Diversion ahead!
Approximating diversion ratios for retail chain mergers

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Abstract

I discuss a methodology for approximating diversion ratios to measure the unilateral effects arising from horizontal mergers in multiple local retail markets. I apply the methodology to data on fascia counts, market shares and geographical proximity from two recent retail chain mergers examined by the UK competition authorities: a cinema merger and a book store merger. The results show some promise, predicting sensible diversion ratios in 68 per cent of the local markets in these mergers, although there are some important caveats. I interpret the results as suggesting that the local market characteristics routinely examined by the UK competition authorities in retail chain mergers may be able to be combined in one measure to rank the degree to which such mergers may give cause for concern over unilateral effects. I suggest some thresholds against which this ranking can be judged.

Keywords: horizontal merger control, unilateral effects, diversion ratios, logit model.

JEL classifications: L41, C25.

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1. Introduction

The competition authorities in the UK (the Office of Fair Trading (OFT) and the Competition Commission (CC))[1] have tended to examine the competitive effects of horizontal retail mergers in multiple geographic markets (known as 'retail chain mergers') using an isochrone and fascia-count methodology, and often also market shares. An isochrone is a set of points that can all be reached in the same time from an origin. Fascia is a term for a particular brand of local retailer: each fascia in a local retail market may have multiple stores.[2]

Recent examples of retail chain mergers examined by the CC and/or OFT that used this methodology to varying degrees include supermarkets, book stores, cinemas, pharmacies, bingo halls, off-licences, funeral homes and pubs. In these cases, the relevant geographic market was delineated with an isochrone of a given time (eg ten minutes' drive-time) around the acquired outlet (supermarket, book store, cinema etc). The reduction in the number of competing fascia in that geographic market as a result of the merger was then calculated. If the merger reduced the number of competing fascia below some critical level—eg 4-to-3—the merger was considered problematic.

[1]The OFT is the 'phase one' merger authority and the CC is the 'phase two' merger authority.
[2]It is usual to count fascias and not individual stores because stores within a fascia are not normally thought to exert any competitive constraint upon each other, given part of the rationale for establishing a chain of retail stores (ie a fascia) is to internalize the cross-price elasticities between them.

Such retail chain mergers typically involve dozens or even hundreds of localities, which precludes definition of each market separately and detailed examination of the merger in each on a case-by-case basis. The methodology described above therefore has the benefit to the competition authorities of expediency and to market participants (including the merging parties) of some degree of certainty (eg in terms of regulatory risk). As a corollary, though, it may not fully capture the competitive impact of retail chain mergers. However, alternative methodologies that may better capture the competitive impact of retail chain mergers tend to be more time-consuming and information-intensive for both the competition authorities and the merging parties.[3]

This paper proposes an alternative way of analysing some competitive effects in such retail chain mergers. It notes that diversion ratios between the acquired and acquiring outlets are a good way to measure the horizontal competitive constraint removed by such mergers. Rather than laboriously measuring diversion ratios using customer surveys at dozens or hundreds of locations, for example, this paper suggests that diversion ratios can be approximated from:

- the number of—and drive-time to—acquiring outlets;
- diversion ratios derived from pre-merger market shares; and
- the number of competing fascias pre-merger.

This approach appears to show some promise, inasmuch as applying it to the relevant data from two retail chain mergers recently examined by the OFT and CC predicts some sensible diversion ratios.

In the remainder of this paper, section 2 discusses the use of diversion ratios to measure the competitive constraint removed by retail chain mergers. Section 3 discusses a methodology for approximating local diversion ratios based upon econometric results relating surveyed diversion ratios to the structural characteristics of local markets using data from the CC's *Somerfield/Morrisons* supermarket merger inquiry.[4] Section 3 also applies this methodology to two other retail chain mergers recently examined by the OFT and CC (the *Vue/A3 Cinema* cinema merger and the *HMV/Ottakar's* book store merger). Section 4 concludes. There is an annex with some econometric results.

2. Diversion ratios

Direct analysis of the competitive constraint removed by retail chain mergers can avoid many of the pitfalls associated with the traditional market-definition/fascia-count/market-share approach.[5] Diversion ratios are a recognized way of directly analysing local competitive constraints. This section explains what diversion ratios are and how they may be used in the analysis of competitive effects in retail chain mergers.

These competitive effects can be of two types: unilateral or coordinated. Unilateral effects arise where the merged firm is able on its own to exploit market power, though its rivals may benefit independently. Coordinated effects arise where a group of firms collectively attain

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[3]The extreme example being econometric estimation of the cross-price elasticities of the merging parties' products (eg see Smith, 2004).
[4]Specifically, this analysis extends the results in the Annex to Appendix D to the CC report.
[5]'Market share analysis fails in these circumstances because market share analysis implicitly treats every percentage point of share of sales of each firm 'in' the market as an equally effective constraint on every other firm in the market, while disregarding any competitive influence of all firms considered 'out' of the market. Direct analysis of the competitive constraints operating on each store avoids making this strong assumption … This avoids many of the difficulties associated with a strict market definition-based approach to competitive analysis in highly differentiated markets such as retailing' Baker *et al* (2002), page 181.

greater market power because of increased concentration and the perceived interdependence between them. For the analysis of unilateral effects of mergers in differentiated-goods markets (including retail chain mergers), a good measure of the extent to which two firms competed pre-merger is the diversion ratio between them. A diversion ratio from A to B represents the proportion of business from customers who would choose firm B (as opposed to firms C, D, E etc) as their second choice in the event of a price increase by firm A.

Diversion ratios may follow market shares. If stores A, B and C have 40 per cent, 30 per cent and 30 per cent of the local market respectively, then A's customers might well divert equally between B and C and both diversion ratios would be 50 per cent.[6] Then, mergers between A and B, and between A and C, may be considered equally likely to give rise to unilateral effects as B and C are equally close competitors to A.

If, however, two-thirds of customers diverting from A would choose C instead of B, then it appears that C is a closer competitor to A than is B. Consequently, a merger between A and C may be considered more likely to give rise to unilateral effects than may a merger between A and B.

In general, though, diversion ratios will not follow market shares because customers might see competing product/service offerings as especially similar or dissimilar. Of particular relevance for retail chain mergers, topographical features (eg rivers), details of traffic flows and the number and location of competitors' outlets might result in diversion ratios between the acquired and acquiring firms that differ significantly from those derived from their market shares.

Formally, the diversion ratio between A and B is defined as the ratio of the cross-elasticity of B's demand to A's price, to the own-price elasticity of demand for A. Intuitively, the own-price elasticity of demand for A tells us how much business A loses if its raises its price; and the cross-price elasticity tells us how much of that loss goes to B.

The diversion ratio alone will not be sufficient to measure the degree to which a retail chain merger may give rise to unilateral effects. It is the combination of high margins and high diversion ratios that is problematic. High margins—implying less elastic residual demand—result in greater incentives to increase price post-merger, for a given diversion ratio between the merging parties. Intuitively, high margins imply a firm faces little competitive constraint; and high diversion ratios imply what little competitive constraint it faces is being removed by the merger.

In fact, in a symmetric, differentiated single-good Bertrand model (the workhorse of the analysis of unilateral effects in retail chain mergers), margins (m) and diversion ratios (d) can be combined to predict post-merger price increases for the merging firms[7] as:

- md/2(1-d) with linear demand; and
- md/1-m-d with isoelastic demand.[8]

[6]Here, the diversion ratio from A to B is the ratio of B's market share (ie 30 per cent) to the residual market share not accounted for by A (ie 60 per cent), which is 30/60 per cent = 50 Per cent.
[7]In general, the equilibrium market-wide post-merger price increase will be lower than the merging parties' price increase.
[8]These formulae can be extended to asymmetric firms and multiple goods but they become very complicated. For details, see Bishop and Walker (2002). For multiple goods, the revenue diversion ratio can be used in the formulae instead of the customer diversion ratio if the amount spent by each customer is known. Predicted price increases are very sensitive to the functional form chosen for demand. Linear and isoelastic demand give the minimum and maximum possible increases respectively, bracketing the price increases predicted by AIDS and logit demand curves (see Werden, Froeb and Scheffman, 2004).

A threshold level of predicted price increase can then be chosen (say, 5 per cent), above which a given retail chain merger can be said to give cause for concern over unilateral effects.

Of course, if the particular local markets under consideration are not well described by the symmetric, differentiated single-good Bertrand model, then the outputs from these equations cannot legitimately be regarded as predictions at all. Then the 'price increases' may best be viewed as illustrative, being a convenient way of combining diversion ratios and margins in one measure.

Alternatively, diversion ratios and margins can be considered in isolation and not combined to predict post-merger price increases for the merging firms. This may beg the question of how high they need be to give concern over unilateral effects.

- The OFT's Merger Guidelines suggest that a merger increasing the Herfindahl-Hirschman Index (HHI, a measure of market concentration calculated as the sum of all firms' squared market shares) by 100 in a concentrated market (ie one with an HHI greater than 1,000), and by 50 in a very concentrated market (ie one with an HHI greater than 1,800), may give rise to potential competition concerns. These HHI increments imply symmetric diversion ratios of 7.6 per cent in a concentrated market and 5.3 per cent in a very concentrated market, which could be regarded as thresholds.[9]

- Previous decisional practice might have used a 5-to-4 or 4-to-3 fascia count rule to assess retail chain mergers. In a 5-to-4 merger between symmetric firms, the diversion ratio between the merging parties would be 25 per cent (ie 20/80 per cent); in a symmetric 4-to-3 merger it would be 33 per cent (ie 25/75 per cent). These could be used as thresholds.[10]

- The CC's *Merger Guidelines* suggest a combined market share of 25 per cent or more would normally be sufficient to raise potential concerns about the effect of a merger on competition.[11] Two merging firms, each with local market shares of 12.5 per cent (giving a combined share of 25 per cent), would have diversion ratios to each other of 14.3 per cent (ie 12.5/87.5 per cent), so this could be regarded as a threshold.[12]

Two caveats are in order, however.

- These potential diversion ratio thresholds are derived from market shares and fascia counts but the usefulness of diversion ratios lies in directly measuring competitive constraints that may not be well represented by market shares or fascia counts. If this is a problem, then it comes from using market-share or fascia-count thresholds at all, however, and not from the analogy between market shares or fascia counts and diversion ratios.

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[9]The HHI increment (or delta) is twice the product of the market shares of the merging parties. For a delta of 50, the parties' symmetric market shares would be 5 per cent (ie the square root of 25 per cent) and the diversion ratio between them 5.3 per cent (ie 5/95 Per cent). For a delta of 100, the parties' symmetric market shares would be 7.1 per cent (ie the square root of 50 per cent) and the diversion ratio between them 7.6 per cent (ie 7.1/92.9 per cent).

[10]It is important to note the differences in deriving diversion ratio thresholds from fascia counts and from market shares as done in the next bullet. In the latter case (ie where a combined market share of 25 or 40 per cent causes concern), assumptions are made about the market shares of the merging firms but not about the market shares of other firms in the market. In the former case (ie where a 5-to-4 or 4-to-3 merger causes concern), all firms in the market are assumed to have equal market shares.

[11]It is important to note that the 25 per cent is a combined share, not an equilibrium post-merger share. To see the difference that this makes, note that in a symmetric, undifferentiated market, if the resulting equilibrium post-merger share is 25 per cent then there can have been at most five firms pre-merger. The symmetric diversion ratio in a five-firm market is 25 per cent, not 14.3 per cent.

[12]Alternatively, previous decisional practice may have considered a given combined level of local market share (say, 40 per cent) as giving rise to competitive concerns. If so, a threshold diversion ratio could be derived from this. In this case, two merging firms each with 20 per cent of the market would have a diversion ratio between them of 25 per cent (ie 20/80 per cent).

- More importantly, diversion ratios should be considered together with other evidence. Regardless of whether one adheres to a threshold or not, diversion ratios (and predicted price increases) may be helpful for ranking the degree to which the merger in each individual area in a retail chain merger is likely to be problematic—just as post-merger market shares traditionally have been seen as good at ranking the degree to which mergers in undifferentiated, traditional 'smoke stack' markets are likely to be problematic; regardless of whether the critical post-merger market share threshold is the CC's 25 per cent or (say) the European Commission's 40 per cent. In the same way that post-merger market shares are now considered useful but not determinative,[13] diversion ratios are evidence that is useful but not determinative and should be considered with other evidence.

Either way—that is, whether post-merger price increases are 'predicted' or not—estimates of diversion ratios are needed. The next section discusses a way of approximating diversion ratios.

3. Regression analysis of measured diversion ratios and structural market factors

In its 2005 *Somerfield/Morrisons* retail chain merger inquiry, the CC found that only proximity and the number of overlapping and competing fascias significantly explained the diversion ratios surveyed at 53 acquired Morrisons supermarkets. The CC used its regression estimates to predict local diversion ratios for three further acquired Morrisons stores, based upon local measures of proximity and of the number of overlapping and competing fascias there. This section extends the CC's analysis in order to predict local diversion ratios using fascia counts, proximity and market shares.

The CC's analysis in Somerfield/Morrisons

In *Somerfield/Morrisons*, the CC conducted surveys of around 100 shoppers at each of 56 acquired Morrisons supermarkets—mostly mid-range stores of between 280 m^2 (3,000 ft^2) and 1,400 m^2 (15,000 ft^2).[14] Among other questions, the CC asked which alternative fascia each shopper would have used had the acquired Morrisons been shut, ie the CC obtained estimates of diversion ratios.[15] The CC used the estimated diversion ratio between Morrisons and Somerfield as part of its unilateral effects analysis.

Of necessity, the CC surveyed 56 Morrisons supermarkets after they had been acquired by Somerfield.[16] In three instances out of 56, however, the acquiring Somerfield supermarket had shut by the time of the survey. So the CC used regression analysis to predict what the diversion ratio could have been before the three Somerfield supermarkets shut. The CC regressed its surveyed post-merger diversion ratios at the other 53 acquired Morrisons supermarkets on:

- the drive-time to the closest Somerfield supermarket;

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[13]For evidence of competition authorities moving away from the so-called structural presumption, see for example the FTC's Horizontal Merger Investigation Data 1996–2003 (in particular Table 3.2), which suggests that mergers in the USA tend to have been challenged at far higher levels of market concentration than the FTC's own merger guidelines suggest should cause concern.

[14]The CC also could have surveyed the acquiring Somerfield supermarkets (given the competitive constraints between the acquired Morrisons and acquiring Somerfield stores need not be symmetric) but did not know their locations at the time it commissioned its survey (see Reynolds and Walters, 2007, for a discussion).

[15]The CC first could have asked whether shoppers would have done their shopping somewhere else if prices had been 5 per cent higher, and then—if so—at which fascia they would have shopped instead (see Reynolds and Walters, 2007, for a discussion).

[16]Notification of mergers is not mandatory in the UK and the merger was completed before the CC examined it.

- the post-merger number of Somerfield supermarkets in the relevant local market (delineated with a 5-minute isochrone for urban stores and a 10-minute isochrone for rural stores[17]);

- Somerfield's post-merger market share;

- the drive-time to the closest one-stop shop; and

- the post-merger count of competing fascias[18] in the relevant local market.

(With the exception of the data on post-merger market share, the CC obtained these independent variables from the isochrone analysis it undertook as part of its market definition exercise, which is publicly available. The CC's market share data was supplied by Somerfield and is confidential.)

The CC then used its regression results to predict the Morrisons-Somerfield diversion ratio for the three local grocery markets where the acquiring Somerfield supermarket had shut. It multiplied the relevant values for each independent variable in these three markets by their estimated coefficients from the regression for the other 53 and added-up the resulting linear combination to get a predicted diversion ratio.

Of the independent variables above, the CC's model suggested that only proximity (ie drive-time to the nearest Somerfield) and the number of overlapping and competing fascias significantly explained observed diversion ratios. The CC's model explained less than half of the variation in observed diversion ratios.

In discussing its modelling results, the CC noted:[19]

> Having carried out the surveys we sought to derive a single formula which might have obviated the need for such extensive surveys and been used not only as an alternative to the methodology we have adopted in this report but as the basis for establishing 'brighter line' guidelines for use in future both by the OFT and ourselves as well as the industry in planning their business…
>
> We nevertheless recognize the appeal of a bright line approach in this important sector of the economy, to avoid the need for similar surveys. We acknowledge these could not readily be carried out by the OFT in assessing future cases nor by the industry in planning their business, though it is possible that equivalent results could be obtained by other means. We would be willing, after the completion of this inquiry, to discuss our methodology in this and earlier supermarkets reports with the OFT, the industry and other interested parties should they be interested in doing so.

In this spirit, the next section extends the CC's analysis.

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[17]This local geographic market definition also came in part from the CC's survey results, see part 4 of Appendix B to the report.
[18]This did not include all supermarkets. The CC had previously concluded that some other supermarkets—the limited assortment discounters (ie Aldi, Lidl and Netto), the symbol groups (eg Spar, Londis), Iceland and Marks & Spencer—were not competing fascias to Somerfield.
[19]See paragraphs 12.2 and 12.3 of the CC report.

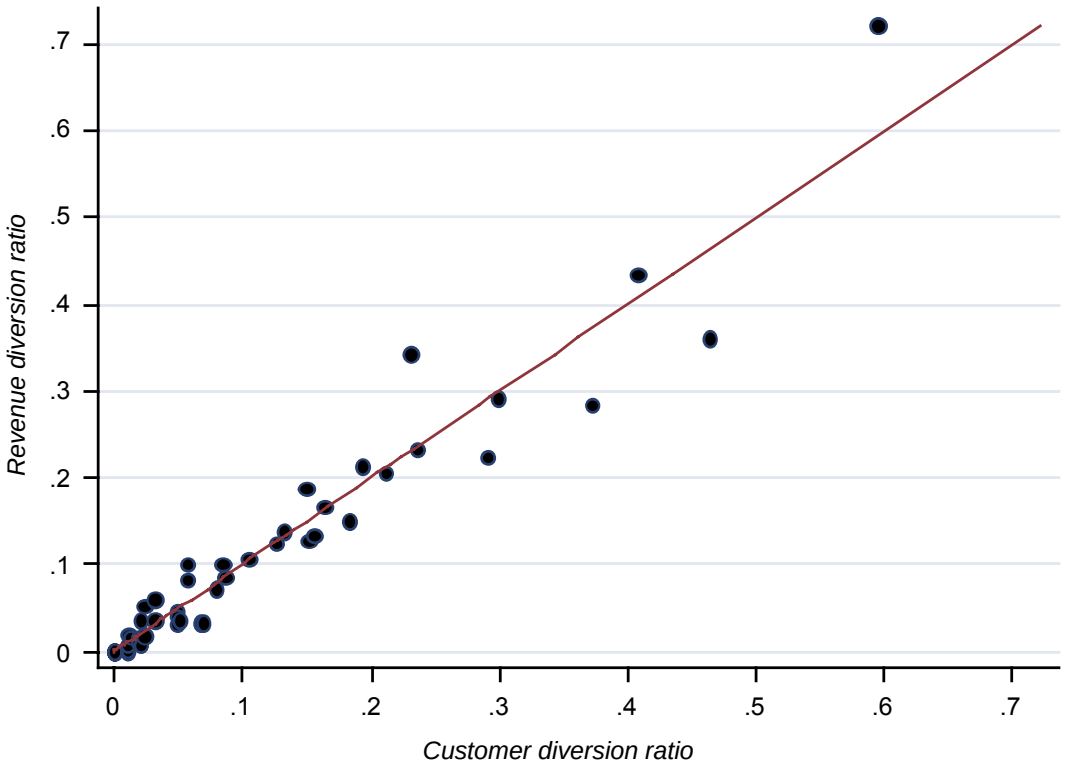
Extending the CC's analysis

The data

For reasons of confidentiality, the present analysis looks only at the CC's customer diversion ratios from Morrisons to Somerfield because these were reported in the CC's survey results, whereas the revenue diversion ratios were not. However, as Figure 1 demonstrates, there is a close, positive relationship between them.

FIGURE 1

Relationship between customer and revenue diversion ratios at 53 acquired Morrisons supermarkets surveyed by the CC



Source: CC.

To make the local retail outlets in the estimation sample as comparable as possible, six observations have been dropped from the sample of 53 acquired Morrisons supermarkets that the CC surveyed:

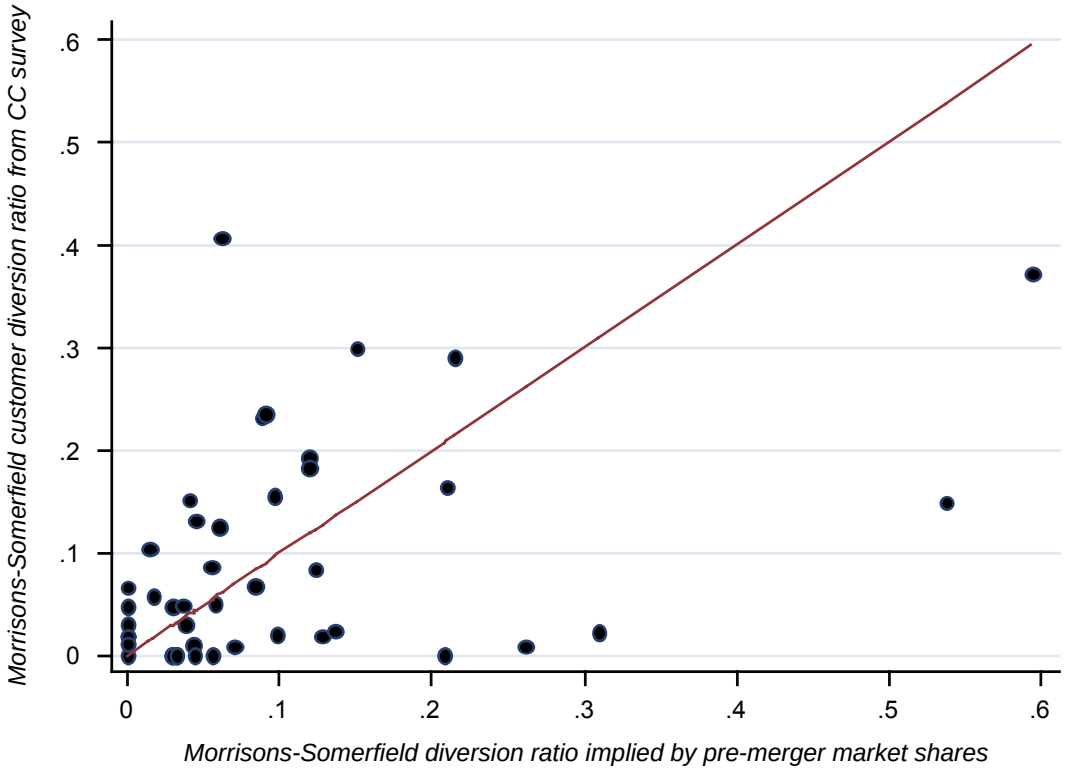
- one acquired Morrisons supermarket where the estimated market share post-merger exceeded 100 per cent;
- two acquired Morrisons supermarkets that were not mid-range (ie were not between 280 m^2 (3,000 ft^2) and 1,400 m^2 (15,000 ft^2)); and

- three acquired Morrisons supermarkets that were not identified as potential problems by the CC's 4-to-3 fascia-count rule but were surveyed only on the basis of isochrone re-centring.[20]

For reasons of confidentiality, this analysis cannot use as an explanatory variable Somerfield's local market share estimates, as the CC's analysis did. However, the diversion ratio between Morrisons and Somerfield implied by their estimated pre-merger market shares is not confidential.[21] These are used in the present analysis and are shown in Figure 2, which also shows the customer diversion ratios from the CC's survey.

FIGURE 2

Relationship between surveyed customer diversion ratio and diversion ratio calculated from estimated pre-merger market shares for 47 acquired Morrisons supermarkets



Source: CC.

There is only a very approximate relationship between the diversion ratios implied by the market share estimates and those from the survey, as may be expected given the differentiated nature of retailers in local grocery markets. Observations above the 45-degree line in Figure 2 are for local grocery markets where Morrisons was a better substitute to Somerfield than its local market share would predict. Observations below the line are for local grocery markets where Morrisons was a worse substitute to Somerfield than its local market share would predict. There are as many of the former as of the latter.

[20] That is, drawing the isochrone not around the acquired store but instead around competing fascias, around local population centres or around census output areas (a census output area covers roughly 150 households). Isochrone re-centring attempts to allow for the fact that any geographic market definition, such as a 10-minute drive-time isochrone, is likely to better apply to some localities than to others. Re-centring the isochrone can help pick up problem areas that may otherwise be missed by such an across-the-board geographic market definition.

[21] The identities of the acquired Morrisons supermarkets are confidential.

The model

Diversion ratios are proportions, ie they are intrinsically non-negative and cannot exceed 1. However, there are eight instances where the CC's survey indicated that there was no diversion from Morrisons to Somerfield, ie the customer diversion ratio was 0. This means that simply transforming the diversion ratio with the usual logit transformation, as is normal for modelling proportions, and estimating the model by least squares will result in eight observations being lost.[22] So instead the present analysis estimates by maximum pseudo-likelihood (iterated, re-weighted least squares) a generalized linear model with a Bernoulli variance function and a logit link function, which preserves these eight observations.[23]

TABLE 1 **Summary statistics for variables in sample**

Variable	*Obs*	*Mean*	*Std dev*	*Min*	*Max*
Customer diversion ratio	47	8.6%	10.4%	0.0%	40.7%
Number of Somerfield supermarkets in local market	47	1	0.8	0	3
Drive-time in minutes to nearest Somerfield supermarket*†	47	4.8	3.7	0.2	14.8
Morrisons-Somerfield diversion ratio based on pre-merger market shares	47	9.3%	12.5%	0.0%	59.4%
Number of competing fascias pre-merger in local market	47	3	0.7	2	4

Source: CC.

*May be outside relevant isochrone.
†For urban stores, drive-time to nearest Somerfield averages 3.9 minutes (standard deviation 2.7, minimum 0.2, maximum 13.3). For rural stores, drive time to nearest Somerfield averages 8.1 minutes (standard deviation 4.9, minimum 0.4, maximum 14.8).

Summary statistics for the relevant variables are given in Table 1. It is interesting to note that the sample means of the observed customer diversion ratio (8.6 per cent) and the diversion ratio implied by pre-merger market shares (9.3 per cent) are close, even though the latter always under- or over-predicts the former according to Figure 2. The analysis therefore includes independent variables in addition to the diversion ratio implied by pre-merger market shares to try and control for this over- and under-prediction. In particular:

- the number of Somerfield supermarkets in the 5-minute (urban) or 10-minute (rural) isochrone centred on the acquired Morrisons supermarket ('the number of proximity stores');

- the drive time in minutes to the nearest proximity store, which may be outside the relevant 5- or 10-minute isochrone[24], interacted with a dummy variable for whether the store is urban or not;[25]

[22]It is usual to assume diversion ratios (d) are generated by a model $d=1/[1+\exp(-x\beta)]$ which depends on parameters β and covariates x. Using the logit transformation gives $\ln[d/(1-d)]=x\beta$, the parameters β of which can be estimated by the usual least squares method. However, if any diversion ratios are 1 or 0 then the logit transformation does not work. In this case, whether the diversion ratio of zero should be discarded or not depends on what a diversion ratio of zero indicates. If there is always some chance of positive diversion but the CC's survey did not capture it, then the zeros should be kept (these are referred to as 'sampling zeros'). If, however, a diversion ratio of zero occurs because no customer would ever divert no matter what, then these diversion ratios are outliers and should be discarded, or at the very least be modelled differently to the positive diversion ratios (these are referred to as 'structural zeros'). In what follows, I assume the zeroes are sampling zeroes and not structural zeroes.
[23]This is the procedure recommended in Papke and Wooldridge (1996) for modelling proportions. A generalized linear model fits $g\{E(y)\}=x\beta$ $y\sim F$, in which g() is the link function and F is the variance function. Although the logit model is often associated with discrete choice problems, it can be used whenever outcomes must be non-negative and sum to one.
[24]In 13 instances, the nearest proximity store is outside the isochrone. For nine urban stores in a 5-minute isochrone, the average drive time is 7.4 minutes (standard deviation 2.3 minutes). For four rural stores in a 10-minute isochrone, the average

- the diversion ratio implied by the local pre-merger market shares of the acquiring Somerfield and acquired Morrisons supermarkets; and

- the pre-merger number of competing fascias in the 5- or 10-minute isochrone.

Using other specifications and other independent variables did not affect the estimates.[26] The model explains 57 per cent of the variation in measured diversion ratios.[27] The results are reported in Table 2.

TABLE 2 **Estimation results**

				Number of obs		47
Pseudo-log likelihood	–9.08			Pseudo R^2		0.57
	Coef	*Std err*	*z-stat*	*P>z*	*95% CI*	
Number of proximity stores	0.480	0.162	2.97	0.003	0.163	0.797
Urban dummy	1.105	0.622	1.78	0.075	–0.113	2.323
Drive time to closest proximity store	–0.008	0.059	–0.13	0.899	–0.124	0.109
Urban dummy X proximity drive-time	–0.246	0.109	–2.25	0.024	–0.461	–0.032
Diversion ratio from pre-merger market shares	3.281	1.171	2.80	0.005	0.986	5.575
Number of pre-merger competing fascias	–0.538	0.237	–2.27	0.023	–1.003	–0.074
Intercept	–2.005	0.964	–2.08	0.038	–3.895	–0.116

Source: CC.

Notes:
1. Dependent variable is ln [customer diversion ratio/(1-customer diversion ratio)].
2. Method of estimation is maximum pseudo-likelihood (iterated, re-weighted least squares).
3. Standard errors are robust to heteroscedasticity and serial correlation.
4. Pseudo R^2 is calculated as the square of the correlation coefficient between the fitted values and the dependent variable.
5. A test for lack of skewness and kurtosis in the residuals (calculated as the dependent variable minus the fitted values) returns $\chi^2(2)=5.56$ (p=0.06), which accepts the hypothesis that the residuals are normally distributed.

By comparison to a model that includes as an independent variable only the diversion ratio implied by pre-merger market shares (ie the relationship in Figure 2), the effect of adding the other independent variables mentioned above is to treble the model's fit, increasing the pseudo-R^2 by 0.39 from 0.18 to 0.57.[28]

Because the model is non-linear, the estimated coefficients do not admit the normal interpretation of the marginal effect of each independent variable on the expected value of the dependent variable. These marginal effects are given in Table 3.[29]

drive time is 12.5 minutes (standard deviation 2.0 minutes). In all 13 instances, therefore, the nearest proximity store is quite close to the isochrone boundary.

[25]This is because the CC used different isochrones for urban and rural stores, which means the impact on a store of having a competitor (say) 4 minutes away is likely to be relatively less in an urban geographic market with a 5-minute isochrone than it is in a rural geographic market with a 10-minute isochrone.

[26]For example, drive-time to the nearest large supermarket, sizes of the acquired and acquiring stores, car parking spaces and opening hours at the acquired store, and separate numbers of Somerfield and Kwik Save proximity stores (Somerfield owns Kwik Save). Some of these variables were also interacted with each other and with the independent variables in the model (eg the ratio of the sizes of the acquired and acquiring stores, and the ratio of the drive times to the nearest proximity store and the nearest large supermarket) but this did not affect the results. Binary indicator variables were also included for the number of proximity stores and the number of fascias pre-merger, instead of their continuous counterparts. This specification improved the fit of the model but reduces the extent to which it can be applied to other cases, given they may not have the same number of proximity stores (ie 0, 1, 2 or 3) or the same number of competing fascias pre-merger (ie 2, 3 or 4).

[27]This is the pseudo-R^2 because the model is estimated by maximum pseudo-likelihood.

[28]Similarly, the hypothesis that the coefficients on these extra variables jointly are zero is rejected, $\chi^2_5=62.8$ (p=0.00).

[29]Because the model is non-linear, these marginal effects will change if they are computed for different values of the independent variables. However, it is usual to pick the mean or median values of the independent variables at which to estimate the marginal effects.

TABLE 3 **Marginal effects of the independent variables on the predicted mean of the diversion ratio in *Somerfield/Morrisons***

Independent variable	*dy/dx*	*Std err*	*z*	*P>z*	*95% CI*		*X**
Number of proximity stores	0.027	0.008	3.25	0.001	0.011	0.043	1
Urban dummy†	0.048	0.022	2.23	0.026	0.006	0.091	1
Drive-time to closest proximity store	–0.000	0.003	–0.13	0.899	–0.007	0.006	4.8
Urban dummy X proximity drive-time	–0.014	0.006	–2.37	0.018	–0.025	–0.002	3.0
Diversion ratio from pre-merger market shares	0.183	0.067	2.73	0.006	0.052	0.314	0.1
Number of pre-merger competing fascias	–0.030	0.012	–2.46	0.014	–0.054	–0.006	3

Source: CC.

*Value of independent variable at which marginal effect is calculated. Given by mean or median of independent variable.
†For a discrete change from 0 to 1.

The marginal effects suggest:

- increasing the number of proximity stores by 1 increases the diversion ratio by 2.7 percentage points;
- urban stores have diversion ratios 4.8 percentage points higher than rural stores;
- for rural stores, proximity matters very little but for urban stores, increasing the drive-time to the nearest proximity store by 1 minute decreases the diversion ratio by 1.4 percentage points;
- increasing the diversion ratio implied by the pre-merger market shares by 1 percentage point increases the diversion ratio by 0.2 percentage points; and
- increasing the pre-merger number of competing fascias by 1 decreases the diversion ratio by 3 percentage points.

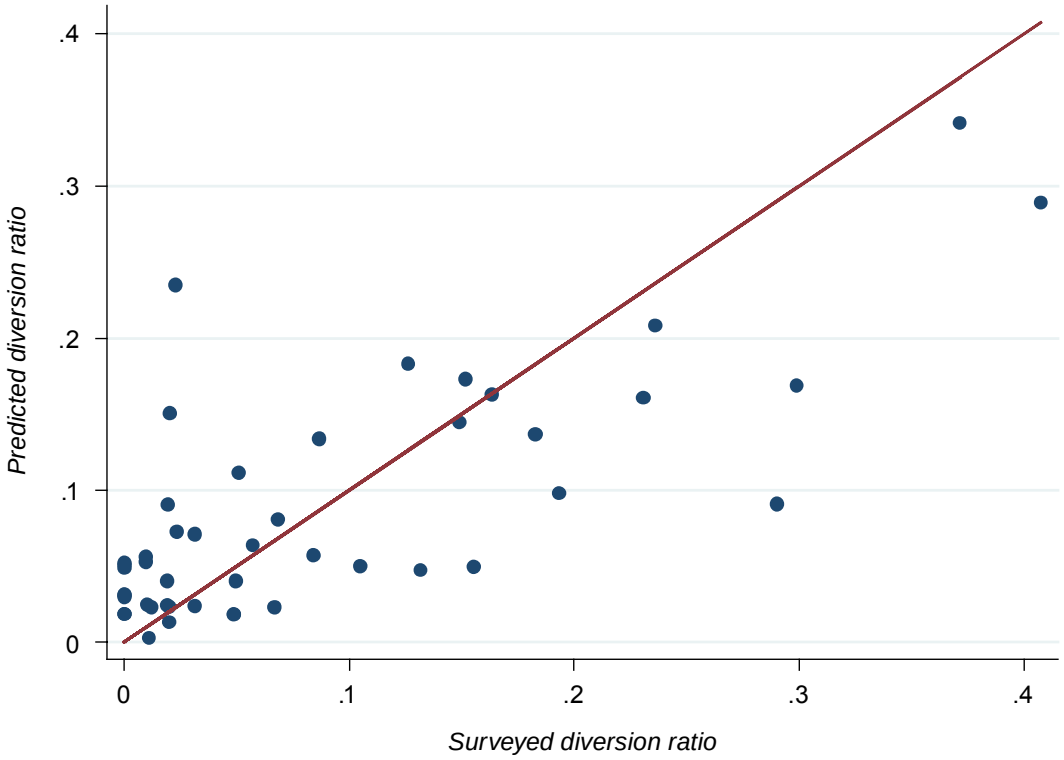
The intercept term does not have a marginal effect but its impact on the predicted diversion ratio essentially is to provide the baseline level of predicted diversion. Although the intercept term in the regression is statistically significant, its impact on the predicted diversion ratio (ie the baseline diversion) could be replaced by the aggregate diversion ratio from Morrisons to Somerfield in the CC's survey (10 per cent[30]), or by the aggregate diversion ratio implied by their national shares of the retail grocery market given both are national players (8.2 per cent[31]).

As can be seen from Figure 3, the marginal effects of the model do a reasonable job of predicting customer diversion ratios, although showing a tendency to under-predict high diversion ratios (ie all the predicted diversion ratios are below the 45-degree line where the observed diversion ratio is 20 per cent or more) and to over-predict low diversion ratios.

[30] $\chi^2(1)=0.04$ ($p=0.84$) accepts the hypothesis that the effect of the intercept on the diversion ratio is 0.1 (ie that the intercept is $\ln(0.1/0.9)=-2.197$).
[31] $\chi^2(1)=0.18$ ($p=0.67$) accepts the hypothesis its effect of the intercept on the diversion ratio is 0.082 (ie that the intercept is $\ln(0.082/0.918)=-2.415$). The national shares of the grocery market exclude the limited assortment discounters, the symbol groups, Iceland and Marks & Spencer.

FIGURE 3

Predicted diversion ratios from model and surveyed diversion ratios for 47 acquired Morrisons supermarkets



Source: CC.

An alternative way of summarizing the results and their goodness of fit is given in Table 4, which shows the actual and predicted diversion ratios for four local competitive scenarios defined by the number of proximity stores.

TABLE 4 **Surveyed and predicted diversion ratios for four local competitive scenarios**

					Diversion ratios			
					Surveyed			
Proximity stores	*Urban**	*Drive-time†*	*Market diversion*	*Competing fascias‡*	*Mean*	*Std dev*	*Predicted*	*Std err*
0	0.69	9.0	0.080	2.62	0.034	0.040	0.024	0.006
1	0.83	3.4	0.106	3.17	0.088	0.110	0.072	0.014
2	0.86	2.1	0.079	3.14	0.151	0.139	0.151	0.021
3	0.67	3.7	0.072	3.33	0.140	0.049	0.172	0.038

Source: CC.

*Proportion of acquired stores that are urban.
†In minutes, to closest proximity store.
‡In a 5- (urban) or 10-minute (rural) isochrone, excluding the LADs, Marks & Spencer, the symbol groups and Iceland.

Extensions

A common problem in studies of this type (ie those with some measure of firms' competitive performance on the left-hand side and some measure of the number of firms on the right-hand side) is simultaneity.[32] In the present context, this might arise because—as well as

[32]See, for example, Beckert and Mazzarotto (2006) for a discussion in the context of estimating a price-concentration relationship.

shoppers going to where supermarkets are—supermarkets locate where shoppers are. Therefore, the diversion ratio between the acquired store and the proximity store(s) (ie the dependent variable) may be determined simultaneously with two of the independent variables; the number of proximity stores and the number of competing fascias pre-merger (which includes the number of proximity stores).

In this case, however, the location of each supermarket was pre-determined when the CC surveyed shoppers at each, so simultaneity should not be a problem. Nonetheless, to investigate this, this section instruments the number of proximity stores and the fascia count with the population in the isochrone (a measure of the size of the market in each area), the number of car parking spaces at each acquired store (a measure of the tightness of the planning regime in each locality) and the size of each acquired store in sq feet (again, a measure of the tightness of the planning regime in each area).[33] The instruments also are interacted with the dummy variable for whether each store is urban or not. These instruments should be correlated with the number of supermarkets but should be uncorrelated with the diversion ratio:[34] the size of the market and the tightness of the planning regime should affect firms' desire to enter the market but should not affect the degree of competition between them once they have entered.[35]

Data limitations for these instruments reduce the sample to 42 stores. The instrumental variables estimation proceeds in two stages. In the first stage, each of the two endogenous variables is regressed in turn on all the exogenous variables (including interactions with the urban dummy variable) and predicted values for both are obtained.[36] In the second stage, these predicted values are included in lieu of the two endogenous variables in the logit model.[37] Results are given Table 5 (under the heading IV), which also shows results with this sample not instrumenting the number of proximity stores and the pre-merger fascia count (under the heading IRLS).

The IRLS results with no instruments with 42 observations are consistent with those with 47 observations in Table 2, as one would expect. For the IV results, the estimated coefficients on the independent variables that are not instrumented are comparable to those in the IRLS results. However, the estimated coefficients on the number of proximity stores and the number of pre-merger competing fascias are double (in absolute terms) the estimated coefficients when these independent variables are not instrumented.

[33]The source for the population data is the isochrone sensitivity analysis conducted for the CC by GeoBusiness Solutions. The source for the other instruments is Somerfield and the data is confidential.
[34]A note of caution is appropriate, however, as the instruments are weak for the pre-merger fascia count (the R^2 from the first stage regression is 0.24), though not for the number of proximity stores (the R^2 from the first stage regression is 0.67).
[35]In the UK, the planning regime permits supermarkets to be built only if there is a local need for further grocery retailing but the regime does not take account of the particular fascia of supermarket built.
[36]Although the endogenous variables are 'count data' (ie are non-negative and take on integer values) this does not invalidate the use of linear least squares regression in the first stage. This is the approach taken in, for example, Beckert and Mazzarotto (2006) who instrument the number of firms in a price-concentration regression using two-stage least squares.
[37]The model again is a generalized linear model with a logit link function and a Bernoulli variance function and is estimated by pseudo-maximum likelihood (iterated, re-weighted least squares).

TABLE 5 **Instrumental variables estimation results for 42 localities**

	*IRLS**		*IV†*	
Number of observations	42		42	
Pseudo R^2	0.56		0.51	
	Coef (SE)	*Z (P>Z)*	*Coef (SE)*	*Z (P>Z)*
Number of proximity stores	0.513 (0.159)	3.22 (0.001)	1.094 (0.345)	3.17 (0.002)
Urban dummy	1.408 (0.758)	1.86 (0.063)	1.200 (0.830)	1.45 (0.148)
Drive-time to closest proximity store	0.023 (0.075)	0.31 (0.760)	0.038 (0.087)	0.44 (0.660)
Urban dummy X proximity drive time	–0.334 (0.144)	–2.31 (0.021)	–0.241 (0.167)	–1.45 (0.148)
Diversion ratio from pre-merger market shares	3.890 (1.439)	2.70 (0.007)	3.572 (1.960)	1.82 (0.068)
Number of pre-merger competing fascias	–0.479 (0.246)	–1.95 (0.052)	–0.956 (0.582)	–1.64 (0.101)
Intercept	–2.512 (1.108)	–2.27 (0.023)	–1.815 (2.096)	–0.87 (0.387)

Source: CC.

*Iterated, re-weighted least squares.
†Instrumental variables.
Notes:
1. Dependent variable is ln [customer diversion ratio/(1-customer diversion ratio)].
2. Method of estimation is maximum pseudo-likelihood (iterated, re-weighted least squares).
3. Standard errors are robust to heteroscedasticity and serial correlation.
4. Pseudo R^2 is calculated as the square of the correlation coefficient between the fitted values and the dependent variable.
5. A test for lack of skewness and kurtosis in the residuals (calculated as the dependent variable minus the fitted values) returns $\chi^2(2)=6.71$ (p=0.04) for the IRLS results, which narrowly rejects the hypothesis that the residuals are normally distributed.
5. A test for lack of skewness and kurtosis in the residuals returns $\chi^2(2)=9.46$ (p=0.01) for the IV results, which rejects the hypothesis that the residuals are normally distributed.

A Hausman test was used to determine which set of estimates is preferred. This compares the coefficients from the two estimates: one that is consistent and efficient under the null hypothesis that the number of proximity stores and the pre-merger fascia count are exogenous; and the other that is inefficient under the null hypothesis but that is consistent under the alternative hypothesis that the number of proximity stores and the pre-merger fascia count are endogenous. Here, the IRLS estimates are consistent and efficient under the null hypothesis of exogeneity and the IV estimates are inefficient under this null hypothesis but consistent under the alternative hypothesis of endogeneity. The Hausman test asks whether any differences in the two sets of coefficients are systematic—if they are not, then the IRLS estimates are preferred whereas if they are, then the IV estimates are preferred. The test returns $\chi^2(6)=1.35$ (p=0.969), which indicates that any differences in the coefficients are not systematic and that the IRLS estimates are preferred, ie that simultaneity does not appear to be a problem.[38]

Applying the results to two recent retail chain mergers

Taken at face value, these results imply that surveyed diversion ratios can be approximated with the number of—and drive-time to—proximity stores (especially urban stores), diversion ratios derived from pre-merger market shares, and the number of competing fascias pre-

[38]The Hausman test could, however, give a false positive if the instruments are not actually exogenous, meaning the IRLS and IV estimates are biased in the same way and the differences between them erroneously appear unsystematic. To check the exogeneity of the instruments, the over-identifying restrictions were tested, given there are more instruments (6, including interactions with the urban dummy variable) than endogenous variables (2). The over-identifying restrictions are accepted, meaning the instruments are valid: the J test returns $\chi^2(4)=0.12$ (p=0.99). The Hausman test also could give a false positive if the instruments are too weak. Here, this could be a concern for the pre-merger fascia count but not for the number of proximity stores (see footnote 34).

merger. The data in the analysis came from the CC's *Somerfield/Morrisons* merger inquiry, however, and the results may be a product only of any peculiarities of that case.[39] This section therefore uses the results (with 47 localities) to predict diversion ratios from two recent retail chain mergers examined by the OFT and CC (the 2006 *Vue/A3 Cinema* cinema merger and the 2006 *HMV/Ottakar's* book store merger), as a robustness check.

The approach in section 3.2 may be especially relevant for local cinema mergers, given their multi-product nature,[40] differences in size (ie number of screens/seats) and relatively small number of very large national players, all of which appear comparable to supermarkets. Much the same is true of book stores but they may present much more of an acid test for the approach, given the CC's *HMV/Ottakar's* report concluded they tend to attract passing custom ('footfall') rather than being seen by customers as destinations in the way that supermarkets and cinemas are.[41]

Vue/A3 Cinema

In April 2005, Vue acquired A3 Cinema's six Ster-Century-branded multiplex cinemas in Basingstoke, Cardiff, Edinburgh, Leeds, Norwich and Romford.[42] The increment to Vue's 13.8 per cent national market share was too small (2.2 per cent) to generate concerns at the national level.

In its analysis of local markets, the OFT examined fascia counts (4-to-3, of multiplexes) and market shares (of multiplexes and non-multiplexes) in geographic markets defined by 20-minute drive-time isochrones centred on the acquired Ster Century cinemas (which it also re-centred on competitors[43] and population centres, and flexed to 30 minutes). On this basis, the OFT referred the completed merger to the CC, concluding:

- that there was a realistic prospect of an substantial lessening of competition (SLC) in Basingstoke and in Romford (the latter on the basis of isochrone re-centring); and

- that Vue and Ster Century were each other's closest competitors in Leeds although the traditional approach did not indicate a competition problem there.

The CC's analysis considered local markets for multiplexes and for all cinemas in 20-minute drive-time isochrones centred on the acquired Ster Century cinema. The CC then looked at the four local markets where Vue and Ster Century overlapped—Basingstoke, Edinburgh, Leeds and Romford—on a case-by-case basis. The CC concluded that there was an SLC only in Basingstoke and Vue divested the acquired Ster Century cinema.

The relevant structural characteristics examined by the OFT and CC are given in Table 6, which also gives the diversion ratios predicted from the marginal effects in the model in Table 3 (the effect of the intercept in the model is replaced by the implied national diversion ratio from Ster to Vue). Table 6 shows that the model predicts a high diversion ratio of 65.2 per cent in Basingstoke but does not predict diversion ratios elsewhere that are much above the implied national diversion ratio, ie were it not for the inclusion of the national

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[39]For example, there is a relative large number of national supermarket chains (8) compared with other retailers. Supermarket fascias tend to have different sizes of store (eg corner shops, high street stores and out-of-town 'superstores'), more than one of which may be present in a given local retail market, whereas other local retailers may not. Supermarkets also are multi-product retailers, whereas other local retailers may not be. There also is a national dimension to supermarket competition (eg national pricing), which may not be the case for other local retailers.

[40]Even though cinema-goers are likely to buy just one product (a film), unlike supermarket shoppers who may have many products in their shopping basket.

[41]A lack of publicly-available data prevents application of the results to the other retail chain mergers mentioned in the second paragraph of section 1.

[42]Multiplex cinemas are defined as those with at least three screens and 696 seats.

[43]Including non-multiplexes.

diversion ratio, the predicted diversion ratio would be close to zero. This seems consistent with the CC's findings.

TABLE 6 **Structural local market characteristics and predicted diversion ratios for six local Ster Century cinemas**

	*Market shares (seats) %**				*Implied diversion ratio from Ster to Vue %*					
	Local†		*National*				*Proximity stores*			*Predicted ratio*
Locality	*Ster*	*Vue*	*Ster*	*Vue*	*Local*	*National*	*Number*	*Drive-time‡*	*Fascias§*	*%*
Basingstoke (urban#)	47	53	14	2	100.0	2.6	1	5	2	65.2
Cardiff (urban)	25	0	14	2	0.0	2.6	0	30	5	2.6
Edinburgh (urban)	15	16	14	2	18.8	2.6	1	5	5	4.9
Leeds (urban)	13	9	14	2	10.3	2.6	1	6	5	3.9
Norwich (rural)	31	0	14	2	0.0	2.6	0	30	3	4.7
Romford¶ (urban)	100	0	14	2	0.0	2.6	0	22	1	2.7

Source: CC.

*Of multiplex and non-multiplex cinemas.
†In 20-minute primary isochrone.
‡To closest proximity cinema. Set to 30 minutes if unknown. For both Cardiff and Norwich, this is probably an underestimate.
§Of multiplex cinemas.
#Treating Basingstoke as rural, its predicted diversion ratio is 0.681.
¶In Romford, there were two Vue cinemas (Dagenham and West Thurrock) and three other multiplex fascias just outside the 20-minute isochrone. Including the two proximity stores and three fascias (making the total number of fascias five), and setting the proximity drive time to 22 minutes and the market share diversion ratio to that in a symmetric five-firm market (25 per cent), gives a predicted diversion ratio of 2.7 per cent. Treating Romford as rural, the predicted diversion ratio is 7.0 per cent.

The predicted diversion ratio in Basingstoke is the highest of the six Ster Century cinemas. The predicted diversion ratio in Basingstoke also is high relative to the putative thresholds suggested in section 2. It is much greater than both the 14.3 per cent (symmetric) diversion ratio implied by a post-merger market share of 25 per cent, and the 33 per cent (symmetric) diversion ratio implied by the 4-to-3 fascia count rule used in previous OFT decisional practice for cinema mergers.[44]

It is interesting to note the low diversion ratio in Romford, a local market that caused the OFT and CC some difficulty. Given the OFT identified Romford as a possible problem only on the basis of isochrone re-centring, it is worth asking whether the model predicts a high diversion ratio if the competitive overlaps picked up by the population re-centring of the 20-minute isochrone are included. It does not: the predicted diversion ratio is 2.7 per cent or 7 per cent, depending on whether Romford is treated as urban or rural.

HMV/Ottakar's

In September 2005, HMV announced that it intended to acquire, through its book-store subsidiary Waterstone's, the 141 book stores of Ottakar's. The combined market shares of Waterstone's and Ottakar's, at 22 per cent, were not high enough to generate concerns at the national level, given the UK retail market for books at the national level was not concentrated. At the local level, Waterstone's and Ottakar's overlapped in 33 locations (ie within 1 mile of each other on the high street).

[44]Specifically, the 2005 *Terra Firma/Odeon/UCI* merger.

The OFT referred the proposed merger to the CC on the basis that there was a loss of close competition between the parties, primarily on non-price factors at the local level. The CC cleared the proposed merger, concluding that it would not result in an SLC at the local level because—although the parties were close competitors—local competition was concentrated on two non-price factors; range of titles in stock and quality of in-store service. The CC concluded that there was no systematic and substantial difference in range or service quality in overlap stores compared with non-overlap stores, and found no evidence that competition at the local level had a significant effect on range or service quality.

Neither the OFT or the CC gave much prominence in their analysis to the traditional isochrone and fascia count methodology, given book stores generally were not out-of-town or destination stores in the same way as (say) supermarkets or cinemas, instead relying on footfall in the immediate vicinity. Instead, the analyses of both the OFT and CC emphasized the degree of direct competition between Waterstone's and Ottakar's. The OFT noted that the strongest competitive constraint upon the parties (apart from each other) appeared to come from the two other major multiple book retailers, Borders/Books Etc and WH Smith. Of particular relevance in the CC's analysis of the degree of direct competition between the parties was a survey it undertook of 861 Ottakar's customers at the 33 overlap locations.[45]

Among other things, the CC's survey asked Ottakar's customers which alternative fascia they would have used had the Ottakar's been shut, ie the CC obtained estimates of diversion ratios. The relevant structural characteristics examined by the OFT and CC are given in Table 7, which also gives these diversion ratios from the CC's survey and the diversion ratios predicted from the marginal effects in the model in Table 3 (the effect of the intercept in the model is replaced by the implied national diversion ratio from Ottakar's to Waterstone's).[46]

(Because of data limitations, Table 7 gives the structural characteristics and diversion ratios for 31 locations and not 33. Because the local market share data is confidential, Table 7 also anonymizes these locations and gives only the diversion ratios implied by these local market shares and not the shares themselves.)

[45]The CC also surveyed 884 Waterstone's customers at the 33 overlap locations. The CC further surveyed 355 Ottakar's customers and 354 Waterstone's customers at 40 non-overlap locations, as a control group.

[46]In Table 6, all locations are assumed to be urban. Given the narrow catchment areas for book stores identified by the OFT and CC—and given the OFT and CC identified that book stores rely on passing footfall rather than being shopping destinations—it does not seem sensible to categorize any locations as rural (which essentially would allow them to have wider catchment areas).

TABLE 7 **Structural local market characteristics and predicted diversion ratios for 31 local Ottakar's book stores**

	Implied diversion ratio from Ottakar's to Waterstone's, %		*Proximity stores*			*Diversion ratio, %*	
*Overlap location**	*Local†*	*National‡*	*Number*	*Drive-time§*	*Fascias¶*	*Actual*	*Predicted*
Location 1	39.1	15.3	1	1	3	34.6	42.1
Location 2	49.8	15.3	1	1	3	34.8	49.5
Location 3	50.0	15.3	1	2	3	36.1	44.2
Location 4	40.2	15.3	2	3	4	41.0	33.0
Location 5	29.4	15.3	1	2	3	41.7	32.4
Location 6	46.4	15.3	1	1	3	45.5	47.0
Location 7	52.4	15.3	1	3	3	47.1	40.7
Location 8	55.6	15.3	1	2	3	51.4	48.1
Location 9	64.5	15.3	1	6	3	52.8	34.4
Location 10	66.4	15.3	1	19	3	53.6	16.2
Location 11	57.8	15.3	1	1	3	54.5	55.6
Location 12	32.7	15.3	1	1	3	55.0	38.2
Location 13	82.6	15.3	1	11	3	56.7	26.0
Location 14	63.8	15.3	2	1	3	57.1	72.3
Location 15	26.6	15.3	1	1	3	57.1	34.8
Location 16	68.2	15.3	1	1	3	59.3	64.0
Location 17	81.3	15.3	1	2	3	60.7	68.4
Location 18	45.4	15.3	1	1	3	61.3	46.3
Location 19	22.8	15.3	1	1	3	63.0	32.9
Location 20	68.3	15.3	1	4	3	63.2	46.1
Location 21	38.0	15.3	1	7	3	63.2	22.4
Location 22	31.4	15.3	1	1	3	63.3	37.4
Location 23	46.3	15.3	1	4	3	63.6	33.1
Location 24	67.8	15.3	1	1	3	64.5	63.7
Location 25	33.4	15.3	1	1	3	65.2	38.6
Location 26	66.7	15.3	1	1	3	67.9	62.8
Location 27	51.1	15.3	1	1	3	73.3	50.4
Location 28	73.3	15.3	1	3	3	77.3	55.6
Location 29	72.8	15.3	3	2	3	82.6	84.4
Location 30	100.0	15.3	1	0	2	83.3	100.0
Location 31	66.7	15.3	1	1	3	87.0	62.8

Source: CC.

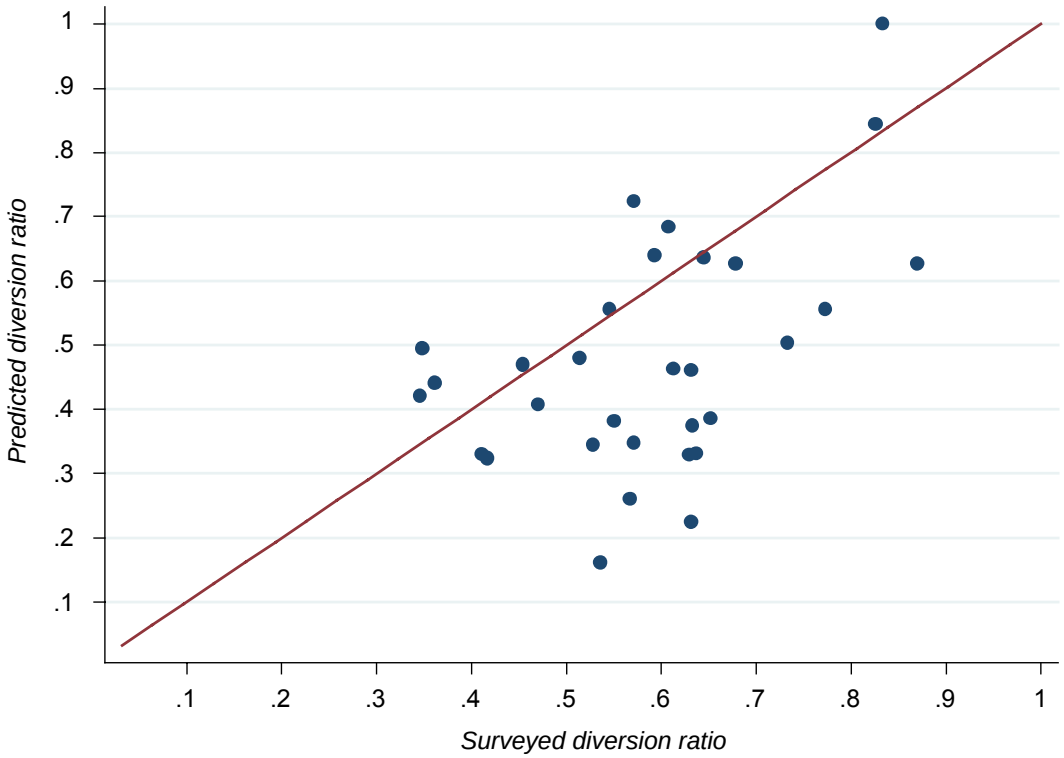
*All localities treated as urban.
†Of sales space, in square feet, for major multiple general booksellers. This may best be viewed as a share of capacity rather than a market share.
‡Ottakar's national market share was 7.7 per cent and Waterstone's was 14.1 per cent.
§In minutes. Source: theaa.com from postcodes of stores (from Appendix E of CC report).
¶Of major multiple general booksellers (ie excluding independent and other general, religious, children's and other specialist book stores).

The diversion ratios predicted by the model match those from the CC's survey quite well, as Figure 4 illustrates.[47] (The correlation between the two sets of diversion ratios in Table 7 is 0.5. The correlation between the locations in Table 7 ranked by surveyed and predicted diversion ratios is 0.4.)

[47]The mean diversion ratio from the CC's survey is 58.6 per cent (standard deviation 13.6 Per cent). The mean predicted diversion ratio is 47.9 per cent (standard deviation 18.2 per cent).

FIGURE 4

Predicted diversion ratios from model and surveyed diversion ratios for 31 acquired Ottakar's book stores



Source: CC.

Indeed, in 19 cases out of 31, the predicted diversion ratio is statistically insignificantly different to the surveyed diversion ratio, as shown in Table 8. The testing proceeds by assuming that the number of survey respondents actually switching is generated by a Bernoulli process (eg flipping a coin). The Bernoulli distribution has a variance of np(1-p) where n is the number of survey respondents and p is the probability of switching, which is given by the diversion ratio. The square root of this variance is the standard deviation. With this standard deviation, Table 8 reports t-tests of whether the number of respondents actually switching and number of respondents predicted to switch (derived from the predicted diversion ratio and the number of respondents) are the same statistically speaking, which they are in 19 cases.

Of the remaining 12 cases, it is apparent from Figure 4 that the model systematically under-predicts the diversion ratio in ten locations (those to the bottom right of Figure 4): the correlation between the surveyed and predicted diversion ratio for the remaining 21 locations is 0.76. These ten locations are those where the acquiring Waterstone's and acquired Ottakar's stores are furthest apart and/or WH Smith has a large market share (either because it has several stores on the high street, or one large store). This might suggest that for book stores—which are not shopping destinations and rely on passing trade—there is a different effect than for supermarkets and cinemas of the impact of travel time and the implied local diversion ratio (which is a function of local market shares) on the predicted diversion ratio.[48]

[48]In principle, it is possible to allow for non-linearity in the impact of drive time and the diversion ratio implied by local market shares on the dependent variable by including drive-time squared and the implied diversion ratio squared as independent variables. However, including these would have the usual drawback for quadratics: implying an eventual positive marginal

TABLE 8 **Tests of whether number of respondents actually switching and number of respondents predicted to switch are the same**

		Surveyed					T-test (a)=(b)*	
Overlap location	*Diversion ratio %*	*Number of respondents*	*Respondents switching (a)†*	*Implied standard deviation‡*	*Predicted diversion ratio %*	*Implied respondents switching (b)§*	*Statistic*	*P-value*
Location 1	34.6	26	9	2.43	42.1	11	0.80	0.43
Location 2	34.8	46	16	3.23	49.5	23	2.09	0.04
Location 3	36.1	36	13	2.88	44.2	16	1.00	0.32
Location 4	41.0	39	16	3.07	33.0	13	1.02	0.32
Location 5	41.7	36	15	2.96	32.4	12	1.13	0.27
Location 6	45.5	33	15	2.86	47.0	16	0.18	0.86
Location 7	47.1	34	16	2.91	40.7	14	0.74	0.46
Location 8	51.4	35	18	2.96	48.1	17	0.40	0.69
Location 9	52.8	36	19	3.00	34.4	12	2.21	0.03
Location 10	53.6	28	15	2.64	16.2	5	3.96	0.00
Location 11	54.5	33	18	2.86	55.6	18	0.12	0.90
Location 12	55.0	20	11	2.22	38.2	8	1.51	0.15
Location 13	56.7	30	17	2.71	26.0	8	3.38	0.00
Location 14	57.1	28	16	2.62	72.3	20	1.63	0.12
Location 15	57.1	21	12	2.27	34.8	7	2.07	0.05
Location 16	59.3	27	16	2.55	64.0	17	0.50	0.62
Location 17	60.7	28	17	2.58	68.4	19	0.83	0.41
Location 18	61.3	31	19	2.71	46.3	14	1.71	0.10
Location 19	63.0	27	17	2.51	32.9	9	3.23	0.00
Location 20	63.2	19	12	2.10	46.1	9	1.54	0.14
Location 21	63.2	19	12	2.10	22.4	4	3.68	0.00
Location 22	63.3	30	19	2.64	37.4	11	2.95	0.01
Location 23	63.6	22	14	2.26	33.1	7	2.98	0.01
Location 24	64.5	31	20	2.66	63.7	20	0.10	0.92
Location 25	65.2	23	15	2.28	38.6	9	2.68	0.01
Location 26	67.9	28	19	2.47	62.8	18	0.58	0.57
Location 27	73.3	15	11	1.71	50.4	8	2.00	0.06
Location 28	77.3	22	17	1.97	55.6	12	2.42	0.02
Location 29	82.6	23	19	1.82	84.4	19	0.23	0.82
Location 30	83.3	24	20	1.83	100.0	24	2.19	0.04
Location 31	87.0	23	20	1.62	62.8	14	3.44	0.00

Source: CC.

*Null hypothesis: surveyed number of respondents switching equals predicted number of respondents switching. Conventionally, we fail to reject the null hypothesis if the p-value is 0.05 or greater.
†Calculated as surveyed diversion ratio multiplied by number of survey respondents.
‡Assuming Bernoulli process for whether survey respondents switch or not. The Bernoulli distribution has a variance of np(1-p), where n is the number of survey respondents and p is the probability of switching (given by the diversion ratio). The standard deviation is the square root of this variance.
§Calculated as predicted diversion ratio multiplied by number of survey respondents.

To investigate this, the data in Table 7 is used to re-estimate the model in Table 2 for book stores. The marginal effects of the independent variables on the diversion ratio from this re-estimated model are shown in Table 9 (regression results are given in the Annex) and appear to confirm this impression. Specifically, comparing Table 9 to Table 3:

- increasing the number of proximity book stores by one increases the diversion ratio by 8.4 percentage points, over three times the impact that increasing the number of proximity supermarkets had in *Somerfield/Morrisons*;

- increasing the drive-time to the nearest proximity book store by 1 minute decreases the diversion ratio by 0.4 percentage points, less then one-third of the impact that increasing the drive time to the nearest proximity supermarket in an urban area had in *Somerfield/Morrisons*;

effect (ie increasing the diversion ratio) for drive time and an eventual negative marginal effect (ie decreasing the diversion ratio) for the diversion ratio implied by local market shares, neither of which seem reasonable in this case.

- increasing the diversion ratio implied by the pre-merger market shares by 1 percentage point increases the diversion ratio by 0.2 percentage points, the same impact as in *Somerfield/Morrisons*; and

- increasing the pre-merger number of competing fascias by 1 decreases the diversion ratio by 21 percentage points, seven times the impact that increasing the number of competing fascias by one had in *Somerfield/Morrisons*.[49]

TABLE 9 **Marginal effects of the independent variables on the predicted mean of the diversion ratio in *HMV/Ottakar's***

Independent variable	*dy/dx*	*Std err*	*z*	*P>z*	*95% CI*		*X**
Number of proximity stores	0.084	0.048	1.75	0.081	–0.010	0.179	1
Drive-time to closest proximity store	–0.004	0.003	–1.28	0.202	–0.011	0.002	2.8
Diversion ratio from pre-merger market shares	0.224	0.123	1.83	0.068	–0.016	0.465	0.5
Number of pre-merger competing fascias	–0.213	0.052	–4.06	0.000	–0.315	–0.110	3

Source: CC.

*Value of independent variable at which marginal effect is calculated. Given by mean or median of independent variable.

From these results, it appears that—although the *Somerfield/Morrisons* model predicts diversion ratios that are statistically insignificantly different from those in the CC's survey in *HMV/Ottakar's* in 19 instances out of 31—the weight attached to the individual factors used to predict those diversion ratios differs markedly between supermarkets and book stores.

4. Conclusions

I discuss an econometric methodology for approximating diversion ratios to measure the unilateral effects arising from horizontal mergers in local retail markets, on the basis of information from the CC's *Somerfield/Morrisons* report on the number of proximity stores, drive-times between the acquired and closest acquiring stores, diversion ratios implied by pre-merger market shares (both local and national), and the number of competing fascias pre-merger.

As a robustness check, I apply the methodology to the data on fascia counts, market shares and geographical proximity from two recent retail chain mergers examined by the OFT and CC: a cinema merger and a book shop merger. The results show some promise, predicting sensible diversion ratios in 25 local markets out of 37 (ie 68 per cent of cases).[50] ('Sensible' in this case meaning (i) being consistent with the CC's SLC/no SLC decisions in *Vue/A3 Cinema* and (ii) being statistically insignificantly different to the CC's surveyed diversion ratios in *HMV/Ottakar's*.)

I interpret the results as suggesting that the local market characteristics routinely examined by the OFT and CC in retail chain mergers (eg fascia counts, market shares, geographical proximity) may be able to be combined in one measure (the predicted diversion ratio) to rank the degree to which retail chain mergers may give cause for concern over unilateral effects. I suggest some thresholds against which this ranking can be judged but note that diversion ratios also should be considered in the context of other evidence.

[49]These marginal effects would differ if they were calculated at the same values of the independent variables as in Table 2 but not by much. The mean predicted diversion ratio implied by these marginal effects is 58.6 per cent (standard deviation 7.6 per cent). The correlation between the predicted diversion ratios in Table 6 and the diversion ratios predicted by the re-estimated model in Table 8 is 0.86.

[50]Six local markets out of six in *Vue/Ster* and 19 local markets out of 31 in *HMV/Ottakar's*.

There are several important caveats. From its application to *Vue/A3 Cinema*, the approach appears to predict sensible diversion ratios for retail chain mergers where there is an overlap between the acquiring and acquired firms in the primary isochrone (ie the isochrone centred on the acquired store), not where the isochrone is flexed. Also from its application to *Vue/A3 Cinema*, the results stress the influence that re-centring isochrones by drawing them around customers, not stores, can have in large urban areas.

From its application to *HMV/Ottakar's*, the marginal effects of the model suggest that the weight attached to the number of proximity stores, drive times between the acquired and closest acquiring stores and the number of competing fascias pre-merger may differ for stores that are destinations and stores that rely on passing trade. Further, both *Somerfield/Morrisons* and *Vue/A3 Cinema* were completed acquisitions (so their diversion ratios are post-merger), whereas *HMV/Ottaker's* was a proposed acquisition.

From its application to both cases, the approach appears sensitive to drive-times, so accurate drive-time data is an important input. National market shares affect the 'baseline' diversion ratio predicted by the marginal effects of the model, so measuring these accurately also is important. Lastly, the approach approximates customer diversion ratios but revenue diversion ratios may be a better measure of the closeness of competition between merging parties in situations where customers buy multiple goods and/or prices differ between customers.

References

Baker, S, A Coscelli and T van Dijk (2002) 'Unilateral Effects in Retail Chain Mergers: An Application to Supermarkets', *European Competition Law Review*, 23:4, 180–192.

Beckert, W and N Mazzarotto (2006) 'Price-Concentration Analysis in Merger Cases with Differentiated Products', *Competition Commission Economics Working Paper 3*.

Bishop, S and M Walker (2002) *The Economics of EC Competition Law: Concepts, Application and Measurement*, Sweet & Maxwell: London.

Papke, L and J Wooldridge (1996) 'Econometric Methods for Fractional Response Variables with an Application to 401(k) Plan Participation Rates', *Journal of Applied Econometrics*, 11, 619–632.

Reynolds, G and C Walters (2007) 'The Use of Customer Surveys for Market Definition and the Competitive Assessment of Horizontal Mergers', *Journal of Competition Law and Economics*, forthcoming.

Smith, H (2004) 'Supermarket Choice and Supermarket Competition in Market Equilibrium', *Review of Economic Studies*, 71:1, 235–263.

Werden, G, L Froeb and D. Scheffman (2004) 'A *Daubert* Discipline for Merger Simulation', *Antitrust*, 18:3, 89–95.

Estimation results for HMV/Ottakar's

				Number of obs		31
Pseudo-log likelihood	–13.90			Pseudo R^2		0.31
	Coef	*Std Err*	*z-stat*	*P>z*	*95% CI*	
Number of proximity stores	0.344	0.195	1.76	0.078	–0.039	0.727
Drive-time to closest proximity store	–0.017	0.014	–1.27	0.206	–0.044	0.010
Diversion ratio from pre-merger market shares	0.915	0.499	1.83	0.067	–0.064	1.893
Number of pre-merger competing fascias	–0.868	0.213	–4.07	0.000	–1.285	–0.450
Intercept	2.126	0.733	2.90	0.004	0.690	3.563

Source: CC.

Notes:
1. Dependent variable is ln [customer diversion ratio/(1-customer diversion ratio)].
2. Method of estimation is maximum pseudo-likelihood (iterated, re-weighted least squares).
3. All stores are treated as urban.
4. Standard errors are robust to heteroscedasticity and serial correlation.
5. Pseudo R^2 is calculated as the square of the correlation coefficient between the fitted values and the dependent variable.
6. A test for lack of skewness and kurtosis in the residuals (calculated as the dependent variable minus the fitted values) returns $\chi^2(2)=0.16$ ($p=0.93$), which accepts the hypothesis that the residuals are normally distributed.