Table 2 shows the extent and character of local price flexing identified by the CC. Individual product prices were found in some retailers to vary considerably (by as much as 100%), but average prices differed across each chain by less than 3%.[14] The CC investigated the basis on which local pricing operated, identifying the critical factors influencing store-level pricing (as shown in the final column of Table 2). Broadly speaking, price flexing was used by those retailers that employed promotional "Hi/Lo" pricing, while national pricing was used by EDLP, hard discount, and premium positioned retailers. For the seven retail groups that did vary prices, both differences in local demand (in respect of income or regional effects) and local competition (in respect of local market power or facing particular price-focused competitors) were found to be important in determining the price band applied to individual stores and the

[14] While the percentage variations might appear fairly small, the monetary sums involved can be quite significant given the size of the sector. For example, the CC (2000, paragraph 7.124) found that for the largest retailer, Tesco, customers in its lower-price stores saved between £10.5 million and £25.9 million a year over the prices charged in higher-price stores.

variation in prices across the chain of stores.[15] Cost elements (like differences in store size) were also found to play a role, but not so significantly as to explain the full extent of store-to-store price variation.[16]

Table 2. Local Price Flexing by UK Grocery Retailers, 1999

Store Fascia	*Price-flexed products * (%)*	*Widest price range on any price-flexed product*	*Average price range for price-flexed products (%)*	*Basket price range across stores (sales weighted) (%)*	*Identifiable store-level price bands (1=Uniform)*	*Factors influencing store-level pricing †*
Tesco	8.5	43.4	19.2	1.69	5	R/Y/E/D
Sainsbury ‡	NA	NA	NA	NA	2+	S/R/E
Asda	0	0	0	0	1	-
Safeway	59.5	31.0	4.3	1.09	3	M/E/D/S/R
Morrison	0	0	0	0	1	-
Somerfield	23.7	100.0	6.3	0.20	10	E/S/M
Kwik Save	2.3	16.1	9.8	0.79	3	D/M
M&S	0	0	0	0	1	-
Waitrose	0	0	0	0	1	-
Aldi	0	0	0	0	1	-
Lidl	0	0	0	0	1	-
Netto	9.9	23.5	13.7	0.001	2	R
Budgens	64.5	62.0	9.8	3.04	5	Y/D/M
Iceland	0	0	0	0	1	-
Booth	0	0	0	0	1	-
Co-op	33.7	57.0	6.7	0.54	4	R/S/M

Notes:
* Based on a basket of up to 200 common products with prices collected from up to 60 stores for each party on January 28, 1999
† Store-level pricing factors identified by CC empirical analysis: R = regional effect (e.g. lower in North, higher in South); Y = local average income; E = local presence of EDLP retailer (Asda or Morrison); D = local presence of hard discount retailer (Aldi, Lidl or Netto); S = store size; M = local market share
‡ Sainsbury did not provide the CC with the requested price data, but instead provided a complete list of stores that might selectively offer lower prices (with 111 of its 422 stores on a lower price tier)

Source: adapted from CC (2000; Tables 7.2 & 7.3, Appendices 7.5 & 7.8)

In its assessment of the practice, the CC concluded that local price flexing was anticompetitive and operated against the public interest when employed by the major one-stop-shop chains (i.e. Tesco,

[15] US evidence, e.g. the findings by Hoch et al. (1995) and Chintagunta et al. (2003) in relation to Dominick's Finer Foods ("DFF") (a large supermarket chain in the Chicago area), shows that zone pricing is mostly driven by differences in local consumer characteristics rather than by local competition or costs.
[16] For instance, the CC undertook detailed analysis on the relative profitability of stores operated on different price tiers by Tesco and Sainsbury. In both cases, the CC found that the higher prices in their higher price tier stores were more than was required to meeting higher operating costs, or indeed higher asset costs (CC 2000; Tables 8.31 & 8.32, paragraphs 8.109 & 8.114).

Sainsbury and Safeway).[17] Nevertheless, they could not identify a suitable remedy and no subsequent action was taken leaving retailers free to continue using the practice.[18]

However, the pattern of pricing practices in the sector changed markedly over the following four years. While price flexing continued to be used by some of the smaller chains, by 2003, both Sainsbury and Tesco had voluntarily moved away from store pricing based on location (CC 2003; paragraphs 5.36 and 5.37).[19] Furthermore, in March 2004, Morrison acquired Safeway and set about converting all the latter's stores into the Morrison format, in the process abandoning Safeway's store-by-store promotional pricing policy in favor of its national pricing policy.

Remarkably, uniform pricing has become the dominant form of pricing in this sector, and the major retailers, at least for the time being, have eschewed the opportunity to customize prices on a store-by-store basis in favor of national pricing. Moreover, while commitments to national pricing may not last forever, they do appear fixed in the short-term, at least, given the public statements made by the retailers[20], their moves into internet grocery retailing (based on offering identical regular on-line and off-line prices), and marketing that is geared to national promotion of retail brands as representing consistent value-for-money (e.g. Tesco's investment in its weekly-updated and very detailed price comparison service "Pricecheck" and the associated marketing).

While the experience of the UK may be far from general (and here US food retailing, with local pricing still appearing to predominate, may stand in marked contrast[21]), it does raise three important questions that might apply to this and perhaps other retail markets as well:

---

[17] On competition effects, the CC concluded that the practice "distorts competition in the retail supply of groceries in the UK in that it tends to focus some elements of price competition into localities where particular lower-priced competitors are present and away from other areas and contributes to the position that a majority of grocery products are not fully exposed to competitive pressure" (CC 2000, paragraph 2.406).

[18] In particular, the CC ruled out the imposition of national pricing (on grounds that this would not allow for differential pricing based on legitimate factors such as regional cost differences) or requiring that any price differences between stores should be broadly related to costs (on the grounds that this would be impractical to implement and regulate).

[19] However, while setting the same prices across the supermarket format, both retailers might vary prices between formats (i.e. between their separately branded convenience store chains as compared to their supermarket chains) – on the basis of operating cost differences.

[20] For instance, in the context of UK grocery retailing, Asda (owned by Wal-Mart) informed the Competition Commission that, in respect of charging the same prices for its products in every one of its stores, "it would be commercial suicide for it to move away from its highly publicized national EDLP pricing strategy and a breach of its relationship of trust with its customers, and it would cause damage to its brand image, which was closely associated with a pricing policy that assured the lowest price always" (CC 2003, paragraph 5.38). Morrison made a similar point.

[21] In the US, there are signs that retailers are extending their local pricing with even finer price zones. For example, Chintagunta et al. (2003) find that DFF moved from three to sixteen price zones applicable to its stores (between 1989 and 1992). In other countries as well it appears that extensive zone pricing is common in grocery retailing, e.g. see Rondán Cataluña (2004) in relation to regional pricing in Spain.

- Firstly, even when retailers have the capability and wherewithal, why might some (but not necessarily all) of them forsake local pricing in favor of setting uniform prices applying across all their stores?
- Secondly, why might there be a mutual move (rather than a unilateral move) away from local pricing to national pricing?
- Thirdly, is it possible that such a general move to uniform pricing might benefit retailers and consumers alike?

In this paper, we do not seek or claim to provide complete answers. Our focus is purely on strategic factors relating to how competition may be altered by pricing policy choices. We model a number of the observed characteristics from this case relating to oligopolistic competition in retail markets that suggest scope for micro-marketing. First, we take consumers as geographically constrained and making purchases within distinct local markets (rather than a single, national market).[22] Second, local markets differ in their size as well as the tastes, preferences and affluence of local consumers. Third, local markets differ in terms of the composition and number of competitors operating in the area; so that, while retailers may be national or supra-regional chains, they operate in only some local markets (either because of the absence of suitable retail locations or thin markets already being well served).

3. Analytical Framework

We start with a general examination of the strategic implications for adopting either a local or a uniform pricing policy across the stores operated by a multi-market retail chain, then move to a more specific model to develop further insights. In the general setting, we show a profit motive for a retailer to choose deliberately not to discriminate across the local markets it serves even when these markets differ in the extent of demand and intensity of competition (and so would naturally appear to be candidates for profitable micro-marketing and price discrimination across localities). Specifically, when a retailer is not a monopolist in all its local markets, strategic considerations impact the decision over whether or not to price discriminate because they affect the pricing decisions of other retailers, and thus market outcomes. We take the simplest case for illustration where a retailer operates in two local markets - in one market it faces no competition (i.e. a local monopoly), in the other market it faces a rival retailer (i.e. a local

[22] This appears reasonable for many low value, everyday items like groceries, toiletries, and other fast-moving consumer goods ("FMCGs"), along with petrol, cigarettes and alcohol, where consumers only normally travel short distances in making shopping trips. In contrast, it may not apply either to higher value shopping goods (like expensive electrical items and other consumer durable goods) or to goods sold mainly through direct selling routes, like the Internet, when this integrates local markets into a becoming a single national or even global market.

duopoly). We show that demand conditions can exist, expressed in the form of a firm-level demand elasticity condition for the two markets, in which the retailer will find it profitable not to discriminate and instead set uniform prices across the local markets it serves.

Nevertheless, while this general result and its extensions offer an existence finding, it provides little indication of the extent to which these conditions would apply for the retailer in practice. We can say when the conditions will make uniform pricing unprofitable. However, are the conditions under which it is profitable broad or limited? To what extent do the conditions depend on differences in the intensity of competition across the local markets? To answer these apposite questions we have to move beyond this general specification to consider specific demand forms that allow for closed-form solutions, enabling relevant profit and welfare comparisons to be made.

3.1. Characterizing the general problem

Firm *A* sells in two independent markets, 1 and 2. Costs are the same in each market and marginal costs are constant. The demand functions are continuous and downward sloping.

We first state an obvious result, demonstrated in Holmes (1989):

LEMMA 1. *Ignoring competitive conditions, if a uniform price is to be set across the two markets, this price will be between the prices the firm would have set had it maximized profits by setting prices individually in each market.*

Now consider the following scenario. In market 1, firm *A* is a monopolist whilst in market 2, a larger market, it faces competition from another firm (*B*). Competition in the duopoly market is in prices, with the products of the two firms being imperfectly competitive substitutes ($\left|\partial q_i/\partial p_i\right| > \partial q_i/\partial p_j > 0$; $i, j = A, B$; $i \neq j$). We assume that $q_i(p_i, p_j)$ is concave in p_i, sufficient for profit to be strictly quasiconcave in p_i (Vives 1999, p149). The firm in question (*A*) has to consider whether to set uniform prices across the two markets, or whether to price locally.[23]

PROPOSITION 1. *In the scenario outlined above, there is a range of demand parameters for which there is some profit incentive for firm A to set a uniform price across the two markets rather than pricing markets separately. The incentive arises when demand facing A is no less elastic in the duopoly market than in the monopoly market.*

[23] Note that this is a different issue from that considered by Holmes (1989), who did not allow the number of firms to differ across markets.

Consider the maximization problem for firm A, assuming its sets prices separately in each market. Its profits are

$$\pi_A \equiv \pi_1(p_1) + \pi_{A2}(p_{A2}, p_{B2}) = p_1 q_1(p_1) + p_{A2} q_{A2}(p_{A2}, p_{B2}) - c.(q_1(p_1) + q_2(p_{A2}, p_{B2}))$$

The first order conditions, succinctly written, are

$$\frac{\partial \pi_1}{\partial p_1} = \frac{\partial \pi_{A2}}{\partial p_{A2}} = 0 \tag{1}$$

In the second condition for equality in (1) above, maximization is done assuming p_{B2} fixed. Call the prices thereby set p_1^* and p_{A2}^* respectively.

On the other hand, if firm A decides to practice uniform pricing, its profits are

$$\pi_A \equiv \pi_1(p_A) + \pi_{A2}(p_A, p_{B2})$$

The first order condition is now

$$\frac{d\pi_A}{dp_A} = \frac{\partial \pi_1}{\partial p_A} + \frac{\partial \pi_{A2}}{\partial p_A} + \frac{\partial \pi_{A2}}{\partial p_{B2}} \cdot \frac{dp_{B2}}{dp_A} = 0 \tag{2}$$

since firm A recognizes the full impact of its price choice. Call the optimal uniform price p_u*. The second order condition for maximization under uniform pricing is $d^2\pi_A(p_u^*, .)/dp_A^2 < 0$.

Take the case where $p_1 * > p_{A2} *$. Turning to the final term in (2), note that since $\partial q_{A2}/\partial p_{B2} > 0$, it follows that $\partial \pi_{A2}(.)/\partial p_{B2} > 0$. Furthermore, $dp_{B2}/dp_A > 0$ since the products are strategic complements in market 2 by assumption. At p_{A2}* we have

$$\frac{d\pi_{A2}(p_{A2}^*)}{dp_{A2}} \equiv \frac{\partial \pi_{A2}(p_{A2}^*)}{\partial p_{A2}} + \frac{\partial \pi_{A2}(p_{A2}^*)}{\partial p_{B2}} \cdot \frac{dp_{B2}}{dp_{A2}} \tag{3}$$

Therefore, there exists a price $p_{A2}*+\varepsilon$ $(\varepsilon > 0)$ at which $\pi_{A2}(p_{A2}*+\varepsilon) > \pi(p_{A2}*)$. Thus, if $p_{A2}*$ and p_1* are sufficiently close (specifically, demand parameters are such that p_1* is less than the maximum value of $p_{A2}*+\varepsilon$) profits are higher under uniform pricing. Hence, there exists a range of parameter values for firm A under which profits earned under uniform pricing are greater (no less) than those earned by setting price individually in each market.

By Lemma 1, this range involves underlying parameter values in which the monopoly price set individually would be higher (no lower) than the duopoly price set individually, rather than the other way around. *Q.E.D.*

The intuition for this result is fairly clear. Given equal *market* demand elasticities, a firm will want to set a lower price in the duopoly market than in the monopoly market. But competitive considerations cannot be ignored. The actions of the two firms are strategic complements, i.e. for firm *A*:

$$\frac{\partial^2 \pi_A}{\partial p_A \partial p_B}(R_B(p_A), p_A) > 0 \tag{4}$$

where R_B is firm *B*'s reaction function.

Thus if firm *A* sets a low price in market 2, this makes *A* a relatively fierce competitor for *B*, meaning that *B* would want to reduce its price (through the equivalent of equation (4)) for good 2. In the terminology of Bulow et al. (1985), investment in reducing price makes firm *A* "tough". By choosing a uniform pricing strategy, thereby raising price in market 2, firm *A* loses some potential profit in the monopolized market. However by being "soft" in setting a high price in the duopoly market, and as a result inducing firm *B* to set a higher price in market 2, *A* gains more profit in the duopoly market than it would do otherwise and hence may benefit in net terms.

On the other hand, if demand *facing A* in the duopoly market is relatively less elastic than demand in the monopoly market, setting a uniform price across both markets would imply reducing price in the duopoly market below the price based on elasticity in that market alone. This would toughen competition, something clearly not in *A*'s interest.

It is clear that Proposition 1 relates to an existence result. Whilst uniform pricing will not be profitable should market demand in the monopoly market be less elastic than in the duopoly market, it *may* but need not be profitable where market demand in the monopoly market is more elastic. In order to characterize this latter situation somewhat more fully without descending immediately to specific parameteric cases, we consider two general issues.

Call the price that the firms would set in market 2 if acting together, P_2*. From Proposition 1, it is evident from (2) that for uniform pricing to be profitable, $P_2^* > p_1^* > p_{A2}^*$. Hence it must be that

$$\eta_2^I(p_u^*) < \eta_1^I(p_u^*) < \eta_2^F(p_u^*) \tag{5}$$

where the η's are price elasticities of demand, superscript *I* referring to the industry, *F* to the firm. Utilising a result due to Holmes (1989) that applies to our firms *in market 2*,[24] he shows that

$$\eta^F(p) = \eta^I(p) + \eta^C(p) \tag{6}$$

where the C superscript shows a cross-elasticity of demand between the two firms' products. Since the products are substitutes, this is positive. Then, putting (5) and (6) together, it is necessary that

$$\eta^C(p_u^*) > \eta_1^I(p_u^*) - \eta_2^I(p_u^*)$$

[24] It does not apply in market 1.

In other words, the products must be sufficiently dissimilar, although recall we have already noted that they must not be too dissimilar! Uniform pricing, then, only becomes profitable over a limited parameter range.

Moreover, it is clear from (5) that market 2 must not be a "simple magnification" of market 1. By this, we refer to the pattern of individual willingnesses to pay across markets. Assume that there is a distribution of willingness to pay across consumers, $f(p)$, with support $[0, \overline{p}\,]$ in market 1 such that each consumer represented will purchase one unit if price is below their p value, zero otherwise. Therefore, demand in market 1 at a given output level $\tilde{q}$ will be given by

$$\tilde{q} \equiv \int_{\tilde{p}}^{\overline{p}} f(p).dp = F(\overline{p}) - F(\tilde{p}) \tag{7}$$

whence $dq(\tilde{p})/dp = -f(\tilde{p})$.

We define a *simple magnification* as willingness to pay in market 2 being $(1+\theta)f(p)$, $\theta>0$. It then becomes apparent through simple substitution that $\eta_1^I(\tilde{p}) = \eta_2^I(\tilde{p})$, violating condition (5) for uniform pricing to be profitable. We have the following remark on Proposition 1:

REMARK 1: *The range of demand parameters under which there is an incentive for uniform pricing does not include cases where market 2 is a simple magnification of market 1.*

The meaning of a simple magnification is that the only difference between the two markets lies in the number of consumers. Their distribution of tastes across the population remains unchanged.[25] However, we take the view that in larger markets it is the case that tastes spread, so that there are some "high end" consumers in a large market not represented in a smaller market. Prima facie evidence for this is that larger outlets of retailers such as supermarkets tend to have broader ranges of products, not simply stocking the products in greater depth.

We define an alternative expansion where the larger market is a "taste-expanding" magnification of the smaller market. This occurs when the distribution of willingness to pay in market 1 is $f(p)$ with support $[0, \overline{p}_1]$, whilst the distribution of willingness to pay in market 2 is $(1+\theta)f(\gamma.p)$ $\theta \geq 0, \gamma>1$ with support $[0, \overline{p}_1\gamma)]$. Here, simple manipulations of the elasticity formula show that there is at least a

[25] This is an assumption made for example in Bresnahan and Reiss (1987) in relation to small towns in the Midwest of the US. In terms of a linear demand function, demand in market 2 would have the same intercept but a shallower slope than in market 1 under a simple magnification.

region of demand where market demand elasticity in market 2 is less than in market 1.[26] Note that the formula for elasticity of demand in market 2 (after slight simplification) is

$$\eta_2^I(\tilde{p}) = \frac{\tilde{p}f(\gamma\tilde{p})}{F(\gamma\overline{p}) - F(\gamma\tilde{p})}$$

Accordingly, there is a natural tendency for the denominator to be larger than that for market 1 at any price. On this basis, we conclude the following:

REMARK 2: *Where market 2 is a "taste-expanding" magnification of market 1, there is a clear potential for uniform pricing to be profitable.*

We assert that a taste-expanding magnification is likely to be the norm, because it may be thought of as demand having some (positive) cross-sectional elasticity with respect to income, say, whilst a taste-contracting magnification is a rather unlikely occurrence, akin to an inferior good.[27]

Finally, we should point out that uniform pricing requires some form of commitment to be credible. Specifically, for uniform pricing to influence the rival's pricing behavior in the desired manner, it must be through a visible, irreversible commitment in order to avoid a "cheap talk" problem where the rival does not believe that the firm will stick to a uniform pricing policy when it comes to setting individual prices. We have already mentioned some aspects of the current commitments given by the leading UK supermarkets groups to uniform pricing. In addition, Dobson and Waterson (2005) discuss more general examples of the forms of commitment that a retail chain may make to uniform national pricing. These include making an expensive commitment that would render its position worse were it not to adopt uniform pricing than it if did so – such as publishing all prices in a catalogue which then applies across the whole country, using national advertising to inform consumers about prices, or using integral price tags standard across a country. Also, Corts (1998) cites the required commitment of retailers pursuing strategies based on providing "every day low prices", where price consistency across markets and over time is a critical feature.

3.2. A Specific Framework

Proposition 1 demonstrates that for certain parameter ranges in which demand elasticity facing the firm in the duopoly market is no less than, but market elasticity is lower than, the elasticity it faces in the monopoly market, the firm will find it profitable to practice uniform pricing. How significant is this? In

[26] Again referring to the linear example, if $\gamma > 1$, $\theta = 0$ then we have demand in market 2 being parallel to but above demand in market 1. In that case, demand is less elastic at any price (up to $\overline{p}$) in market 2.

[27] Taste contraction would imply not that there were relatively few high end customers in a larger market, but rather that there is an absence of high end customers who are present in a small market but not in a large one.

order to identify the extent of this force, we move to a specific modeling framework; we choose a linear demand structure. Within this structure, we adopt a straightforward parameterization in which the various forces exhibited in equation (2) are represented. We extend the analysis to the case where both firms *A* and *B* make strategic pricing decisions through a framework in which there are two identical markets like market 1 above, together with one market of type 2. To adapt the terminology in a memorable way, we call the market where only firm *A* operates market "*A*1", the market where only firm *B* operates market "*B*1" and the market where both operate, market "2".

Thus we represent the country as consisting of just three separate local markets. Both retailers operate in the "high-demand" market that supports both firms, for example a large/affluent city. In each of the other two ("low-demand") markets, only one of the retailers operates. Here, the two local monopoly markets can be thought of as smaller, less affluent towns or rural areas where opportunities for opening stores are greatly restricted either by tight planning rules or the paucity of demand relative to fixed set up costs.[28] Consumers purchase only in their own market.

Of course, this oversimplifies the differences in demand and competition conditions that are likely to exist between real local markets. However, this bifurcation of markets encapsulates the practical observation that local markets differ in both the extent of demand (e.g. where population sizes, as well as consumer tastes and incomes, vary from one region to another) and the number of players operating. In particular, it captures the general fact that while retail chains may operate right across a geographical entity, they do not commonly operate in every local market, facing competitors in some locations but not others.

To ease exposition, we assume that the two firms are in symmetric positions. Specifically, whilst the competing retail services are different, each chain has no cost or demand advantage over its rival.[29] Hence the two "monopoly" markets are assumed to be identical, while in the "duopoly" market the firms face symmetric demand for their respective differentiated retail offerings. We incorporate variations in the extent of consumer demand across the two market types by allowing the demand intercept term (α) to be lower in each of the two monopoly markets than in the duopoly market whilst differentiation between the firms is captured by a parameter γ.

[28] See Bresnahan and Reiss (1987) for some general empirical support, in the context of US retail markets, for the assumption that entry conditions vary across local markets. In the case of UK grocery retailing, very tight planning restrictions for large superstore and hypermarket developments pose a major barrier to entry and expansion (CC 2000; Chapter 12).

[29] It is possible to extend our framework to consider the firms in asymmetric positions, e.g., by having the firms operate in different numbers of markets. However, this adds a good deal to the complexity but little to the insights offered. In relation to the effect of cost and demand asymmetries, see Dobson and Waterson (2005).

Firms are assumed fully aware of each other's cost and demand, as well as their own respective positions. Armed with this information, firms compete through setting prices having made their choices of pricing policy (i.e. whether they have each decided to adopt local or uniform pricing).

We use a simple linear demand specification that allows us to compute and compare outcomes, yet enables us to develop intuitions regarding the impact of differences in demand and the intensity of competition between the local markets.[30] An added benefit of this approach, especially in view of the complexity of the equations, is that all the results can be neatly portrayed in a simple diagrammatic form.

Consumer preferences in each of the two market types are represented by a standard quadratic utility function in respect of purchasing a composite good.[31] In the case of the duopoly market, the utility function for the representative consumer takes the form

$$V_2(q_{A2},q_{B2}) = q_{A2} + q_{B2} - (q_{A2}^2 + 2\gamma q_{A2}q_{B2} + q_{B2}^2)/2 + z_2$$

where q_{A2} and q_{B2} respectively represent the quantity supplied by each retail chain for market 2, while $\gamma \in [0,1)$ captures the consumer's perception of the substitutability between the retailers' services and product offering (becoming closer substitutes as $\gamma \to 1$), and z_2 represents all other goods and has a price normalized to unity. The consumer's budget constraint is taken as $m_2 = p_{A2}q_{A2} + p_{B2}q_{B2} + z_2$.

In the monopoly market controlled by firm A, given the absence of variety, the utility function takes the form for market $A1$:

$$V_{A1}(q_{A1}) = \alpha q_{A1} - (q_{A1}^2)/2 + z_{A1} \qquad \alpha \in (0,1]$$

Here, the consumer's budget constraint is $m_{A1} = p_{A1}q_{A1} + z_{A1.}$ Similarly, for the monopoly market controlled by firm B, the utility function for market $B1$ is

$$V_{B1}(q_{B1}) = \alpha q_{B1} - (q_{B1}^2)/2 + z_{B1} \qquad \alpha \in (0,1]$$

The analogous budget constraint is $m_{B1} = p_{B1}q_{B1} + z_{B1}$.

Constrained optimization of the utility functions reveals indirect demand in each market as

$$p_{A2}(q_{A2},q_{B2}) = 1 - q_{A2} - \gamma q_{B2} \tag{8a}$$

$$p_{B2}(q_{B2},q_{A2}) = 1 - q_{B2} - \gamma q_{A2} \tag{8b}$$

$$p_{A1}(q_{A1}) = \alpha - q_{A1} \tag{8c}$$

$$p_{B1}(q_{B1}) = \alpha - q_{B1} \tag{8d}$$

---

[30] In particular, we adopt a representative consumer perspective (along the lines of Bowley (1924), Dixit (1979) and Singh and Vives (1984)), that allows firm-level and market-level demand to be subject to both own-price and cross-price effects, rather than use considerably more complex discrete choice or location models (e.g., multinomial logit or Hotelling with variable demand) that provide similar demand and competition features (Anderson et al. 1992).

[31] This "good" could be thought of as either an individual good with a specific amount of retail service attached or more appropriately in the case of multi-line retailers a composite basket of goods. Clearly, in practice, retailers may operate with multiple lines and micro-marketing techniques may then be applied to price each of these individually across stores. Instead, our simplifying assumption can be thought as determining general store-level price bands applying across the range of goods.

Solving for the direct demand functions reveals

$$q_{A2}(p_{A2},p_{B2}) = (1-\gamma-p_{A2}+\gamma p_{B2})/(1-\gamma^2) \quad (9a)$$

$$q_{B2}(p_{A2},p_{B2}) = (1-\gamma-p_{B2}+\gamma p_{A2})/(1-\gamma^2) \quad (9b)$$

$$q_{A1}(p_{A1}) = \alpha - p_{A1} \quad (9c)$$

$$q_{B1}(p_{B1}) = \alpha - p_{B1} \quad (9d)$$

Thus the two critical parameters of our framework, which have a considerable bearing on our results, are α and γ. The former captures in a simple way the notion that in the "smaller" monopoly markets consumer demand may be less, in respect of both consumers' willingness to pay and the scale of demand, than in the "larger" duopoly market, with the difference becoming greater the closer α is to zero. In terms of equation (2) above, it impacts upon the first term. Parameter γ allows for different intensities of price competition in the duopoly market with which to compare the absence of competition in the monopoly markets, with the difference becoming greater the closer γ is to unity. It relates to the final term in (2). In fact, in developing our intuition, we focus on the role of γ.

Equilibrium outcomes for the retailers are modeled as a two-stage game. In the first stage, each retailer decides its pricing policy – whether to practice local (*L*) or uniform (*U*) pricing. In the second stage, the firms simultaneously determine their prices, being aware of each other's first-stage decision. The equilibrium concept is sub-game perfection. The outcomes from the second stage are considered in the next section, examining in turn each of the four possible pricing policy configurations that might arise depending on each retailer's choice over whether to use local pricing or uniform national pricing.[32] Section 5 then considers the outcomes from the first stage, where the retailers individually choose (and commit to) their pricing policy.

4. Pricing Outcomes

We begin by solving for outcomes when both retail chains adopt local pricing before considering the situation where they both adopt uniform pricing, followed by the asymmetric situation where one adopts local pricing while the other adopts uniform pricing.

[32] The decision over pricing strategy is modeled as a dichotomous choice between setting individual prices purely according to local conditions or setting a single price to cover all markets served. Conceivably, though, a retailer might have mixed interests, such as using a "half-way-house" strategy of setting prices partly according to individual market conditions and partly according to average conditions across all markets served. We limit attention here to the dichotomous choice in view of the commitment requirements that, in order to be effective, competition-softening pricing strategies must be visible and irreversible.

4.1. Local Pricing by Both Retailers – (*L,L*)

When both retailers adopt local pricing, each retailer sets a price for each local market to maximize profit in that local market. First, consider firm *A*'s situation. With zero operating costs, its profit function in its monopoly market is $\pi_{A1} = p_{A1}q_{A1}$. Substituting in the expression for demand, (9c), optimizing with respect to p_{A1} and solving yields the monopoly price as $p_{A1}^{LL} = \alpha/2$, quantity as $q_{A1}^{LL} = \alpha/2$ and local market profit as $\pi_{A1}^{LL} = \alpha^2/4$. Identical results hold for firm *B* in respect of its monopoly market.

In the contested market, firm *A*'s profit function is

$$\pi_{A2} = p_{A2}q_{A2}(p_{A2}, p_{B2}) = p_{A2}(1-\gamma-p_{A2}+\gamma p_{B2})/(1-\gamma^2) \tag{10}$$

On optimizing with respect to p_{A2}, firm *A*'s best-response function in the contested market is

$$p_{A2}(p_{B2}) = (1-\gamma+\gamma p_{B2})/2 \tag{11}$$

Similarly for firm *B*, we can analogously derive its best-response function in the market as

$$p_{B2}(p_{A2}) = (1-\gamma+\gamma p_{A2})/2 \tag{12}$$

Using (9) and (10), we can solve for the pair of local pricing equilibrium prices

$$p_{A2}^{LL} = p_{B2}^{LL} = (1-\gamma)/(2-\gamma) \tag{13}$$

Then, from (9a), (9b), (10) and (13), the quantities sold by each retailer and their respective profit levels in the contested market are:

$$q_{A2}^{LL} = q_{B2}^{LL} = 1/[(1+\gamma)(2-\gamma)]; \quad \pi_{A2}^{LL} = \pi_{B2}^{LL} = (1-\gamma)/[(1+\gamma)(2-\gamma)^2] \tag{14}$$

Combined profits for each retailer across both its markets under local pricing are thus

$$\Pi_A^{LL} = \Pi_B^{LL} = (1-\gamma)/[(1+\gamma)(2-\gamma)^2] + (\alpha^2/4) \tag{15}$$

4.2. Uniform Pricing by Both Retailers - (*U,U*)

With both retailers adopting uniform pricing, each of them sets a single price to maximize its combined profits. For firm *A*, this is

$$\Pi_A(p_A, p_B) = p_A(q_{A2}+q_{A1}) = p_A\left(\frac{(1-\gamma-p_A+\gamma p_B)}{1-\gamma^2} + (\alpha - p_A)\right) \tag{16}$$

Rearrangement of the FOC shows that the best-response function for chain *A* in this case is

$$p_A(p_B) = \tfrac{1}{2}\left(\frac{(1-\gamma)(1+\alpha(1+\gamma))+\gamma p_B}{2-\gamma^2}\right) \tag{17}$$

The analogous best-response function for chain *B* is

$$p_B(p_A) = \tfrac{1}{2}\left(\frac{(1-\gamma)(1+\alpha(1+\gamma))+\gamma p_A}{2-\gamma^2}\right) \tag{18}$$

Using (17) and (18) to solve for the pair of equilibrium prices reveals

$$p_A^{UU} = p_B^{UU} = \frac{(1-\gamma)(1+\alpha(1+\gamma))}{(4-\gamma-2\gamma^2)} \tag{19}$$

Using (9), the quantity sold by each firm in each market is

$$q_{A1}^{UU} = q_{B1}^{UU} = \frac{\alpha(3-\gamma-\gamma^2)-1+\gamma)}{(4-\gamma-2\gamma^2)} > 0 \quad \text{if } \alpha > \frac{1-\gamma}{3-\gamma-\gamma^2} \tag{20a}$$

$$q_{A2}^{UU} = q_{B2}^{UU} = \frac{3-2\gamma^2-\alpha(1-\gamma^2)}{(1+\gamma)(4-\gamma-2\gamma^2)} \tag{20b}$$

We assume that the condition specified in (20a) holds, noting that it is sufficient for $\alpha > 1/3$; otherwise the retailers would withdraw from the (small) monopoly markets to concentrate on the (much larger) duopoly market (if they could not price discriminate). On the basis of this condition being satisfied, total profits for each retailer are then

$$\Pi_A^{UU} = \Pi_B^{UU} = \frac{(1-\gamma)(2-\gamma^2)[1+\alpha(1+\gamma)]^2}{(1+\gamma)[4-\gamma-2\gamma^2]^2} \tag{21}$$

4.3. Uniform Pricing by One Firm and Local Pricing by the Other – (*L,U*) and (*U,L*)

We can also calculate magnitudes in the situation where firm *A*, say, sets local prices while firm *B* sets a uniform price applicable to both of its stores (observing that these roles can be reversed without affecting the overall analysis). Here, firm *A* sets the local monopoly price ($\alpha/2$) in its monopoly market while its best-response function in relation to the contested market, where it faces competition from retailer *B*, is represented by (11). In contrast, firm *B*'s best-response function is given by (18). Solving for the equilibrium prices shows

$$p_{A1}^{LU} = \frac{\alpha}{2} \tag{22a}$$

$$p_{A2}^{LU} = \frac{(1-\gamma)[4+\gamma-2\gamma^2+\alpha\gamma(1+\gamma)]}{8-5\gamma^2} \tag{22b}$$

$$p_B^{LU} = \frac{(1-\gamma)[2+\gamma+2\alpha(1+\gamma)]}{8-5\gamma^2} \tag{22c}$$

The individual equilibrium quantities are

$$q_{A1}^{LU} = \frac{\alpha}{2} \tag{23a}$$

$$q_{A2}^{LU} = \frac{4+\gamma-2\gamma^2+\alpha\gamma(1+\gamma)}{(1+\gamma)(8-5\gamma^2)} \tag{23b}$$

$$q_{B1}^{LU} = \frac{3\alpha(2-\gamma^2)-(1-\gamma)(2+\gamma)}{8-5\gamma^2} > 0 \text{ if } \alpha > \frac{(1-\gamma)(2+\gamma)}{3(2-\gamma^2)} \tag{23c}$$

$$q_{B2}^{LU} = \frac{(2+\gamma)(3-2\gamma^2)-\alpha(1+\gamma)(2-\gamma^2)}{(1+\gamma)(8-5\gamma^2)} \tag{23d}$$

Again, we assume that the monopoly markets not so small as to rule out profitable supply, noting it is sufficient for $\alpha > 1/3$ to ensure that the condition in (23c) holds. On this basis, total profits for each retailer are then

$$\Pi_A^{LU} \equiv \pi_{Ai}^{LU} + \pi_{Aj}^{LU} = \frac{(1-\gamma)[2+\gamma+(1+\gamma)(2(1-\gamma)+\alpha\gamma)]^2}{(1+\gamma)(8-5\gamma^2)^2} + \frac{\alpha^2}{4} \tag{24}$$

$$\Pi_B^{LU} = p_B^{LU}(q_{B1}^{LU} + q_{B2}^{LU}) = \frac{(1-\gamma)(2-\gamma^2)[2+\gamma+2\alpha(1+\gamma)]^2}{(1+\gamma)(8-5\gamma^2)^2} \tag{25}$$

5. Individual Preferences over Pricing Policy

Having identified the outcomes under each of the four possible pricing policy combinations, we now compare the profits for each firm in order to determine each firm's preferences according to the different possible demand and competitive conditions. Here, it will prove convenient to refer to the local pricing equilibrium price in each monopoly market as p^m ($\equiv p_{A1}^{LL} = p_{B1}^{LL} = \alpha/2$) and the corresponding price in the duopoly market as p^d ($\equiv p_{A2}^{LL} = p_{B2}^{LL} = (1-\gamma)/(2-\gamma)$). In addition, three identities labeled as Z_1, Z_2 and Z_3 (each defined below) are useful in establishing propositions relating to comparisons over the retailers' profits.

We need to consider two key profit comparisons. The first is between the firm locally pricing and uniformly pricing when its rival is *locally* pricing. The second is between the firm locally pricing and uniformly pricing when its rival is *uniformly* pricing. Together, the two profit comparisons allow us to determine the preference for each firm given the position of its rival, and so identify the (sub-game perfect) equilibrium choice of pricing policy for a given set of market conditions (i.e. as determined by the parameter values taken by α and γ). We will focus on the profit comparisons regarding firm *A*, bearing in mind that the profit comparisons for firm *B* are directly analogous.

In respect of the first comparison, taking the difference between the relevant expressions from (15) and (25) (adapted for retailer *A*) and rearranging reveals:

$$\Pi_A^{LL} - \Pi_A^{UL} = \frac{[2(1-\gamma)-\alpha(2-\gamma)][2(1-\gamma)X_1 - \alpha(2-\gamma)Y_1]}{4(2-\gamma)^2(8-5\gamma^2)^2} \tag{26}$$

where $X_1 \equiv 16(2-\gamma^2)-\gamma^4 > 0$, $Y_2 \equiv 32(1-\gamma^2)+9\gamma^4 > 0$.

The denominator in (26) is clearly positive, and thus the sign of the expression hinges on the sign of the other two terms in square brackets. Here, we can establish that these two terms can be positive or negative and that the signs do not necessarily coincide. Therefore, when its rival prices locally, each retailer may under particular market conditions (i.e. given certain values of α and γ) have a strict preference for uniform pricing over local pricing. This finding is formalized in the following proposition:[33]

PROPOSITION 2. *For $\alpha \in (0,1)$ the zone in (α,γ) space for which a retailer prefers uniform pricing when its rival is locally pricing has two boundaries. The first boundary is given by the condition that the monopoly market price is equal to the duopoly market price, i.e. $p^m = p^d$. The other boundary is $p^m = p^d Z_1$, where $Z_1 \equiv X_1/Y_1$, and this lies above (i.e. outside) the first in (α,γ) space.*

The second relevant profit comparison for each firm is between local and uniform pricing when its rival is *uniform* pricing. For firm *A*, this is the difference between (24) and (21). Upon rearrangement this yields the following expression:

$$\Pi_A^{LU} - \Pi_A^{UU} = \frac{[2(1-\gamma)-\alpha(2-\gamma)][2(1-\gamma)X_2 - \alpha(2-\gamma)Y_2]}{(2-\gamma)[2(8-5\gamma^2)(4-\gamma-2\gamma^2)]^2} \tag{27}$$

where

$$X_2 \equiv (2-\gamma)(128-192\gamma^2+95\gamma^4-16\gamma^6) = (2-\gamma)[(16(1-\gamma^2)(8-4\gamma^2+\gamma^4)+15\gamma^4] > 0$$

$$Y_2 \equiv 256-128\gamma-448\gamma^2+208\gamma^3+262\gamma^4-105\gamma^5-52\gamma^6+16\gamma^7$$

$$= (1-\gamma)^2(256+384\gamma+64\gamma^2-48\gamma^3+7\gamma^4+7\gamma^5)+(1-\gamma)(95\gamma^4+45\gamma^5)+9\gamma^7 > 0$$

As with the previous profit comparison, (26), the sign of the expression in (27) hinges on the sign of the other two numerator terms in square brackets, which can be positive or negative. As before, preference exists for uniform pricing over local pricing:

PROPOSITION 3. *For $\alpha \in (0,1)$ the zone in (α,γ) space for which a retailer prefers uniform pricing when its rival is uniform pricing has two boundaries. The first boundary is given by the condition that the monopoly market price is equal to the duopoly market price, i.e. $p^m = p^d$. The other boundary is $p^m = p^d Z_2$, where $Z_2 \equiv X_2/Y_2$, and this lies above (i.e. outside) the first in (α,γ) space.*

[33] Proofs for this and all subsequent propositions are contained in the Appendix.

Ostensibly, the zones supporting individual preferences for uniform or local pricing appear very similar. In particular, Propositions 2 and 3 taken together establish that a firm may have an individual preference for uniform pricing regardless of its rival's choice for certain values of α and γ. In addition though, comparing the boundary conditions from the two profit comparisons, represented by (25) and (26), allows us to establish the following important result:

PROPOSITION 4. *The scope for (individually) preferring uniform pricing is greater when the rival chain retailer is using local pricing rather than uniform pricing.*

To put some color on these results, recall from Lemma 1 the averaging effect that uniform pricing offers in comparison to local pricing. If a firm were a monopolist in each of its markets, it could use local pricing to exploit differences in local demand levels and earn the local monopoly profit in each instance. If instead the monopolist decided to use a uniform price, it would in effect be raising the price in its low-demand markets while cutting the price in its high-demand markets. Because it would have already been maximizing its profits in every possible instance, such a move would be expected to reduce its profits in each of its markets. This is borne out in the present setting when $\gamma = 0$, where the retailers' services are viewed as demand independent in the duopoly market. Then, as evident from (26) and (27), regardless of the choice made by its rival, each firm's profit would always be higher under local pricing so long as there was a difference in demand levels to exploit (i.e. for $\alpha < 1$).

In contrast, when the firms' products are competitors in the same market, a strategic motive may exist for adopting uniform pricing. Specifically, a firm may be willing to sacrifice its freedom to price discriminate, thereby losing some profits in one market, if it can be compensated by higher profits in another market. This becomes possible if a visible, irreversible commitment to uniform pricing influences the behavior of a rival so as to dampen the competition between them when they compete in the same market (e.g. along the commitment means discussed at the end of section 3.1 above). Thus, if the firm could commit to a uniform pricing policy that would entail it setting a higher price, it could induce a rival competing in the same market also to raise its price. However, while the softened competition might raise profits in that market, this could only come about from a lower price in the monopoly market that would reduce its profit there.

So what market conditions are most likely to justify making a commitment to uniform pricing? We already know that uniform pricing would never be profitable if $p^m < p^d$. Furthermore, we can note that this condition applies to a wide range of parameter space, notably when α and γ take on low values, given that the boundary condition $p^m = p^d$ (i.e., $\alpha = 2(1-\gamma)/(2-\gamma)$) is downward sloping and concave to the origin in (α,γ) space, ranging from co-ordinates (1,0) towards (0,1).

In the region where $p^m > p^d$, the averaging effect would mean lowering the monopoly price but raising the duopoly price. However, the greater the relative gap between *A*'s (higher) monopoly-market price and its (lower) duopoly-market price when it uses local pricing, the less inclined *A* will be to make this sacrifice by adopting uniform pricing. To see this, note that such a price gap is particularly pronounced when α and γ both take on high values. Similarly, the gap in profits made in the two markets will be pronounced. In this case, to soften competition in the duopoly market, in order for it to earn higher profits there, firm *A* would need to commit to raising its price considerably to induce *B* to respond by raising its price significantly. This becomes less likely the higher is the value of γ, since the more substitutable the services are perceived to be, the less *B* would need to raise its price in order to increase its own profits as it could simply use the price differential to attract significantly more demand (at the other retailer's expense).

In other words, when γ is high, all that a commitment to uniform pricing would do is to provide its local-pricing rival *B* with a "pricing umbrella" under which it could set a lower price so as to take custom away from *A* to its own benefit, with little or nothing gained by *A* in making the uniform-pricing commitment. Thus, if *A* can earn high profits from its monopoly market by local pricing, it would be better off not sacrificing these to try to dampen competition in what is naturally an intensely competitive duopoly market. The larger the monopoly market relative to the duopoly market, the greater this force is likely to be.

This tendency for high values of α and γ to limit the scope for a firm being prepared to adopt uniform pricing applies regardless of whether the rival adopts local or uniform pricing. This explains the outer boundaries relating to both Proposition 2 and 3. However, these effects are somewhat tempered if the rival is adopting uniform pricing since here the firm is aware that its rival is also prepared to commit to a higher price in the duopoly. This explains the finding expressed in Proposition 4. By the same token, the desire to free ride on a rival's commitment to uniform pricing will be stronger the greater the monopoly-profit sacrifice that would be needed if it were to make a similar commitment. Accordingly, with independent choices of pricing policy we should expect the scope for committing to uniform pricing, in the absence of being sure that the rival is likely to match this commitment, as a further limiting factor in support of uniform pricing.

All of this suggests that uniform pricing is only likely to arise as an independent commitment when competition in the duopoly can be suitably softened without too much of a drop in the monopoly-market price (e.g. when p^m is only slightly above p^d) and when the tendency to free ride is small as a consequence of a similar need and ability to dampen competition suitably (e.g. for mid-high values of both α and γ).

Nevertheless, an important corollary of Propositions 2-4 is that market conditions exist which separately support all three possible pricing configurations, i.e. the two symmetric configurations where both adopt uniform pricing or both adopt local pricing, along with the asymmetric configuration where one adopts uniform pricing and the other adopts local pricing. The equilibrium pricing configurations that emerge from this analysis are illustrated in Figure 1, showing the preferences of the firms in (α,γ) space. Here, we have three distinct, non-crossing boundaries, shown as solid lines, dividing (α,γ) space into four zones. The symmetry assumption means that the same preference structure holds for both firms, so that the diagram is identical whether we are considering firm *A* or firm *B*.

- Figure 1 near here -

The equilibrium pricing-strategy choices follow directly from the position of the three boundary lines. Both retailers prefer adopting local pricing below the lower boundary, where $p^m < p^d$, and above the upper boundary, where $p^m > p^d Z_1$, hence the outcome (L,L) in these two zones.[34] Between these two boundary lines, we have two zones separated by a middle boundary line, $p^m = p^d Z_2$. In the lower of these two zones, that is where $p^m > p^d$ and both $p^m < p^d Z_1$ and $p^m < p^d Z_2$, then both firms would individually prefer to commit to uniform pricing, irrespective of the rival's choice, as this offers each of them higher profits than locally pricing, hence the outcome (U,U). However, in the upper of these two zones, where $p^m > p^d$ and $p^m < p^d Z_1$ but $p^m > p^d Z_2$, each retailer is better off doing the opposite of its rival. In other words, we have an asymmetric (sub-game perfect) equilibrium zone where one firm would prefer committing to uniform pricing if the other firm locally priced, but it would prefer locally pricing if the other firm committed to uniform pricing, i.e. (U,L) or equivalently (L,U) applies. Nevertheless, in this "chicken game" situation, each firm would prefer its rival to adopt uniform pricing while it adopted local pricing.

The implication is that in the asymmetric equilibrium zone there is likely to be a co-ordination problem (with each retailer preferring local pricing while its rival uniformly prices) when the firms simultaneously make their choice over pricing policy. The only escape from this (at least in pure strategy terms) is for one of the firms to commit both credibly and visibly to its pricing policy in advance of its rival; a change in the underlying game. In this case there would be a first-mover advantage from committing to local pricing, leaving the rival to commit to uniform pricing. In the absence of sequential commitments though, the co-ordination problem points to each firm adopting a mixed strategy, as usual in such "chicken" circumstances.

---

[34] As can be observed, the conditions for non-negative quantities in the monopoly markets under uniform pricing are therefore not relevant as the respective boundary lines ($q_{A1}^{UU} = q_{B1}^{UU} = 0$ and $q_{A1}^{UL} = q_{B1}^{LU} = 0$) lie below the $p^m = p^d$ boundary line and local pricing is always preferred to uniform pricing in these circumstances.

6. Joint Preferences over Pricing Policy

Whilst there is scope for a firm independently to commit profitably to uniform pricing, the free-rider problem associated with independent choices restricts this prospect, since a firm making this commitment effectively provides an attractive pricing umbrella for its rival. Therefore it is possible for the firms to be caught in a prisoners' dilemma, with each preferring the other to commit to uniform pricing but each not prepared itself to commit to such a policy, even though both of them could be better off if they both made such a commitment. Clearly, this is only likely to apply to certain market circumstances.

Nevertheless, at the margin, it is possible that joint preferences allow for greater scope in favor of uniform pricing (i.e. as long as α and γ are not "too high"). The above intuition is supported by a comparison between the firms' joint profits when they both use local pricing as opposed to when they both use uniform pricing. Using (15) and (21), the difference between the combined profits of firms *A* and *B* when they both use local pricing compared to when they both use uniform pricing is:

$$(\Pi_A^{LL}+\Pi_B^{LL})-(\Pi_A^{UU}+\Pi_B^{UU})=\frac{[2(1-\gamma)-\alpha(2-\gamma)][2(1-\gamma)\mathrm{X}_3-\alpha(2-\gamma)\mathrm{Y}_3]}{2(2-\gamma)^2(4-\gamma-2\gamma^2)^2} \tag{28}$$

$$\text{where } \mathrm{X}_3\equiv 8-5\gamma^2>0,\quad \mathrm{Y}_3\equiv 8-8\gamma-3\gamma^2+4\gamma^3=(1-\gamma)(8-3\gamma^2)+\gamma^3>0.$$

Using this comparison, we can establish the following proposition concerning joint preferences for both retailers adopting uniform pricing as opposed to both adopting local pricing:

PROPOSITION 5. *For $\alpha \in (0,1)$, a zone exists in (α,γ) space for which the retailers jointly prefer mutual uniform pricing over mutual local pricing, as defined by two non-overlapping boundaries, the inner one in (α,γ) space being $p^m = p^d$ and the outer one being $p^m = p^d Z_3$, where $Z_3 \equiv X_3/Y_3$. Furthermore, this upper/outer boundary lies above the two upper boundaries for private preferences towards uniform pricing as established in Propositions 2 and 3.*

Proposition 5 shows that if joint agreement on a common pricing policy were possible then this extends the range over which uniform pricing would be chosen compared to when firms had to make unilateral commitments. Figure 2 illustrates the result, where the outer boundary for joint preferences over uniform pricing, indicated by $p^m = p^d Z_3$, lies above and to the right of the private preference outer boundaries, respectively $p^m = p^d Z_1$ and $p^m = p^d Z_2$, shown as dashed lines. The area where uniform pricing is jointly preferred, labeled (U^*,U^*), extends particularly to higher values of α, as well as higher values of γ. Correspondingly, the upper zone where local pricing is jointly preferred, i.e. the upper (L^*,L^*) zone in

Figure 2, is considerably smaller in size than the equivalent area in Figure 1 where symmetric local pricing emerges under individual preferences.

- Figure 2 near here -

Accordingly, we can see that circumstances might arise where it would be in the joint interest of the firms to determine a common policy of uniform pricing.[35] However, this still begs the question of how in practice they could secure this outcome and overcome the prisoners' dilemma nature of the situation.

Indeed, the situation could be viewed as "partial collusion", in the sense of the firms agreeing over a pricing policy but not individual prices. In a related context involving collusion over relative prices, Winter (1997) cites situations where firms have made formal agreements to limit the extent to which they price discriminate between different groups of consumers (distinguished by their price sensitivity), in relation to discounts offered through coupons. He argues there may be practical reasons that support this form of partial collusion, since it is likely to be easier to observe and monitor each other's general pricing policy than to monitor individual prices when each stocks several thousand product lines. However, in the event that legally binding agreements of this type are not permitted (and all the agreements that Winter cites have been struck down by the courts on price-fixing grounds), firms would have to resort to tacit collusion.

An alternative means of achieving the same outcome would be for the firms to be jointly obliged to set uniform prices by an outside body.[36] For instance, a competition authority which required the retailers not to price discriminate and instead to offer uniform prices could, perhaps unwittingly, allow the firms to achieve this outcome when the firms could not achieve this by themselves. Indeed, it is possible that even a signal (or veiled threat) from a competition authority, that it was unhappy with third-degree price discrimination being practiced against geographically constrained consumers, might provide the necessary impetus for firms collectively to adopt uniform pricing.[37]

---

[35] There are, of course, two other profit comparisons, namely between the asymmetric case and each of the two symmetric cases. Analysis of these shows that there is no zone in (α,γ) space in which joint profits in the asymmetric case are greater than in both symmetric cases. Details are available upon request.

[36] Producers supplying the retailers are unlikely to be able to achieve this (even if they wanted to and had the power over retailers to make them comply) since such a move would likely be regarded as an attempt to set or influence resale prices, which in most countries might be regarded as illegal if it were viewed as amounting to resale price maintenance. See Chen (1999) for a full analysis and Office of Fair Trading (2003) for a particular case.

[37] In this context, the requirement for the major UK supermarket retailers to set uniform national prices was considered but rejected by the Competition Commission in 2000. However, by designating local price flexing as anticompetitive and against the public interest, there has been a subsequent change in the stance by those retailers using the practice, either through a shift to national pricing for stores catering for the one-stop-shop grocery market or a lessening on the extent of the goods price flexed, as became evident in the submissions made to the Competition Commission (2003) inquiry on the contemplated mergers involving Safeway.

7. Consumer Welfare Considerations

So far we have considered the preferences of the firms competing in the market without regard to how pricing policy decisions would impact on consumers. While the local markets served may be geographically separate, retailers may nonetheless have some regard to consumer sentiment when practicing price discrimination – not least if consumers perceive that retailers are exploiting either a lack of competition or high demand levels by price gouging. While negative sentiment may not necessarily impact demand in the short term, it could adversely impact demand in the longer-term if consumers shift their preferences to other products or indeed boycott retailers perceived to be "ripping off" local consumers.

Accordingly, retailers may take some account of the impact of their pricing policy on consumer welfare. Uniform pricing, by offering all consumers the same price regardless of their location, may be perceived as being inherently fairer (even when it may mean higher prices for some consumers and lower prices for others) than a discriminatory pricing policy in which the retailer customizes prices according to local demand or local competition conditions. Indeed, this is a point often advanced by EDLP retailers that set national prices. Equally, retailers that use local pricing may be more guarded about their pricing policy, preferring to keep consumers in the dark about how they are treated compared to consumers in other locations, thereby reinforcing the separation of local markets.[38]

Clearly, uniform pricing can normally be expected to benefit consumers in the monopoly markets relative to those in the duopoly market. With this inherent welfare trade-off between the two groups in mind, we consider the overall impact on consumers by examining the respective levels of aggregate consumer surplus under each pricing regime, as an unweighted aggregation of the consumer utility functions.

Specifically, aggregate consumer surplus, S, is taken as the sum of the (constrained) representative consumer utility functions over the three markets (i.e. respectively over $V_2(q_{A2},q_{B2})$, $V_{A1}(q_{A1})$ and $V_{B1}(q_{B1})$):

$$\begin{aligned} S = &[q_{A2} + q_{B2} - \tfrac{1}{2}((q_{A1})^2 + 2\gamma q_{A1}q_{B1} + (q_{B1})^2) + m_2 - p_{A2}q_{A2} - p_{B2}q_{B2}] \\ &+ [\alpha q_{A1} - \tfrac{1}{2}(q_{A1})^2 + m_{A1} - p_{A1}q_{A1}] + [\alpha q_{B1} - \tfrac{1}{2}(q_{B1})^2 + m_{B1} - p_{B1}q_{B1}] \end{aligned} \quad (29)$$

[38] Here, a common concern is the prospect of the media instigating a consumer backlash, even when local price differences may be genuinely cost driven by higher overheads and staff costs (e.g. "Tesco makes city shoppers pay a premium" *Daily Mail* (London), September 13, 2003; "M&S rip-off in stores in the South", *Daily Mail* (London), September 12, 2003).

Evaluating the terms with respect to the different equilibrium values when both firms adopt local pricing and when they both adopt uniform pricing, the aggregate consumer surplus in each respective case, i.e. S^{LL} and S^{UU}, abstracting from any income effects, is:

$$S^{LL} = \frac{1}{(1+\gamma)(2-\gamma)^2} + \frac{\alpha^2}{4} \tag{30}$$

and

$$S^{UU} = \frac{10-\gamma-13\gamma^2+\gamma^3+4\gamma^4+2\alpha(1-\gamma^2)(6-\gamma-3\gamma^2)+\alpha^2(1+\gamma)(10-7\gamma-6\gamma^2+3\gamma^3+\gamma^4)}{(1+\gamma)(4-\gamma-2\gamma^2)^2} \tag{31}$$

Taking the difference between the two levels and rearranging reveals:

$$S^{LL} - S^{UU} = -\frac{[2(1-\gamma)-\alpha(2-\gamma)][2(1-\gamma)X_S - \alpha(2-\gamma)Y_S]}{4(2-\gamma)^2(4-2\gamma-\gamma^2)^2} \tag{32}$$

where $X_S \equiv 24-12\gamma-11\gamma^2+4\gamma^3 > 0, \quad Y_S \equiv 24-20\gamma-9\gamma^2+8\gamma^3 = 11(1-\gamma)+9(1-\gamma)(1-\gamma^2)+(4-\gamma^3) > 0$

As with the profit comparisons, the sign of the above expression rests on the sign of the term in square brackets on the numerator in the first part of the equation and the square bracketed term in the second part of the equation. The following proposition establishes the market conditions where aggregate consumer surplus is higher depending on the choice by both firms of local pricing or uniform pricing:

PROPOSITION 6. *For $\alpha \in (0,1)$ there exists a zone in (α,γ) space for which aggregate consumer surplus is greater under local pricing. This zone has an inner boundary where $p^m = p^d$ while the other boundary, $p^m = p^d Z_S$, where $Z_S \equiv X_S/Y_S$, lies strictly above (i.e. outside) the first. On the other side of these boundaries, uniform pricing by both firms offers higher aggregate consumer surplus.*

Again, as with the profit comparisons, conditions on the nature and shape of these boundaries can be readily identified. The inner boundary is, of course, the same as before where $p^m = p^d$, i.e. strictly downward sloping and concave in (α,γ) space. The outer boundary can be shown to be strictly downward sloping and concave. Furthermore, the two boundaries converge at opposite extremes of the parameter space, i.e. as $\alpha \to 1$, $\gamma \to 0$ and $\alpha \to 0$, $\gamma \to 1$.

It might at first seem that firms' preferences would be directly at odds with consumers' preferences. However, this is not the case as the following proposition establishes:

PROPOSITION 7. *(a) For $p^m < p^d$ then firms' individual and joint preferences over pricing policy are directly at odds with those of consumers. (b) For $p^m > p^d$, firms' individual choice of pricing policy leading to (U,U) or (U,L) is always at odds with consumers' aggregate preference, but for (L,L) some*

market conditions exist where there is a shared preference. (c) For $p^m > p^d$, firms' joint/coordinated choice of pricing policy leading to (L^*,L^*) is always at odds with consumers' aggregate preference, but for (U^*,U^*) some market conditions exist where there is a shared preference.

Proposition 7(a) makes immediate sense in view of the effect that uniform pricing has in these circumstances. By comparison with local pricing, the averaging effect intensifies competition in the duopoly market, resulting in lower prices to the benefit of consumers, while raising prices in the monopoly markets where consumer surplus is low anyway. The mutual preference for local pricing expressed in Proposition 7(b) is explained by the prisoners' dilemma that the firms face, jointly wishing to coordinate on uniform pricing but not prepared to commit unilaterally to such a policy, thereby leading to lower prices in the duopoly market for the benefit of consumers overall. In contrast, the mutual preference for uniform pricing expressed in Proposition 7(c) relates to the sizeable gains in surplus that consumers in the monopoly market make through the averaging effect of uniform prices, which more than offset the reduced surplus that consumers in the duopoly market suffer.

To provide some further insight into the above propositions and their link with the outcomes of the previous section, Table 3 covers some examples of key magnitudes in particular cases.[39] Taking Case 1, this shows the common situation ($p^m < p^d$) where firms individually (and jointly) find it optimal to price locally, but consumers as a group would prefer uniform pricing. Case 2, however, is more subtle and less common; it occurs for parameter constellations such that $Z_1 < p^m/p^d < Z_S$. Here, the equilibrium outcome is local pricing, and this is the outcome preferred by consumers. However, the firms face a prisoners' dilemma and would jointly prefer uniform pricing. This case is easy to explain intuitively. It is akin to the well known result that Cournot is better for consumers than collusion (since collusion would lead to higher profits for the firms as a result of higher prices and reduced quantity but is not sustainable as an equilibrium in a single-stage game).

The other two cases are illustrated in Figure 3. In Case 3 (prices subscripted 3, being an example of the cases for which $1 < p^m/p^d < Z_2$) the equilibrium is for the firms to practice uniform pricing. But in this case, consumers would prefer local pricing. Finally, Case 4 (prices subscripted 4, an example of $Z_S < p^m/p^d < Z_3$) has firms practicing local pricing but preferring uniform pricing. Moreover, if uniform pricing were imposed, *both* firms and consumers (as a group) would be better off.

[39] Full details of these and other numerical examples are available on request from the authors.

Table 3. Retailer Profits and Aggregate Consumer Surplus for Various Values of α and γ

Pricing Configuration	Firm-Level Profits				Aggregate Consumer Surplus			
	Case 1 α, γ = 0.5	**Case 2** $\alpha = \gamma$ = 0.6667	**Case 3** α =0.5, γ = 0.75	**Case 4** α =0.5, γ = 0.85	**Case 1** α, γ = 0.5	**Case 2** $\alpha = \gamma$ = 0.6667	**Case 3** α = 0.5, γ = 0.75	**Case 4** α =0.5, γ = 0.85
(*L*,*L*)	***0.2107***	**0.2236**	0.1539	**0.1238**	**0.3588**	***0.4486***	*0.4282*	**0.4712**
(*U*,*L*)	0.2048	0.2228	0.1545	0.1189	0.3696	0.4484	0.4266	0.4780
(*L*,*U*)	0.2025	0.2334	0.1598	0.1365	0.3696	0.4484	0.4266	0.4780
(*U*,*U*)	0.1985	*0.2321*	***0.1599***	*0.1320*	*0.3779*	0.4475	**0.4252**	*0.4823*

Note: **Bold** indicates equilibrium configurations; *Italics* indicates joint (firm or consumer) preferences

- Figure 3 near here -

This last is the most intriguing result. If we compare local prices or uniform prices, we see in Figure 3 that moving from local to uniform implies price falling in the uncontested market and rising in the contested market. Of course, quantity rises in the uncontested market and falls in the contested, but note also that quantity rises significantly overall in Case 4, unlike Case 3. There is a powerful force making for profits and consumer surplus to move in opposite directions. This is the transfer from one to the other as a result of an increase/decrease in price. However, there is also another force that works in the same direction for both profit and consumer surplus, namely that an output increase is good, and an output decrease bad. In Case 4, this latter effect is large.

Another way to think of this positive link between profit and consumer surplus extends the intuition provided by Winter (1997). Considering the firms first, a marginal increase in price above the duopoly level in the contested market is profit improving, whilst a marginal decrease in price below the monopoly level in the uncontested market has no impact, through the envelope theorem. Of course, Winter's intuition works only for marginal changes, but it indicates that there is scope for the firms to gain through moving to uniform prices. Now consider the consumers. Under local pricing, there are people in the uncontested market who are unable to consume the good, despite having higher reservation values than people in the contested market who do consume the good. This is socially inefficient. By moving to uniform pricing, some relatively high valuation consumers get to buy the good at the expense of some relatively low valuation consumers, meaning that there can be an aggregate gain in consumer surplus. Thus there is no inconsistency between the observation that firms are better off and consumers, as a group, are better off, although it clearly happens only for a limited range of parameters.

8. Conclusion

8.1. Managerial Implications

Modern computer billing systems and scanning techniques have enabled micro-marketing to develop rapidly across retailing. In this context, it might be seen as a natural weapon in the marketer's armory in generating additional profit, along the lines of the very careful empirical work on the subject (Montgomery 1997, Chintagunta et al. 2003, *inter alia*). Yet some market-leading retailers forsake local pricing in favor of uniform pricing. Our analysis qualifies the belief that local pricing raises profit, by showing that there are strategic, as well as customer relations, reasons why it may have an adverse impact on profit. However, it also suggests that only in quite specific circumstances will a move to uniform pricing be worthwhile, namely if it softens the nature of oligopolistic competition. This means that in order to gain any possible profit advantage from moving to uniform pricing the retailer would need to undertake a form of unilateral commitment that is both visible and essentially irreversible or, if as a joint move, be in a situation where tacit collusion over pricing policy choices can be supported. The greatest scope for uniform pricing appears to be from a joint move. Nevertheless, a unilateral move to uniform pricing may be worth making although it can involve benefiting a rival more.

Public statements in support of a permanent move to EDLP might be one means of adopting a uniform pricing policy with a softening impact.[40] Alternatively, retailers should look to lock-in their pricing policy through expensive commitments (such as printing catalogues for national use like the furniture retailer IKEA, or have goods delivered with standardized integral pricing tags – like clothing retailers Zara and Marks & Spencer).

In all of this, consumers' attitudes cannot be forgotten. Local pricing necessarily entails at least one group of consumers being made worse off than they would otherwise be under uniform pricing. Thus at least one group may feel aggrieved by micro-marketing. Therefore using local pricing may well impact detrimentally on the image of retailers in the long run (potentially affecting future demand). The interesting case is that where uniform pricing can benefit both firms and consumers. In these circumstances a true win-win situation may arise (especially as the consumer benefit may go to the poorer consumers).

8.2. Extensions

Beyond our simple model there are other factors, apart from concerns about retail image, which may impact on the choice of pricing policy. First, despite advances in information technology, there may be

[40] See footnote 32 above in relation to declarations by Asda.

significant costs associated with a complicated local pricing policy, involving highly customized prices.[41] Second, there may be longer-term considerations, with local pricing providing greater flexibility in driving out existing competitors or even deterring new competitors from entering local markets, allowing the retailer to consolidate its local position. Third, and in contrast to the flexibility advantages of local pricing, uniform pricing provides a clear, consistent policy that may facilitate greater price understanding between rivals, lessening competitive intensity (though may ultimately be deemed illegal if it amounts to tacit collusion in the form of full parallel pricing). Fourth, it obscures the possible impact of retail mergers.[42]

Finally, we see potential for future research in changing or relaxing some of the assumptions in our model. For example, it might be interesting to see how preferences for uniform pricing change under different specific demand assumptions. It would also be interesting to consider asymmetries between the firms, for example in respect of the number of markets that each covers. Intuitively, we would expect large chains with more monopoly markets to be more inclined towards uniform pricing than smaller chains, because a large chain would be in a better position to make a profit sacrifice to dampen overall competition, than would a smaller chain obliged to give up considerable local monopoly profits to have any noticeable effect on competition in duopoly markets shared with the large chain.[43] Another line of inquiry might be to consider cost differences at the local level. We conjecture that the scope for uniform pricing would more likely hold if operating costs were higher in more affluent, but more competitive, "urban" areas than in poorer, but less competitive, "rural" areas if this closes the gap between lower prices in the former areas and higher prices in the latter areas by reducing local profit sacrifice.

[41] For instance, it has been estimated that local pricing and promotions in respect of the discounts, printing and administration cost the UK retailer Safeway (as an extensive user of zone pricing prior to being taken over by Morrison) around one percent of its turnover (McGoldrick 2002, p. 386).

[42] This argument may, for example, have had some bearing on the developments in the UK grocery sector with Tesco, Sainsbury and Morrison all going on the acquisition trail in recent years. This argument also relates to the blocked *Staples/Office Depot* merger, where the FTC was able to show that this "3 to 2" merger would likely raise prices in local markets based on existing prices being significantly higher in monopoly and duopoly local markets than in triopoly markets – see Dalkir and Warren-Boulton (1999) for details.

[43] Interestingly, this pattern does match what has happened in the UK grocery sector, described above in section 2, where the large retailers have moved to uniform pricing but some of the smaller chains still practice local pricing.

APPENDIX

Proofs to Propositions 2-7

PROPOSITION 2. PROOF. Adapting the method used in Dobson and Waterson (2005), let us take the case of firm *A* (noting that firm *B*'s case is directly analogous). The sign of the equation in (26) rests on two terms. These can be re-expressed to yield two conditions, relating α and γ, such that when either holds the value of (26) is zero. Specifically $\Pi_A^{LL} = \Pi_A^{UL}$ if $\alpha = 2(1-\gamma)/(2-\gamma)$ or $\alpha = [2(1-\gamma)/(2-\gamma)]Z_1$. Note that the first condition amounts to $p^m = p^d$ while the second is $p^m = p^d Z_1$. Next, observe that Z_1 takes a value strictly greater than unity as long as $\gamma \in (0,1)$. This follows since $X_1 - Y_1 = 8\gamma^2(2-\gamma^2) > 0$. Thus these two loci divide the profit space in dimensions (α, γ) into three segments. Expression (26) must take on either a positive or a negative value in each of these segments. Further, by simple substitution, of (α, γ) values (0,0) and (1,1), we see that in the lowest and uppermost segments, the expression is positive. Next note that the expression is strictly convex with respect to α since $\partial^2(\Pi_A^{LL} - \Pi_A^{UL})/\partial\alpha^2 = Y_1/[2(8-5\gamma^2)^2] > 0$. Hence in the middle section, the expression is negative. *Q.E.D.*

PROPOSITION 3. PROOF. By exactly the same method as the proof to Proposition 2, observing that, from (27), $\Pi_A^{LU} = \Pi_A^{UU}$ if $p^m = p^d$ or $p^m = p^d Z_2$, where $Z_2 > 1$ for $\gamma \in (0,1)$ since $X_2 - Y_2 = 2\gamma^2(4 - \gamma - \gamma^2)(8 - 5\gamma^2) > 0$, and that $\partial^2(\Pi_A^{LU} - \Pi_A^{UU})/\partial\alpha^2 = 2(2-\gamma)Y_2/[2(8-5\gamma^2)(4-\gamma-2\gamma^2)]^2 > 0$. *Q.E.D.*

PROPOSITION 4. PROOF. Noting that (26) and (27) each yield two equality conditions and that, in terms of (α,γ) space, the inner boundary for both is the same, i.e. $p^m = p^d$, proof amounts to showing that the outer boundary for the former lies outside of the latter. This will be true if $Z_1 > Z_2$. Observing that both identities and their components are signed positive, it follows that if $X_1Y_2 - X_2Y_1 > 0$ then $Z_1 - Z_2 > 0$. This is indeed the case as $X_1Y_2 - X_2Y_1 = 4\gamma^2(1-\gamma^2)(8-5\gamma^2)[64-48\gamma-64\gamma^2+40\gamma^3+17\gamma^4-8\gamma^5] = 4\gamma^2(1-\gamma^2)(8-5\gamma^2)[8(1-\gamma)(2-\gamma^2)(4+\gamma-\gamma^2)+\gamma^4] > 0$, noting that all bracketed terms are positive. *Q.E.D.*

PROPOSITION 5. PROOF. The existence of the zone where uniform pricing is jointly preferred and the nature of its two boundaries follow directly from the method used as the proof for Proposition 2, observing that, from (28), $(\Pi_A^{LL} + \Pi_B^{LL}) = (\Pi_A^{UU} = \Pi_B^{UU})$ if $p^m = p^d$ or $p^m = p^d Z_3$, where $Z_3 > 1$ for $\gamma \in (0,1)$ since $X_3 - Y_3 = 8\gamma - 2\gamma^2 - 4\gamma^3 > 0$, and that $\partial^2(\Pi_A^{LL}+\Pi_B^{LL} - \Pi_A^{UU} - \Pi_B^{UU})/\partial\alpha^2 = Y_3/[(4-\gamma^2-2\gamma^2)^2] > 0$. Next, from Proposition 3 we know that the upper boundary for privately preferring uniform pricing when the rival is uniform pricing (i.e. $p^m = p^d Z_1$) lies, in (α,γ) space, strictly above and outside that corresponding to

when the rival adopts local pricing (i.e. $p^m = p^d Z_2$), this follows since $Z_1 > Z_2$. Accordingly, to conclude the proof we are required to show that $Z_3 > Z_1$. This is the case since $X_3Y_1 - X_1Y_3 = 4\gamma(2-\gamma)(2-\gamma^2)[16-4\gamma^2-10\gamma^2+\gamma^3] > 0$. *Q.E.D.*

PROPOSITION 6. PROOF. The proof is on the same basis as that to Proposition 2. Specifically, we find that, from (32), $S^{LL} = S^{UU}$ if $\alpha = 2(1-\gamma)/(2-\gamma)$ or $\alpha = 2(1-\gamma)X_S/[(2-\gamma)Y_S]$, with the former condition amounting to $p^m = p^d$ and the latter to $p^m = p^d Z_S$. Then, observe that $Z_S > 1$ for $\gamma \in (0,1)$, since $X_S - Y_S = 8\gamma - 2\gamma^2 - 4\gamma^3 > 0$. Thus, the second condition requires higher values of α for it to hold when compared to the first condition. Next, evaluate the surplus comparison with the extreme values of α and γ and observe that $\partial^2(S^{LL}-S^{UU})/\partial\alpha^2 = -Y_S/[2(4-\gamma^2-2\gamma^2)^2] < 0$, hence the expression is strictly concave with respect to α. It then follows that the zone which supports $S^{LL} > S^{UU}$ applies where $\alpha,\gamma \in (0,1)$ with $p^m = p^d$ operating as the lower boundary and $p^m = p^d Z_S$ as the upper boundary. *Q.E.D.*

PROPOSITION 7. PROOF. (a) By direct reference to Propositions 2, 3, 5 and 6. (b) By reference to Propositions 2, 3, 4 and 6, while noting that $X_SY_2 - X_2Y_S = 4\gamma(1-\gamma)(2-\gamma)[32-8\gamma-36\gamma^2+6\gamma^3+11\gamma^4] = 4\gamma(1-\gamma)(2-\gamma)[11(1-\gamma^2)^2+6(1-\gamma^2)(1-\gamma)+(15-2\gamma-8\gamma^2)] > 0$, so $Z_S > Z_1$ and thus the boundary $p^m = p^d Z_S$ lies above the boundary $p^m = p^d Z_1$ in (α,γ) space. (c) By reference to Propositions 5 and 6, while noting $X_SY_3 - X_3Y_S = -4\gamma(2-\gamma)(4-\gamma-2\gamma^2) < 0$, so $Z_S < Z_3$ and thus the boundary $p^m = p^d Z_S$ lies below the boundary $p^m = p^d Z_1$. *Q.E.D.*

References

Acquisti, Alessandro, Hal R. Varian. 2005. Conditioning prices on purchase history. *Marketing Sci.* **24**(3) 367-381.

Anderson, Eric T., Duncan I. Simester. 2001. Price discrimination as an adverse signal: Why an offer to spread payments may hurt demand. *Marketing Sci*. **20**(3) 315-327.

Anderson, Simon P., Andre de Palma, Jacques-François Thisse. 1992. *Discrete Choice Theory of Product Differentiation*. MIT Press, Cambridge, MA.

Armstrong, Mark. 2005. Recent developments in the economics of price discrimination. Working paper, University College London, London, UK.

Besanko, David, Jean-Pierre Dube, Sachin Gupta. 2003. Competitive price discrimination strategies in a vertical channel using aggregate retail data. *Management Sci.* **49**(9) 1121-1138.

Bester, Helmut, Emmanuel Petrakis. 1996. Coupons and oligopolistic price discrimination. *Internat. J. Indust. Organ.* **14**(2) 227-242.

Bowley, Arthur L. 1924. *The Mathematical Groundwork of Economics*, Oxford University Press, Oxford, UK.

Bresnahan, Timothy F. and Peter Reiss. 1987. Do entry conditions vary across markets? *Brookings Papers Econom. Activity* **1987**(3) 833-871.

Bulow, Jeremy I., John D. Geanakoplos, Paul D. Klemperer. 1985. Multimarket oligopoly: strategic substitutes and complements. *J. Polit Econom.* **93**(3) 488-511.

Chen, Yuxin. 1999. Oligopoly price discrimination and resale price maintenance. *RAND J. Econom.* **30**(3) 441-455.

Chen, Yuxin, Ganesh Iyer. 2002. Consumer addressability and customized pricing. *Marketing Sci.* **21**(2) 197-208.

Chintagunta, Pradeep, Jean-Pierre Dube, V. Singh. 2003. Balancing profitability and customer welfare in a supermarket chain. *Quantitative Marketing Econom.* **1**(1) 111-147.

Competition Commission. 2000. *Supermarkets: A report on the supply of groceries from multiple stores in the United Kingdom*. Cm 4842. TSO, London, UK.

Competition Commission. 2003. *Safeway plc and Asda Group Limited (owned by Wal-Mart Stores Inc); Wm Morrison Supermarkets PLC; J Sainsbury plc; and Tesco plc: A Report on the Mergers in Contemplation*. Cm 5950. TSO, London, UK.

Competition Commission. 2005. *Somerfield plc and Wm Morrison Supermarkets plc: A report on the acquisition by Somerfield plc of 115 stores from Wm Morrison Supermarkets plc.* http://www.competition-commission.gov.uk/rep_pub/reports/2005/fulltext/501.pdf

Corts, Kenneth S. 1998. Third-degree price discrimination in oligopoly: all-out competition and strategic commitment. *RAND J. Econom.* **29**(2) 306-323.

Dalkir, Serdar, Frederick R. Warren-Boulton. 1999. Prices, market definition, and the effects of merger: Staples-Office Depot (1997). John E. Kwoka, Lawrrence J. White, eds. *The Antirust Revolution: Economics, Competition and Policy*, 3rd Edition. Oxford University Press, Oxford, UK, 64-88.

Dixit, Avinash. 1979. A model of duopoly suggesting a theory of entry barriers. *Bell J. Econom.* **10**(1) 20-32.

Dobson, Paul W., Michael Waterson. 2005. Chain-store pricing across local markets. *J. Econom. Management Strategy* **14**(1) 93-119.

Ghose, Anindya, Vidyanand Choudhary, Tridas Mukhopadhyay, Uday Rajan. 2005. Personalized pricing and quality differentiation. *Management Sci.* **51**(7) 1120-1130.

Goldberg, Pinelopi K., Frank Verboven. 2005. Market integration and conversion to the law of one price: evidence from the European car market. *J. Internat. Econom.* **61**(1) 49-73.

Hoch, Stephen J., Byung-Do Kim, Alan L. Montgomery, Peter E. Rossi (1995). Determinants of store-level price elasticity. *J. Marketing Res.* **32**(1) 17-29.

Holmes, Thomas J. 1989. The effects of third degree price discrimination in oligopoly. *American Econom Rev.* **79**(1) 244-250.

IGD. 2005. *Grocery Retailing 2005*. Institute of Grocery Distribution, UK.

Lal, Rajiv, Ram Rao. 1997. Supermarket competition: the case of every day low pricing. *Marketing Sci.* **16**(1) 60-80.

Liu, Qihong, Constantinos Serfes. 2004. Quality of information and oligopolistic price discrimination. *J. Econom. Management Strategy* **13**(4) 671-702.

McGoldrick, Peter J. 2002. *Retail Marketing*, Second Edition. McGraw-Hill, London, UK.

Mintel. 2005. *Food Retailing – UK – November 2005*. Mintel Group, UK.

Montgomery, Alan, L. 1997. Creating micro-marketing pricing strategies using supermarket scanner data. *Marketing Sci.* **16**(4) 315-337.

Shaffer, Greg, Z. John Zhang. 1995. Competitive coupon targeting. *Marketing Sci.* **14**(4) 395-416.

Shaffer, Greg, Z. John Zhang. 2002. Competitive one-to-one promotions. *Management Sci.* **48**(9) 1143-1160.

Singh, Nirvikar and Xavier Vives. 1984. Price and quantity competition in a differentiated duopoly. *RAND J. Econom.* **15**(4) 546-554.

Stole, Lars A. 2006. Price discrimination and imperfect competition. Mark Armstrong, Robert Porter, eds. *Handbook of Industrial Organization Vol. 3*. Elsevier, Amsterdam, The Netherlands.

Thomadsen, Raphael. 2006. The effect of ownership structure on prices in geographically differentiated industries. *RAND J. Econom.* Forthcoming.

Vives, Xavier. 1999. *Oligopoly Pricing: Old Ideas and New Tools*. MIT Press, Cambridge, MA.

Winter, Ralph A. 1997. Colluding on relative prices. *RAND J. Econom.* **28**(2) 359-371.

Figure 1. Equilibrium Pricing Policy Configurations

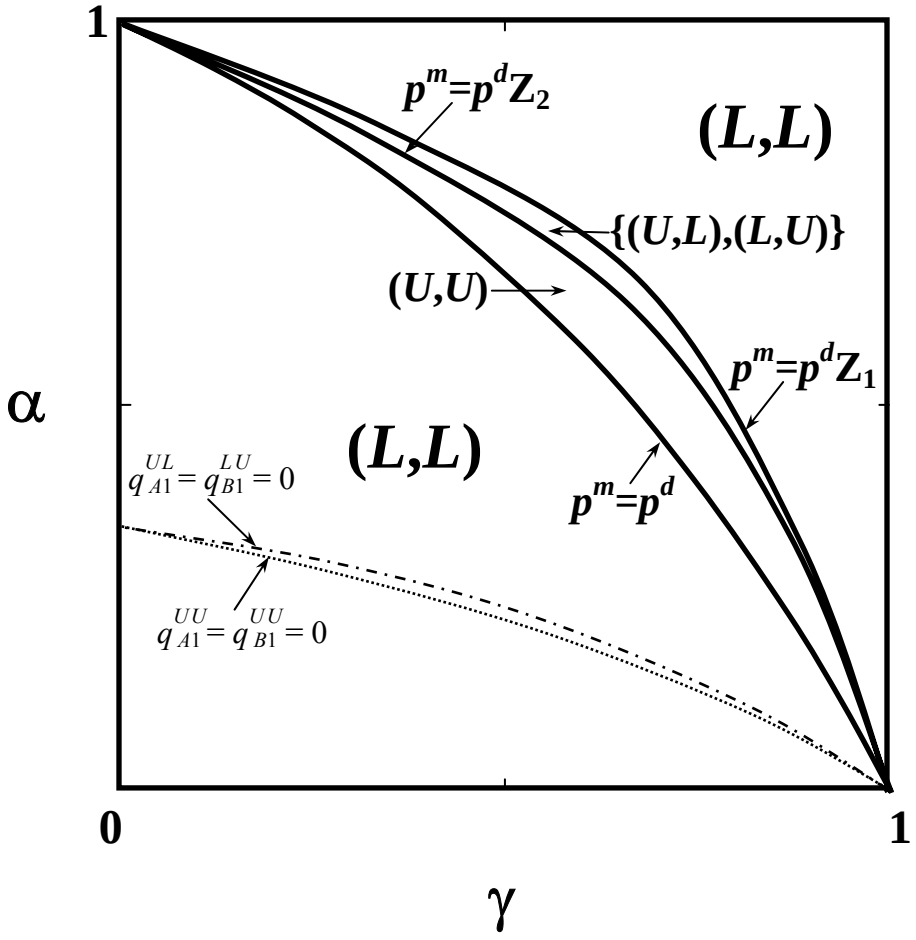

Figure 2. Configurations under Joint Preferences

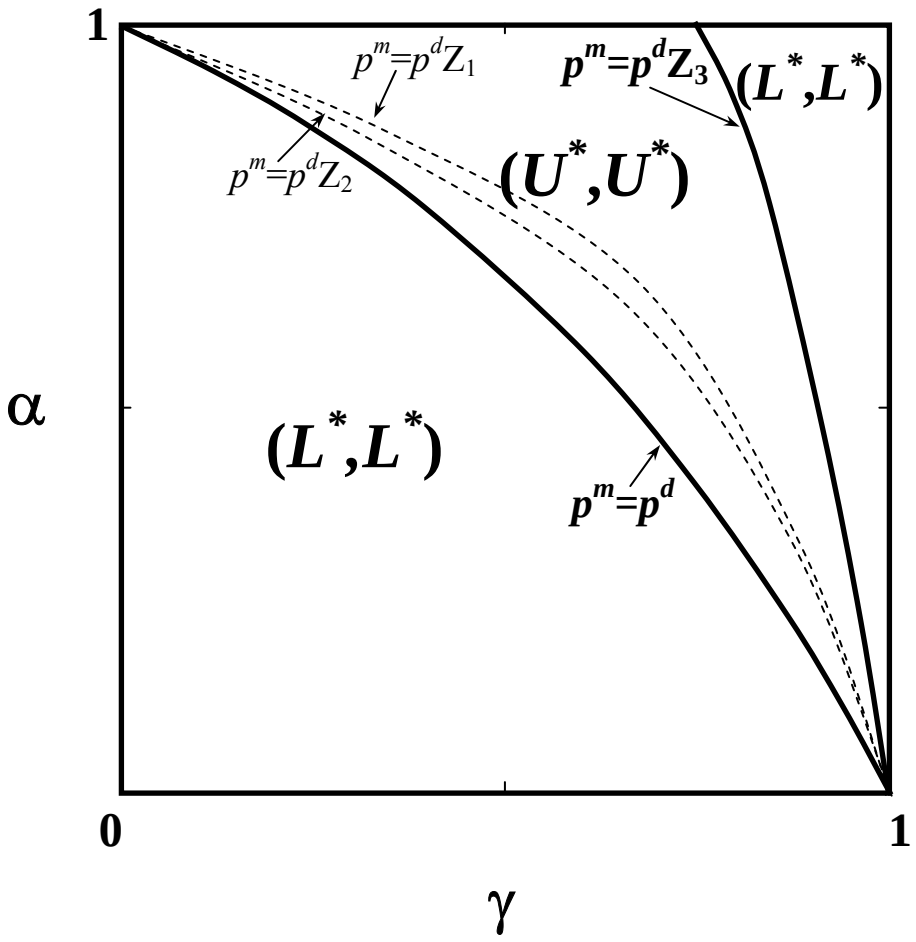

Figure 3. Producer and Consumer Welfare across Markets in Cases 3 and 4