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Identifying and characterising price leadership in British supermarkets

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Abstract

Price leadership is a concept that lacks precision. We propose a deliberately narrow, falsifiable, definition and illustrate its feasibility using the two leading British supermarket chains. We find both firms engaging in leadership behaviour over a range of products, with the larger being somewhat more dominant but the smaller increasing leadership activity over time. Surprisingly, more price leadership events are price reductions than price increases, but the increases are of larger monetary amounts (so average price increases over time) and the events appear not necessarily related to cost changes. Price leadership appears to play some role in price increases.

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1. Introduction

The concept of price leadership lacks precision in existing literature. We see a precise definition as fulfilling at least two criteria. First, it must incorporate a careful and *falsifiable* definition of the concept. Second, a suitable starting point for observation needs to be chosen. Unfortunately, both are more difficult than it might seem. To illustrate the first point, the OECD definition “Price leadership refers to a situation where prices and price changes established by a dominant firm, or a firm are accepted by others as the leader, and which other firms in the industry adopt and follow”² seems rather circular. Similarly, in characterising three types of price leadership, Dominant firm, Collusive and Barometric, Scherer and Ross (1990, p.249) suggest as distinguishing characteristics for the last of these “occasional changes in the identity of the price leader ... the absence of leader power to coerce others into accepting its price; a tendency for the leader formally to validate price reductions that other sellers have already initiated ...”. Since this well-established text is a common source of reference for subsequent work, the situation remains confused. Some analyses have argued from effect to attribution of leadership, for example the limited analysis in Competition Commission (2000, ch.7), rather than from an exogenous starting point to examination of the phenomenon. Finally, we need to accommodate the fact that firms are multiproduct in nature.

As an empirical illustration, we examine leadership behaviour in the British supermarket industry. Here, for reasons we spell out below, there are two obvious leadership candidates, Tesco and Asda. We examine their pricing behaviour using a new leadership concept seeking to avoid the various pitfalls. In our illustration, we take a particular neutral starting point, at which both key firms charge the same price for the set of products we examine.

We propose a new *definition* of what constitutes price leadership (and, by implication, what does not):

Price leadership occurs when one firm makes a change in its *Regular Price* (Nakamura 2008) that is followed within the next two weeks by the other (another) firm making a Regular Price change of exactly the same monetary amount in the same direction on the *same product*.

This definition therefore excludes temporary price changes (by focussing on regular prices), simultaneous price changes, those followed with a long lag, price changes of similar monetary amounts, or on a similar but not the same product. It is clearly falsifiable in the sense that it may not occur. More positively, the definition reveals which firm is engaging in leadership on which products when. It is deliberately defined narrowly, with the choice of two weeks interval reducing the possibility that

² See <http://stats.oecd.org/glossary/detail.asp?ID=3285>.

chance movements are included, but allowing time for reaction, so that the bias if any is towards not observing it when it occurs. Since we start from a position where both firms charge the same price, our approach is not affected by the starting point.

However, the definition does imply deliberate action and reaction. Given this, following our basic characterisation of the phenomenon, we discuss in section 6 how leadership as defined can be distinguished from random behaviour. Before that, we outline the theoretical literature; describe the industry (section 3), the nature of our sample data (section 4) and pricing behaviour in the industry (section 5). We move on in sections 7 and 8 to characterise upward and downward price leadership separately. Finally, section 9 offers a brief conclusion.

2. The theoretical literature on price leadership

The modern analytical literature on price leadership is comparatively thin. Amongst the main contributions are Rotemberg and Saloner (1990), Deneckere and Kovenock (1992), Deneckere et al (1992), Pastine and Pastine (2004) and Amir and Stepanova (2006). Various modelling strands emerge from this literature. The papers' focus is on all (both) firms in the market being strategic players, rather than one main actor together with a raft of passive firms, which was common in the more traditional literature.

Rotemberg and Saloner have a collusive story underlying their model. That is, price leadership facilitates collusion by one firm signalling to others that prices should rise. One firm raises its price and the other firm decides non-cooperatively whether to follow- this involves the usual tradeoff between the immediate benefits of deviating from this strategy against the longer term benefits of holding to it. They show existence of such an equilibrium but go beyond this to characterise it. The leader earns higher profit but leadership may emerge endogenously with the less informed firm wishing to follow the better informed. Interestingly, leadership in their model may be characterised by extensive periods of static prices after a leadership move upwards, because the follower benefits from rigid prices.

Again, endogenous leadership is an outcome of the Deneckere papers, although the underlying models are quite different. The Deneckere and Kovenock paper criticises the dominant firm pricing model, which comes from an earlier less rigorous tradition, under which a large firm with significant market share is assumed to take on the leadership role with the others being passive. In their duopoly game, in which firms' capacities are in the range where the simultaneous game leads to mixed strategy solutions, a game of timing emerges in which the high capacity player becomes the price leader. Deneckere et al has firms who cannot discriminate between loyal consumers and others. The firm with the smaller loyal segment strictly prefers to be a follower in pricing. Thus in this model consumer behaviour significantly influences the identity of the price leader, where the firm with the larger loyal consumer base

takes on the leadership role. Pastine and Pastine add to this analysis by noting two things. First, there should arguably be a cost of delay, however small, in making a later price announcement. Second, they allow firms to make price announcements at any time. This allows firms in their model to mix over the timing of their pricing moves. Hence, occasional changes in the identity of the price leader will occur.

Amir and Stepanova have a model where one firm enjoys lower costs than the other. Despite endogenous timing, the equilibrium outcome is that a firm with sufficiently lower costs takes on the leadership role; that is it has a first-mover advantage.

In sum, our reading of this literature leads to several key conclusions. First, the identity of the leader is not assured- it may not be the largest firm, which is the assumption the traditional literature made. Second, following from this, the leader may differ over time or products- if for example loyalties shift, or multiproduct firms have strengths that vary across the product range. However, some changes over time, or alternatively mixing over timing of moves, are required to allow changes in the identity of the price leader. Third, leadership may or may not have collusion as its driving force. Of the papers discussed above, only Rotemberg and Saloner focus on collusion as the driver. Fourth, a common implicit assumption is that price leadership involves upward price movements. The models are essentially silent on leadership of price reductions.

3. The British supermarket industry

Grocery retailing is the largest retail sector in the UK and an important market. Verdict Research (2008), a market research organization, estimates that in 2007, food and grocery retailing accounted for around 42% of total UK retail spending. They predicted that this share would rise thereafter, to around 45% in 2012. The sector is dominated by four players. Table 1 below, extracted from Competition Commission (2008), shows that in 2007, nearly 2/3 of these retail sales are made by Tesco, Asda, Sainsbury's or Morrisons.³

As can be seen from the table, Tesco is by far the biggest of these, with Kantar putting its share at around 30% in 2011. In other words, Tesco alone accounts for over 1/8 of British retail consumer spending, on these figures. In recent years Tesco, and to a lesser extent, Asda, now the second largest firm, have grown significantly. In fact, on Kantar figures up until 1995, Sainsbury's was the largest firm, but first Tesco then, during 2003, Asda overtook it and Asda has maintained second position ever since.⁴ Both these firms operate large stores extensively; in fact according to the Competition Commission (2008), substantially fewer than ten of Asda's stores are less than

³ Kantar Worldpanel (2011), a rival source of market share information, gives them a total of around 72% of the market in 2011, on a slightly different definition of the market.

⁴ Both our sources agree on the latter point.

1,400sq.m in size.⁵ Tesco operates more of a variety of store sizes. Its nearly 1,400 stores in 2008 consisted of four main groups, the two largest accounting for 564 stores (and undoubtedly a major share of their sales). It then has two smaller groups, styled Metro and Express. Tesco and Asda together account for well over 40% of grocery sales.⁶

TABLE 1 Grocery sales share of UK grocery retailers

	2002	2003	2004	2005	2006	per cent e2007
Tesco	20.2	22.4	23.8	25.4	26.8	27.6
Asda	12.3	12.9	13.3	13.4	13.7	14.1
Sainsbury's	12.8	12.5	12.6	12.8	13.4	13.8
Morrisons	3.8	4.2	10.3	9.6	9.7	9.9
Safeway	8.2	7.8	2.4	0	0	0
Somerfield Chain	2.9	2.8	3	3.7	4.1	3.9
M&S	3.3	3.4	3.4	3.5	3.6	3.8
CGL	2.8	3.2	3	2.9	2.8	3.8
Waitrose	2.5	2.6	2.8	3	3.2	3.3
Iceland	1.7	1.6	1.5	1.4	1.4	1.5
Aldi	0.9	1	1.1	1.3	1.4	1.5
Lidl	1.1	1.1	1	1.1	1.2	1.3
Netto	0.5	0.6	0.6	0.6	0.6	0.6
Kwik Save	2	1.8	1.6	1.3	0.7	0
Others	24.9	22.1	19.6	20	17.4	14.9
Total	100	100	100	100	100	100

Source: Verdict, UK Grocery Retailers 2008, February 2008.

Note: Table drawn directly from Competition Commission (2008) Appendix 3.1

A key feature of the industry (Competition Commission, 2003) is that the major firms practise national pricing. In other words, whether shopping in Cornwall or the Scottish Highlands, the consumer faces the same prices in their larger stores. Asda operates a uniform national pricing policy (with very minor differences) across all its stores in Britain. Tesco operates a uniform national pricing policy across its large stores, and many of the Metro stores also adhere to these prices.⁷ These uniform prices hold across the whole of the country- there are none of the intricate variations in prices that characterise US grocery retailing. Thus national advertising, for example, will include (selective) price information. This feature of the market is in itself curious,⁸ since costs will differ from location to location, as do incomes and

⁵ Very recently, Asda has purchased a smaller operator, Netto, which will have increased its store numbers in the smaller category.

⁶ TNS (2009) puts it at almost 50%.

⁷ This has not always been Tesco's policy, but it was at least since 2003, when our data start.

⁸ This is studied in Dobson and Waterson (2008),

indeed the extent of competition from one or more of the other major players. However, for present purposes, we take it as a given.

Both Tesco and Asda are part of major international retailing groups, in Tesco's case the base is in the UK. Tesco is one of the world's top four retailers; Asda is the British subsidiary of Walmart. Hence their pricing strategies are backed by powerful groups in each case. They are the obvious candidates for price leadership in the market, given their size and growth. Tesco is a natural candidate as a price leader, since it is the dominant player in the market in terms of market share and it enjoys a cost advantage (Competition Commission, 2008). Asda has been chosen for study because it has a reputation both as a keen pricer in relation to Tesco and an aggressive player in the market- it is the chain most driven by price. At the start of our period, it was the third player in the market but has moved up to and sustained second place, ousting Sainsbury, which has been much less concerned to price match. Sainsbury's, the number three firm, has been notably less aggressive and more idiosyncratic in its pricing practices, preferring a quality image, whilst Morrisons is very much the fourth player, absorbed with consolidating a difficult merger with Safeway (a very different store) in late 2003 and without an internet arm. Various reports including official investigations (e.g. Competition Commission 2000, 2008) have described Tesco and Asda as leading market trends. Given their national pricing practices, we can examine their pricing interrelationship using these national prices as our key statistics,

4. The data sample

We have available, week-by-week, the store prices for 370 precisely defined products over seven years from late 2003 to late 2010 for both key players in the British supermarket industry. Our sample starts when Tesco started its "Tesco Pricecheck" website. This was an independently collected large scale weekly comparison of precisely defined products across these two store chains plus Sainsbury's and Safeway then Morrisons. We supplement this with data, from 2008 onwards, downloaded from a website called mysupermarket.co.uk (who collected across Tesco, Asda and Sainsbury's) to create the seven year sample. Thus we have consistent weekly data for Tesco, Asda and Sainsbury's over seven years. We use the Tesco and Asda data in this analysis. The advantage of this long spell of prices is that different macroeconomic conditions are experienced over the period.

Our 370 products are those for which we are able to form a good quality price series over the full period.⁹ Some are branded products (for example, Nescafe Gold Blend Coffee 200g), others are essentially identical store brand products (e.g. Own label fresh single cream, 568ml). Of the 370 products, within the first 6 weeks of the sample, a total of 331 products were priced identically by Tesco and Asda, either right

⁹ The sample is clearly not random. However, appropriately weighted, it tracks the official CPI well (see Chakraborty et al, 2011). The correlation between baskets constructed from our supermarket prices to mimic the CPI index and the index itself is uniformly very high, in excess of 0.93.

from the start or quite soon thereafter.¹⁰ These 331 products, as from the 7th week, were taken for further examination and are the subject of our analysis below.¹¹ Of these 202, or almost 2/3 of the products, were also priced identically at the end of the sample (within the final month). Of course, the prices were not identical at beginning and end, in fact the mean item price at the start was a little over £1.50, but by the end it was £1.85 and had been up to £1.90. This raises the question of leadership's role in prices moving up by roughly 25% over the period.

We want to avoid complications introduced by temporary price offers. Hence, we identified temporary "V shaped" price offers and then eliminated them using (a slight variant of) the Nakamura algorithm (described in Nakamura and Steinsson, 2010) to create "regular" prices. The eliminated offers were defined as decreases in price that were associated, up to 6 weeks later, with increases of the same amount, or moves to a new regular price. We dropped these observations in favour of a regular price spanning this period. All subsequent discussion relates to regular prices. In fact, it probably should be emphasised that there is an element of nonlinear pricing in temporary offers made by these and other store chains (three for the price of two offers, etc). Since we examine regular prices we look only at prices for a single item, not package deals. This is in line with the Macroeconomic literature on micro pricing behaviour (Nakamura and Steinsson, 2008, 2010; Kehoe and Midrigan, 2010 and others)¹².

5. Characterising pricing in the supermarket industry

Before we move to examining leadership specifically, we discuss the nature of pricing behaviour in the industry more generally, to explain further why it is a good case study for examining price leadership and why we do not consider cost changes to be the sole, or even perhaps an important, drive of price changes.¹³

The first thing to point out is that prices in the industry are very flexible, even when considering regular prices. In fact, they are much more flexible than could possibly be explainable through changes in costs. Figure 1 shows median duration of price across our products and time period. As can be seen, for most products at either of our two stores, the median duration is only a little over a month, whereas Sainsbury's prices tend to be rather more stable.

¹⁰ Here, including Sainsbury's would have required a change in methodology, because of its different pricing levels.

¹¹ Our justification on timing is that once the Tesco Pricecheck started, all players were able to compare prices easily, so initial moves to align themselves are allowed. In total we use 365 weeks of observations.

¹² Kehoe and Midrigan (2010) have an alternative definition of regular prices, but we do not adopt this here, because it might interfere with phenomena we wish to examine.

¹³ Much more detail on general pricing behaviour in the industry is provided in Chakraborty et al, (2011).

The second point to emphasise is the variety of experience across products in terms of pricing behaviour, implicit in Figure 1. Whilst in both stores milk (products) change prices only infrequently, perhaps as little as once per year, other products change price rapidly; amongst these alcoholic drinks are a category that stands out. Again this speaks to the proposition that costs are unlikely to be the prime driver of price changes.

A third feature of pricing in the industry, itself the subject of study in Chakraborty et al (2011), is that at various times, markedly so in 2008, there is a welter of price cuts of very small monetary value. Indeed, penny price cuts are very common. Also, a feature of the market across these two and the other two major players is that there is remarkable concordance in the majority of small price changes made being cuts (up to values of around 8 pence) whilst the majority of larger price changes, above 10 pence, relate to price rises, rather than falls. Again, this is a pattern at the lower end that is unlikely to be related to changes in costs. Small value price changes, even as low as one penny, are seen on products costing several pounds on occasion.

Finally, in figure 2 below we show weighted basket prices calculated from our data sample of 370 products, using weights equivalent to those used in the CPI. As with other evidence, this shows how Sainsbury's takes a somewhat different path from Asda or Tesco, with somewhat higher pricing.

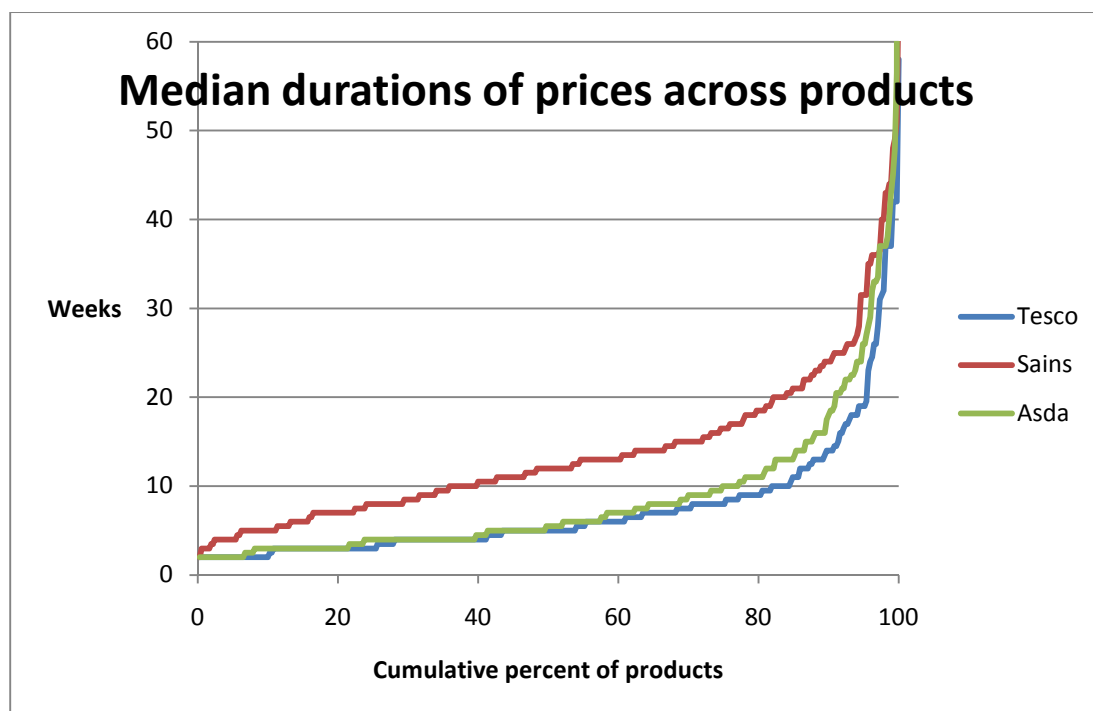


Figure 1: Median duration of prices in our data sample

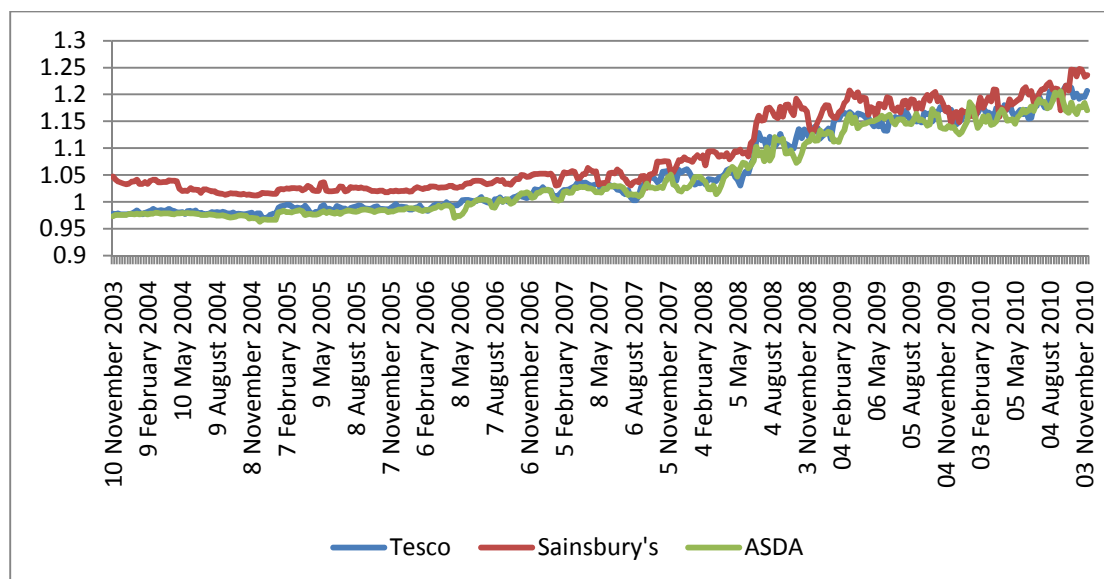


Figure 2: Prices indices calculated using CPI weights from our data sample

6. Leadership incidence, significance and impact

We now turn to an empirical examination of leadership as between Tesco and Asda, using the definition we proposed. We identify two broad types of leadership. One is upward price leadership- a regular price movement upwards by one of the players that is associated with an increase of exactly the same amount one or two weeks later by the other player. Downward price leadership is defined completely analogously. Logically, there are four forms of price leadership that could exist here- it could come from Tesco or Asda, and it could be upward or downward. Within the sample, there are many examples of each over the period, as Table 2 shows.

Table 2: Summary of findings on price leadership

Occasions on which firm led	Tesco	Asda
On price rise	347	256
Average rise, pence	15.2p	14.2p
Products illustrating leadership	58%	53%
Maximum leads/week	12	7
On price fall	562	1328
Average fall , pence	5.3p	3.5p
Products illustrating leadership	62%	87%
Maximum leads/week	21	39

These results represent findings over 331 products for 369 weeks using “regular” prices

Table 2 summarises our broad findings on price leadership. Even given our tight definition, we see several hundred episodes of price leadership over our (large and quite lengthy) sample. Thus price leadership is extremely common, it resides in both players and it covers a majority of the goods at some stage or another over the seven year period we have examined. In this sense, neither player is “the” price leader. Yet, it is difficult to think how the definition of leadership could be made narrower than the one we have employed, to reduce the incidence of leadership episodes. Our findings here are strongly confirmatory of the recent literature’s broad emphasis that leadership is endogenous, not residing in one player and not necessarily associated with the largest player.

Tesco is more often the price leader over price rises. In an echo of Walmart’s “rollback” programmes, Asda dominates leadership in price falls, although these are on average smaller in magnitude than rises. In fact, one of the most significant findings is that in sheer numbers leadership over price falls greatly dominates leadership over price rises. Thus it is clearly not the case that price leadership as defined here is necessarily creating higher prices than otherwise would be observed. This finding relates to the literature in the following sense. Although the traditional literature emphasised implicit collusion as a motive for leadership, the evidence of a dominance of downward price movements in leadership episodes strongly argues against this conclusion. In that sense, our evidence is more in line with the less obviously motive-driven analyses of Deneckere and others (Deneckere and Kovenock, 1992; Deneckere et al, 1992; Pastine and Pastine, 2004; Amir and Stepanova, 2006), rather than the Rothenberg and Saloner (1990) collusion story.

The overall picture conceals some important temporal variation, which is illustrated in Table 3. Price leadership becomes more significant as a phenomenon over the seven year period, measured either in absolute terms or relative to the total number of price changes. It peaks in extent in 2009, with nearly a quarter of all the regular price changes made within the year (therefore covering almost 50% of regular price movements by these two companies) being leadership moves. Here we should recall that 2008 was a time of rapid commodity cost increases, many of which were reversed in the subsequent recession of 2009. Moreover, over our time period, Asda comes to dominate in leadership on our definition, not only on price falls but also price rises, although it remains the smaller firm. This outcome is also in line with the view that leadership is endogenous rather than residing in the largest firm, in addition to the view that occasional changes to the leader may occur.

The discussion above makes the presumption that the behaviour exhibited in table 3 is different in a temporal, directional or fascia sense from random behaviour. We can test this formally using a set of chi-squared tests, with the null hypotheses (i) that behaviour is random across the years in terms of upwards versus downwards movements, (ii) that the share of upwards movements by Tesco versus Asda is randomly distributed across the years, (iii) the same for downwards movements, (iv)

that upwards and downwards movements are a random proportion of total price changes. In each case, the calculated chi-squared value is substantially in excess of the chi-squared value for six degrees of freedom at the 0.01 level, meaning we can reject each of these hypotheses. In all these senses, what we have identified as price leadership behaviour is not random.

Table 3: Price movements by year, firm and direction

		2004	2005	2006	2007	2008	2009	2010 (part)	Total
Up	Tesco	35	60	84	75	50	13	28	345
	Asda	4	15	19	10	99	69	40	256
Down	Tesco	7	13	42	47	138	259	54	560
	Asda	47	61	32	43	329	649	162	1323
	Sum	93	149	177	175	616	990	284	2484
Total price changes		826	1142	1240	1776	4247	3994	2412	15637
Proportion		0.113	0.130	0.143	0.099	0.145	0.248	0.118	0.159

Note: Excludes the closing weeks of 2003. 2010 ends in November.

Of course, firms are likely to be subject to common cost shocks. Hence, on one view, what we identify as leadership might be considered as merely the effects on price of common cost increases.¹⁴ We are not able to get a clean identification of when this happens. However, it is important to recall the definition we use. In order to count as a leadership event, the price rise (fall) cannot be simultaneous. It also has to be the same number of pence. Moreover, we judge it rather likely that single penny drops in price that are followed do not have their origin in cost shocks. Given that around half the price fall leadership cases relate to such penny drops, this is a significant consideration.

One way of getting a handle on the impact of cost shocks as an explanation more broadly is to compare the figures in table 3 with simultaneous price movements on otherwise the same definition (i.e. identical price changes). Table 4 lists these movements in our sample. We can thereby evaluate the likely extent to which what we are identifying as price leadership is in fact simple (but slightly staggered) responses to cost changes. If cost changes are the underlying cause, then what we style leadership would occur roughly as often as simultaneous price moves that otherwise fit our definition.¹⁵ When we make this comparison, we find on average a significant excess of “leadership” events compared with what would be expected given numbers of simultaneous price rises, as illustrated in the final two rows of table

¹⁴ An alternative view on this point is that any event we identify as leadership is clearly leadership, since someone has initiated the rise in the product’s price, rather than leaving it unchanged.

¹⁵ Of course, our definition of “leadership” involves the price change being over either of the next two weeks. Therefore, in making comparisons between simultaneous and staggered price movements, we must divide the latter by 2.

4. This is particularly true (a) in 2009 and 2010 and (b) in respect of price falls. The latter finding is certainly what might be anticipated, since the data exhibit many price falls and it is almost inconceivable that costs have fallen to suit. We test the null hypothesis of consistency in the ratio of “leadership” rises (falls) to simultaneous rises (falls) over time, versus non-consistency, using a chi-squared test. Here the null is very clearly rejected. Along with the other evidence, this is a substantial confirmation that we are identifying conscious behaviour, although possibly what we call leadership has different causes on different occasions, sometimes relating to cost movements and sometimes not.

Table 4: Examining simultaneous price movements

	2004	2005	2006	2007	2008	2009	2010 (part)	Total
Any	20	50	43	75	180	44	13	425
Up	15	30	32	43	57	11	10	198
Down	5	20	11	32	123	33	3	227
Ratio prices led up to simultaneous	1.30	1.25	1.61	0.99	1.31	3.73	3.40	
Ratio prices led down to simultaneous	5.40	1.85	3.36	1.41	1.90	13.76	36.00	

7. Upward price leadership

We now move to considering upward and downward price leadership separately. A tentative negative finding is that there is very little by way of a clear pattern to the set of products where one firm leads prices upward. In other words, it is not the case that Tesco for example tends to lead on packaged goods and Asda on fresh goods; this is somewhat surprising given the flavour of the theoretical literature. In order to illuminate this issue, in table 5 we cut the sample another way, looking at the set of products led upwards by each firm. The way to read this is as follows: Almost 30% of the specific products in our sample are led upwards by each firm at some point in time (that it by one firm at least once and by the other at least once) across the period. In terms of the range of products covered by our definition and sample, Tesco leads upwards more than Asda does, leading on 58% of our 331 products over the period. The maximum number of occasions in seven years that a particular product is led upwards by one firm is six. But only 19% are not led upwards at all within the period.

Looking specifically at “own brand” products, there are 96 such products in our sample, i.e. just under 30%. Perhaps surprisingly, it appears that these are slightly more likely to be led upwards than are branded products, but the excess movement is not large. Both firms engage in leadership across both branded and unbranded

product. So, to the extent we are able to evaluate it, the identity of product leader is not a product-specific attribute and does change from time to time. Indeed, for around 30% of our products, leadership switches back and forth between firms over time.

Table 5: Upward leadership on prices across products- product proportions by category

	Asda	Leads	Follows
Tesco	Leads	29.6%	28.4%
	Follows	23.0%	19.0%

In a little more depth, 13 of the 17 broad categories of product (bread and cereals is an example of a category) in our full sample are represented within the 331 items we study. Of these, we have many more examples in some categories than others. There are a few striking things that come out of examining behaviour by category in relationship to price leadership upwards. First, we observe only Tesco leading upward in the area of tea and coffee products and spirits, whilst we observe only Asda leading up on beers. In the soaps and detergents category, we do not see any product example in which *both* firms lead up at one time or another, although there are particular items for which one firm or the other leads. But the overall impression is of relatively limited patterns of specialisation, since 11 of 13 broad categories contain products on which both lead prices upwards, together with other products on which one (but not both) leads and products on which neither leads.

The impact of price leadership is also important. Examining upward price leadership, a legitimate question given our narrow definition is whether those products exhibiting most upward price leadership episodes also increase most in price, there being several other means whereby prices can rise (for example, simultaneous price rises). We examined the percentage price changes over time across all 331 products we use for this exercise and correlated these with the number of upward leadership episodes by each player. So far as Tesco leadership episodes are concerned, these appear moderately important in explaining price rises, with a simple correlation of 0.307, significant at conventional levels, although this does not of course demonstrate causation. But for Asda, the correlation is insignificant at 0.076.

We also find that within the most numerous sub-categories of goods in our sample,¹⁶ those that experience more Tesco price leadership episodes also exhibit greater overall price increases. For example, within the largest category within our sample, Bread and Cereals, the mean price increase across the seven products with five or six instances of such leadership was 68.6%, whereas for those 16 with zero instances it

¹⁶ We look at sub-categories since within these there are likely to be very similar cost pressures. For example, if wheat rises in price, this will affect all bread and cereal products similarly. Less populated sub-categories exhibit too few degrees of freedom to examine this question with any degree of confidence.

was 34.4%, a figure which is significantly lower, based on a t-test for mean differences. Hence there is some evidence that upward price leadership is instrumental in raising prices.

8. Downward price leadership

Rather more briefly, we attempt a characterisation of downward price leadership. The picture is very different from upward leadership. Table 6 shows that almost 60% of our products are led downwards by both firms at least at one point over the period (i.e. one leads down while the other follows, but at another time the roles are reversed). There are very few products where only Tesco leads downward, whereas it is rather more common for Asda to lead downward whilst Tesco follows. Remarkably, under 10% of our products are never led downward by either firm. In consequence, downward movements range very widely across the categories of products.

Table 6: Downward leadership on prices across products- product proportions

	Asda	Leads	Follows
Tesco	Leads	58.3%	3.9%
	Follows	28.7%	9.1%

There is one thing that stands out. Almost all the products that are *never* led downwards are own label; in fact the total number of occasions on which either or both firms reduces the price of own label goods and the other follows is small relative to the total number of downward followed moves at under 7%.

The theoretical literature gives almost no guidance as to the drivers of downward price leadership. What we observe, including the relative focus on branded goods, is most consistent with a casual theory in which supermarkets are very concerned about their position on price comparisons, so that downward price moves are followed defensively in order that the supermarket is not singled out as being relatively expensive. This is consistent, on a casual basis, with the type of publicity these firms have engaged in at various stages, where prices of particular items are highlighted.¹⁷ The puzzling factor is why these firms engage in this game of reducing prices, when they know that the likely end result is that both achieve lower prices on the product itself after the move. A saving grace is provided by the fact that many of the moves are very small in money value. Thus the main impact is arguably on publicity, generating greater store footfall, not on profits, and perhaps drawing attention away from price increases elsewhere in the store.

¹⁷ Recall here that national pricing means these comparisons may be, and are, publicised on national television.

9. Conclusion

We propose a very tight definition of price leadership. Nevertheless, our main finding is that attempting to identify a single firm as the clear food market price leader from our sample is doomed to failure. Leadership is a very common phenomenon, across firms, products and time; it cannot be explained away as randomness in the data. It also appears that leadership, even narrowly defined, has become more important in recent years as a phenomenon in the British supermarket industry. But the leader differs over products as well as time, particularly as regards upward price leadership. This finding is consistent with the more recent theoretical literature's emphasis on endogenous leadership and occasional changes in leadership, rather than leadership by a dominant firm. Significantly, the leadership we observe does not seem to have collusion as its main driver, or outcome. Having said that, under our definition Tesco appears to be the more successful in using upward price leadership as a mechanism to raise prices over the period (to the extent that we can judge this).

Our definition does not allow us to infer intent, only to describe and categorise. Indeed, one reflection of our work here is that the traditional concept of price leadership lacks not only precision but also causation, unlike the more recent game-theoretically based models. However, our empirical work has also exposed a large gap in the more recent modelling. In all cases, the models have focussed implicitly on upward price movements, whereas what we observe is a plethora of downward leadership moves alongside the upward trends. This is a modelling gap that needs to be filled by more than the casual theorising we have put forward. Ideally, such a model would encompass both upward and downward leadership.

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